```
Index: Afforestation.R
===================================================================
--- Afforestation.R (revision 4457)
+++ Afforestation.R (revision 4641)
@@ -1,5 +1,5 @@
 #' Removals from Afforestation - Total of upland and lowland
-#'
+#'
 #' This function references Equation (34) to calculate the removals from
 #' afforestation/reforestation for the year The resulting value is expressed in
 #' tCO2e.Upland and lowland data was provided for the FRL but total
@@ -7,7 +7,8 @@
 #' for future reporting.
 #'
 #' @references [TBC - ERPD citation - Section 8.3.4.1]
-#'
+#'
+#' @param Age The number of years of regrowth
 #' @param AreaTotal Total Area of Afforestation over the period
 #' @param MAIV Mean annual volume increment for afforestation/reforestation
 #'    m^3/hectare/year
@@ -19,26 +20,27 @@
 CalcGrossRemARefor <- function(AreaTotal,
                                MAIV,
                                BCEF,
-                               RootToShootRatio) {
+                               RootToShootRatio,
+                               Age = 1) {
   # Biomass gains from afforested area over the yr
   MAIC <- MAIV * BCEF * (1 + RootToShootRatio)
-  Biomass <- AreaTotal * MAIC * (-1)
-  # Removals from afforestation/reforestation for the year
-  CO2e <- ConvBiomassToCO2e(Biomass)
+  Biomass <- Age * AreaTotal * MAIC * (-1)
+  # Total Removals from afforestation/reforestation for all years
+  CO2e <- ConvBiomassToCO2e(sum(Biomass))
   return(CO2e)
 }

 #' Removals from Afforestation - upland and lowland
-#'
+#'
 #' This function references Equation (34) to calculate the removals from
 #' afforestation/reforestation for the year. The resulting value is expressed in
 #' tCO2e. Upland and lowland data was provided for the FRL but total
 #' afforestation area, not aggregated for upland and lowland,  will be provided
-#' for future reporting. The gross removals can be obtained with the
+#' for future reporting. The gross removals can be obtained with the
 #' CalcGrossRemARefor() function.
 #'
 #' @references [TBC - ERPD citation - Section 8.3.4.1]
-#'
+#'
```

```
+#'
 #' @param AreaUpland Area of afforestation/reforestation in Natural Forest,
 #'   Upland stratum in year
 #' @param AreaLowland Area of afforestation/reforestation in Natural Forest,
Index: CalcFRLAfforestation.R
===================================================================
--- CalcFRLAfforestation.R  (nonexistent)
+++ CalcFRLAfforestation.R  (revision 4641)
@@ -0,0 +1,143 @@
+
+
+
+#' @export
+calcFRLAfforestation <- function() {
+
+  # Uncertainty attached to the estimated total carbon increment for AR
+  varmaic <- rtriangle(
+    # Random mean annual carbon increment
+    n = FRLParams$runs,
+    theta = FRLParams$maicar,
+    lower = FRLParams$maicar - FRLParams$maicar * FRLParams$errmaicar,
+    upper = FRLParams$maicar + FRLParams$maicar * FRLParams$errmaicar
+  ) * # Uncertainty attached to root-to-shoot ratio (tropical rainforest)
+    (1 + rtriangle(
+      n = FRLParams$runs,
+      theta = FRLParams$Rlwk,
+      lower = FRLParams$Rlwk - FRLParams$Rlwk * FRLParams$errRlwk,
+      upper = FRLParams$Rlwk + FRLParams$Rlwk * FRLParams$errRlwk
+    ))
+
+  # Adding below-ground carbon
+  # Carbon gains on areas afforested/reforested in year t (over the Reference Period)
+  arcgainst <- FRLParams$deltaT * AdjustedAreas$ARareas * FRLParams$maicar * (1 + FRLParams$Rlwk)
+
+  if (debug_frl) {
+    print(paste0("==== debug: ", "CalcFRLAfforestation.R", ":28"))
+    # Create a data frame of C gains over the Reference Period
+    arcgains <- data.frame(
+      interval = as.character(FRLParams$Ty),
+      C_gain_t = arcgainst
+    )
+    print(arcgains)
+  }
+
+  # Average annual C gains (AR) over the Reference Period
+  araacg <- sum(arcgainst) / FRLParams$Tl
+  if (debug_frl) {
+    print(paste0("==== debug: ", "CalcFRLAfforestation.R", ":50"))
+    print(araacg)
+  }
+
+  # Uncertainty analysis
```

```
105  +  # Create vector
106  +  varaacg <- vector()
107  +
108  +  # MC simulation
109  +  for (i in 1:FRLParams$runs) { # i <- 1
110  +    varaacg[i] <- (sum(FRLParams$deltaT * # Time available for growth...
111  +      sum(AdjustedAreas$MCaaafor[i, ]) * # Average annual area of AR
112  +      varmaic[i]) # Random increment
113  +    ) / FRLParams$Tl # Length of the FRL Reference Period
114  +  }
115  +
116  +  # Average annual removals from afforestation/reforestation (AR)
117  +  ec_ar_aar <- araacg * FRLParams$etacc # Estimate
118  +  lciaraar <- quantile(varaacg * FRLParams$etacc, probs =                ↵
     FRLParams$qlci) # Lower confidence limit
119  +  uciaraar <- quantile(varaacg * FRLParams$etacc, probs =                ↵
     FRLParams$quci) # Upper confidence limit
120  +  v_ec_ar_aar <- varaacg * FRLParams$etacc # MC estimates
121  +
122  +  # Result table AR (estimates are multiplied by -1, because removals    ↵
     always have
123  +  # a negative sign)
124  +  rs_ec_ar <- data.frame(
125  +    aa_removals_tco2e_yr = ec_ar_aar * -1,
126  +    lci_aa_removals_tco2e_yr = uciaraar * -1,
127  +    uci_aa_removals_tco2e_yr = lciaraar * -1
128  +  )
129  +
130  +  row.names(rs_ec_ar) <- "1"
131  +  # Show result table
132  +  if (debug_frl) {
133  +    print(paste0("==== debug: ", "CalcFRLAfforestation.R", ":83"))
134  +    print(rs_ec_ar)
135  +  }
136  +
137  +  # Growth tables projection rather than average yearly growth
138  +  yearly_growth <- c(0.5,rep_len(1,FRLParams$Tl-1))
139  +
140  +  arcstock <- growthTotals(
141  +        FRLParams$Ty,
142  +        rep(AdjustedAreas$ARareas, FRLParams$Tl),
143  +        growthMatrix(FRLParams$Ty,
144  +                     rep(AdjustedAreas$ARareas, FRLParams$Tl),
145  +                     yearly_growth, projection=7, offset = 14) *       ↵
     FRLParams$maicar * (1 + FRLParams$Rlwk),
146  +        projection=7, offset = 14
147  +  )
148  +
149  +  if (debug_frl) {
150  +    print(paste0("==== debug: ", "CalcFRLAfforestation.R", ":76"))
151  +    print(arcstock)
152  +  }
153  +
154  +  # Uncertainty analysis
155  +  varcstock <- matrix(nrow=0,ncol=length(FRLParams$Ty)+4)
```

```
156 +  gm <-                                                                ↵
    growthMatrix(FRLParams$Ty,rep_len(1,length(FRLParams$Ty)),c(0.5,rep_len(1,l ↵
    ength(FRLParams$Ty)-1)), projection=7, offset = 14)
157 +
158 +  # MC simulation
159 +  for (i in 1:FRLParams$runs) { # i <- 1
160 +    vAreas <-  sum(AdjustedAreas$MCaaafor[i, ]) # Up and Low land
161 +    varmai <- rtriangle(
162 +      # Random mean annual carbon increment
163 +      n = FRLParams$Ty+7,
164 +      theta = FRLParams$maicar,
165 +      lower = FRLParams$maicar - FRLParams$maicar * FRLParams$errmaicar,
166 +      upper = FRLParams$maicar + FRLParams$maicar * FRLParams$errmaicar
167 +    )
168 +    # Uncertainty attached to root-to-shoot ratio (tropical rainforest)
169 +    varRlw <- (1 + rtriangle(
170 +      n = FRLParams$Ty+7,
171 +      theta = FRLParams$Rlwk,
172 +      lower = FRLParams$Rlwk - FRLParams$Rlwk * FRLParams$errRlwk,
173 +      upper = FRLParams$Rlwk + FRLParams$Rlwk * FRLParams$errRlwk
174 +    ))
175 +    r <- colSums(gm * vAreas * varmai * varRlw)
176 +    if (i==1) varcstock <- r
177 +    else varcstock <- rbind(varcstock, r)
178 +  }
179 +  colnames(varcstock) <- colnames(gm)
180 +
181 +  # Yearly removals from afforestation/reforestation (AR)
182 +  ec_ar_cstock <- arcstock[c(-1,-2)] * FRLParams$etacc# Estimate
183 +  mucstock <- apply(varcstock * FRLParams$etacc,2, quantile, probs =      ↵
    0.5) # Lower confidence limit
184 +  lciarcstock <- apply(varcstock * FRLParams$etacc,2, quantile, probs =   ↵
    FRLParams$qlci) # Lower confidence limit
185 +  uciarcstock <- apply(varcstock * FRLParams$etacc,2, quantile, probs =   ↵
    FRLParams$quci) # Upper confidence limit
186 +  v_ec_ar_cstock <- varcstock* FRLParams$etacc # MC estimates
187 +  # Result table AR CStock
188 +  rs_ec_ar_cstock <- data.frame(
189 +    rbind(
190 +      removals_tco2e_yr = ec_ar_cstock * -1,
191 +      lci_removals_tco2e_yr = lciarcstock * -1,
192 +      uci_removals_tco2e_yr = uciarcstock * -1,
193 +      mu_removals_tco2e_yr = mucstock * -1),
194 +    check.names = F
195 +  )
196 +
197 +  result <- list()
198 +  result$rs_ec_ar <- rs_ec_ar
199 +  result$v_ec_ar_aar <- v_ec_ar_aar
200 +  result$ar_aa_area <- AdjustedAreas$ARareas
201 +  result$rs_ec_ar_cstock <- rs_ec_ar_cstock
202 +  result$v_ec_ar_cstock <- v_ec_ar_cstock
203 +  return(result)
204 +}
205  Index: CalcFRLFelling.R
```

```
206 ===================================================================
207 --- CalcFRLFelling.R    (revision 4457)
208 +++ CalcFRLFelling.R    (revision 4641)
209 @@ -5,7 +5,10 @@
210    # Create a data.frame for logging in Natural Forest (lnf); taking data from
211    # 'lnf_logging'
212    # Volumes logged [m^3] in Natural Forest
213 -  if (debug_frl) print(lnf_volume)
214 +  if (debug_frl) {
215 +    print(paste0("==== debug: ", "CalcFRLFelling.R", ":9"))
216 +    print(lnf_volume)
217 +  }
218    # Average annual volume extracted from Natural Forest [m^3]
219    (avg_vol_lnf <- mean(lnf_volume$volume))
220
221 @@ -38,12 +41,25 @@
222    #TODO: Need to handle removals being negative
223    # Above-ground carbon (AGC) accumulated over the Reference Period. This gives
224    # the CO2 accumulation OVER the Reference Period.
225 -  co2egain_t <- FRLParams$deltaT * sapply(lnf_area$area_harvested_total_ha,function(v) CalcEstRemFell(FRLParams$maiclnf,v)) * -1
226 +  co2egain_t <- FRLParams$deltaT * sapply(lnf_area$area_harvested_total_ha,function(v) CalcEstRemFell(v, FRLParams$maiclnf,c(1))) * -1
227
228    # Average annual CO2 removals over the Reference Period from forest degradation
229    # tCO_2e (removals)
230    fd_lg_aar <- mean(co2egain_t)
231
232 +  if (debug_frl) {
233 +    print(paste0("==== debug: ", "CalcFRLFelling.R", ":51"))
234 +    lgcstock <- growthTotals(
235 +      FRLParams$Ty, lnf_area$area_harvested_total_ha,
236 +      sapply(
237 +        growthMatrix(FRLParams$Ty, lnf_area$area_harvested_total_ha, FRLParams$rdeltaT),
238 +        function(v) {
239 +          sapply(v, CalcEstRemFell, FRLParams$maiclnf,c(1))
240 +        }
241 +      )
242 +    )
243 +    print(lgcstock)
244 +  }
245    # Uncertainty assessment (MC simulation): gross removals after logging
246    fdaacg <- vector() # Vector that collects the results
247
248 @@ -67,7 +83,7 @@
249        )
250
251      # CO2 accumulation (over the Reference Period) on areas harvested in year t
```

```
252 -    agcrlt <- FRLParams$deltaT *                                          ↵
    sapply(v_area_harvested_total_ha,function(v) CalcEstRemFell(maicli,v)) * -1
253 +    agcrlt <- FRLParams$deltaT *                                          ↵
    sapply(v_area_harvested_total_ha,function(v) CalcEstRemFell(v,            ↵
    maicli,c(1))) * -1
254      # Collect results
255      fdaacg[i] <- mean(agcrlt)
256    }
257 @@ -103,7 +119,10 @@
258    )
259
260    # Show annual data
261 -  if (debug_frl) print(fd)
262 +  if (debug_frl) {
263 +    print(paste0("==== debug: ", "CalcFRLFelling.R", ":110"))
264 +    print(fd)
265 +  }
266
267    # Results (net emissions from logging in Natural Forest; source        ↵
    'forest degradation'
268    # Create nice result table (annual average)
269 @@ -119,12 +138,79 @@
270    rs_fd_lg$lci <- c(lcifdaae, ucifdaar * -1, lcifdaane)
271    rs_fd_lg$uci <- c(ucifdaae, lcifdaar * -1, ucifdaane)
272
273 +  # Growth tables projection rather than average yearly growth
274 +  yearly_growth <- c(0.5,rep_len(1,FRLParams$Tl-1))
275 +  area <- lnf_area$area_harvested_total_ha
276 +
277 +  lnf_planted_cstock <- growthTotals(
278 +        FRLParams$Ty, area,
279 +        sapply(
280 +          growthMatrix(FRLParams$Ty,
281 +                       area,
282 +                       yearly_growth,
283 +                       projection=7, offset = 14),
284 +          function(v) {
285 +            sapply(v, CalcEstRemFell, FRLParams$maiclnf,c(1))
286 +          }
287 +        ),
288 +        projection=7, offset = 14)
289 +
290 +  if (debug_frl) {
291 +    print(paste0("==== debug: ", "CalcFRLHardwoodPlantations", ":204"))
292 +    print(lnf_planted_cstock)
293 +  }
294 +
295 +  # Uncertainty analysis
296 +  vlnfcstock <- matrix(nrow=0,ncol=length(FRLParams$Ty)+4)
297 +  gm <-                                                                   ↵
    growthMatrix(FRLParams$Ty,rep_len(1,length(FRLParams$Ty)),c(0.5,rep_len(1,l ↵
    ength(FRLParams$Ty)-1)), projection=7, offset = 14)
298 +
299 +  mArea  <- mean(area)
300 +  # MC simulation
```

```
301 +  for (i in 1:FRLParams$runs) { # i <- 1
302 +    # Random MAI for CO2 accumulation
303 +    maicli <- rtriangle(
304 +      n = 1, theta = FRLParams$maiclnf,
305 +      lower = FRLParams$maiclnf - FRLParams$maiclnf * FRLParams$errmaiclnf,
306 +      upper = FRLParams$maiclnf + FRLParams$maiclnf * FRLParams$errmaiclnf
307 +    )
308 +
309 +    # Random sample of areas harvested in year t
310 +    vAreas <-
311 +      rtriangle(
312 +        n = 1, theta = mArea,
313 +        lower = mArea - mArea * FRLParams$erralnf,
314 +        upper = mArea + mArea * FRLParams$erralnf
315 +      )
316 +    r <- apply(gm*vAreas, 2, CalcEstRemFell, maicli,1)
317 +    if (i==1) vlnfcstock <- r
318 +    else vlnfcstock <- rbind(vlnfcstock, r)
319 +  }
320 +  colnames(vlnfcstock) <- colnames(gm)
321 +
322 +  # Yearly removals
323 +  ec_lnf_cstock <- lnf_planted_cstock[c(-1,-2)]# Estimate
324 +  mucstock <- apply(vlnfcstock,2, mean)
325 +  lcilnfcstock <- apply(vlnfcstock,2, quantile, probs = FRLParams$qlci)    ↵
    # Lower confidence limit
326 +  ucilnfcstock <- apply(vlnfcstock,2, quantile, probs = FRLParams$quci)    ↵
    # Upper confidence limit
327 +  v_ec_lnf_cstock <- vlnfcstock# MC estimates
328 +  # Result table CStock
329 +  rs_ec_lnf_cstock <- data.frame(
330 +    rbind(
331 +      removals_tco2e_yr = ec_lnf_cstock,
332 +      lci_removals_tco2e_yr = lcilnfcstock,
333 +      uci_removals_tco2e_yr = ucilnfcstock,
334 +      mu_removals_tco2e_yr = mucstock),
335 +    check.names = F
336 +  )
337    result <- list()
338    result$rs_fd_lg <- rs_fd_lg
339 +  result$fd_lg_area <- lnf_area$area_harvested_total_ha
340    result$fd_lg_aane <- fd_lg_aane
341    result$v_fd_lg_aae <- v_fd_lg_aae
342    result$v_fd_lg_aar <- v_fd_lg_aar
343    result$v_fd_lg_aane <- v_fd_lg_aane
344 +  result$rs_ec_lnf_cstock <- rs_ec_lnf_cstock
345 +  result$v_ec_lnf_cstock <- v_ec_lnf_cstock
346
347    return(result)
348  }
349 Index: CalcFRLHardwoodPlantations.R
350 ===================================================================
351 --- CalcFRLHardwoodPlantations.R    (revision 4457)
352 +++ CalcFRLHardwoodPlantations.R    (revision 4641)
353 @@ -2,74 +2,14 @@
```

```
354   #' @export
355   calcFRLHardwoodPlantations <- function() {
356
357 -  # Uncertainty attached to the estimated total carbon increment for AR
358 -  varmaic <- rtriangle(
359 -    # Random mean annual carbon increment
360 -    n = FRLParams$runs,
361 -    theta = FRLParams$maicar,
362 -    lower = FRLParams$maicar - FRLParams$maicar * FRLParams$errmaicar,
363 -    upper = FRLParams$maicar + FRLParams$maicar * FRLParams$errmaicar
364 -  ) *
365 -    # Uncertainty attached to root-to-shoot ratio (tropical rainforest)
366 -    (1 + rtriangle(
367 -      n = FRLParams$runs,
368 -      theta = FRLParams$Rlwk,
369 -      lower = FRLParams$Rlwk - FRLParams$Rlwk * FRLParams$errRlwk,
370 -      upper = FRLParams$Rlwk + FRLParams$Rlwk * FRLParams$errRlwk
371 -    ))
372 -
373 -  # Adding below-ground carbon
374 -  # Carbon gains on areas afforested/reforested in year t (over the Reference Period)
375 -  arcgainst <- FRLParams$deltaT * AdjustedAreas$ARareas * FRLParams$maicar * (1 + FRLParams$Rlwk)
376 -
377 -  if (debug_frl) {
378 -    # Create a data frame of C gains over the Reference Period
379 -    arcgains <- data.frame(
380 -      interval = as.character(FRLParams$Ty),
381 -      C_gain_t = arcgainst
382 -    )
383 -    print(arcgains)
384 -  }
385 -
386 -  # Average annual C gains (AR) over the Reference Period
387 -  araacg <- sum(arcgainst) / FRLParams$Tl
388 -  if (debug_frl) print(araacg)
389 -
390 -  # Uncertainty analysis
391 -  # Create vector
392 -  varaacg <- vector()
393 -
394 -  # MC simulation
395 -  for (i in 1:FRLParams$runs) { # i <- 1
396 -    varaacg[i] <- (sum(FRLParams$deltaT * # Time available for growth...
397 -      sum(AdjustedAreas$MCaaafor[i, ]) * # Average annual area of AR
398 -      varmaic[i]) # Random increment
399 -    ) / FRLParams$Tl # Length of the FRL Reference Period
400 -  }
401 -
402 -  # Average annual removals from afforestation/reforestation (AR)
403 -  ec_ar_aar <- araacg * FRLParams$etacc # Estimate
404 -  lciaraar <- quantile(varaacg * FRLParams$etacc, probs = FRLParams$qlci) # Lower confidence limit
405 -  uciaraar <- quantile(varaacg * FRLParams$etacc, probs =
```

```
FRLParams$quci) # Upper confidence limit
-  v_ec_ar_aar <- varaacg * FRLParams$etacc # MC estimates
-
-  # Result table AR (estimates are multiplied by -1, because removals always have
-  # a negative sign)
-  rs_ec_ar <- data.frame(
-    aa_removals_tco2e_yr = ec_ar_aar * -1,
-    lci_aa_removals_tco2e_yr = uciaraar * -1,
-    uci_aa_removals_tco2e_yr = lciaraar * -1
-  )
-
-  row.names(rs_ec_ar) <- "1"
-  # Show result table
-  if (debug_frl) print(rs_ec_ar)
-
   # Volumes extracted from Hardwood Plantations
   # These data were provided by Fiji Hardwood Corporation Limited (FHCL)
   hw <- hwsw_volharv[, 1:2] # Hardwood data
   names(hw) <- c("year", "vol_m3") # Rename columns
-  if (debug_frl) print(hw) # Print 'hw'
+  if (debug_frl) {
+    print(paste0("==== debug: ", "CalcFRLHardwoodPlantations.R", ":10"))
+    print(hw) # Print 'hw'
+  }


   # Compute AGB for extracted volumes for the years 2006 to 2016
@@ -135,14 +75,40 @@
   # Mean annual C removals on areas that just grow during the Reference Period
   ctm <- atm * maicm

+  if (debug_frl) {
+    print(paste0("==== debug: ", "CalcFRLHardwoodPlantations.R", ":79"))
+    print(ctm)
+  }
+
   # Accumulation of C on planted areas over the Reference Period
   hw$cpmt <- hw$apmt * FRLParams$deltaT * maicm
   # Average annual C accumulation on planted areas over the Reference Period
   mcpm <- mean(hw$cpmt)

+  if (debug_frl) {
+    print(paste0("==== debug: ", "CalcFRLHardwoodPlantations.R", ":89"))
+    print(hw$cpmt)
+    print(mcpm)
+  }
+
   # C accumulation on areas that were harvested in year t
   mchm <- mean(hw$ahmt * FRLParams$rdeltaT * maicm)

+  if (debug_frl) {
+    print(paste0("==== debug: ", "CalcFRLHardwoodPlantations.R", ":107"))
```

```
457 +    print(hw$ahmt)
458 +    print(mchm)
459 +  }
460 +
461 +  if (debug_frl) {
462 +    print(paste0("==== debug: ", "CalcFRLHardwoodPlantations.R", ":113"))
463 +    harvested_cstock <- growthTotals(
464 +      FRLParams$Ty, hw$ahmt,
465 +      growthMatrix(FRLParams$Ty, hw$ahmt, FRLParams$deltaT) * maicm
466 +    )
467 +    print(harvested_cstock)
468 +  }
469 +
470     # Total average annual C removals
471     mcrm <- mcpm + ctm + mchm
472
473 @@ -216,9 +182,82 @@
474                                  v_ec_hw_aar,
475                                  probs = FRLParams$quci)
476
477 +  # Growth tables projection rather than average yearly growth
478 +  yearly_growth <- c(0.5,rep_len(1,FRLParams$Tl-1))
479 +  area <- hw$apmt
480 +
481 +  hwd_planted_cstock <- growthTotals(
482 +        FRLParams$Ty, area,
483 +        growthMatrix(FRLParams$Ty,
484 +                     area,
485 +                     yearly_growth,
486 +                     projection=7, offset = 14) * maicm,
487 +        projection=7, offset = 14)
488 +
489 +  if (debug_frl) {
490 +    print(paste0("==== debug: ", "CalcFRLHardwoodPlantations", ":204"))
491 +    print(hwd_planted_cstock)
492 +  }
493 +
494 +  # Uncertainty analysis
495 +  vhwcstock <- matrix(nrow=0,ncol=length(FRLParams$Ty)+4)
496 +  gm <-                                                                    ↵
    growthMatrix(FRLParams$Ty,rep_len(1,length(FRLParams$Ty)),c(0.5,rep_len(1,l ↵
    ength(FRLParams$Ty)-1)), projection=7, offset = 14)
497 +
498 +  mArea  <- mean(area)
499 +  # MC simulation
500 +  for (i in 1:FRLParams$runs) { # i <- 1
501 +    vAreas <- rtriangle(
502 +      n = 1,
503 +      theta = mArea,
504 +      lower = mArea - mArea * FRLParams$errHwPlantations,
505 +      upper = mArea + mArea * FRLParams$errHwPlantations
506 +    )
507 +    # Random realization of MAI volume
508 +    maivmi <- rtriangle(1,
509 +      theta = FRLParams$maivhww,
```

```
+      lower = FRLParams$maivhww - FRLParams$maivhww * FRLParams$errmaivhw,
+      upper = FRLParams$maivhww + FRLParams$maivhww * FRLParams$errmaivhw
+    )
+    # Random realization of BCEF_IM
+    bcefimi <- rtriangle(1,
+      theta = FRLParams$bcefihw,
+      lower = FRLParams$bcefihw - FRLParams$bcefihw * FRLParams$errbcefihw,
+      upper = FRLParams$bcefihw + FRLParams$bcefihw * FRLParams$errbcefihw
+    )
+    # Random root-to-shoot ratio for Wet Lowland
+    rwli <- rtriangle(1,
+      theta = FRLParams$Rlwk,
+      lower = FRLParams$Rlwk - FRLParams$Rlwk * FRLParams$errRlwk,
+      upper = FRLParams$Rlwk + FRLParams$Rlwk * FRLParams$errRlwk
+    )
+    # Compute MAI for C
+    maicmi <- (maivmi * bcefimi + maivmi * bcefimi * rwli) * FRLParams$etacf
+    r <- colSums(gm * vAreas * maicmi)
+    if (i==1) vhwcstock <- r
+    else vhwcstock <- rbind(vhwcstock, r)
+  }
+  colnames(vhwcstock) <- colnames(gm)
+
+  # Yearly removals
+  ec_hw_cstock <- hwd_planted_cstock[c(-1,-2)] * FRLParams$etacc# Estimate
+  mucstock <- apply(vhwcstock * FRLParams$etacc,2, quantile, probs = 0.5) # Lower confidence limit
+  lcihwcstock <- apply(vhwcstock * FRLParams$etacc,2, quantile, probs = FRLParams$qlci) # Lower confidence limit
+  ucihwcstock <- apply(vhwcstock * FRLParams$etacc,2, quantile, probs = FRLParams$quci) # Upper confidence limit
+  v_ec_hw_cstock <- vhwcstock * FRLParams$etacc * -1# MC estimates
+  # Result table CStock
+  rs_ec_hw_cstock <- data.frame(
+    rbind(
+      removals_tco2e_yr = ec_hw_cstock * -1,
+      lci_removals_tco2e_yr = lcihwcstock * -1,
+      uci_removals_tco2e_yr = ucihwcstock * -1,
+      mu_removals_tco2e_yr = mucstock * -1),
+    check.names = F
+  )
+
+
   result <- list()
-  result$rs_ec_ar <- rs_ec_ar
-  result$v_ec_ar_aar <- v_ec_ar_aar
+  result$hw_h_area <- hw$ahmt
+  result$hw_p_area <- hw$apmt
   result$ec_hw_aae <- ec_hw_aae
   result$ec_hw_aar <- ec_hw_aar
   result$ec_hw_aane <- ec_hw_aane
@@ -231,5 +270,9 @@
   result$v_ec_hw_aane <- v_ec_hw_aane
   result$lciv_ec_hw_aane <- lciv_ec_hw_aane
```

```
   result$uciv_ec_hw_aane <- uciv_ec_hw_aane
+  result$lciv_ec_hw_aane <- lciv_ec_hw_aane
+  result$uciv_ec_hw_aane <- uciv_ec_hw_aane
+  result$rs_ec_hw_cstock <- rs_ec_hw_cstock
+  result$v_ec_hw_cstock <- v_ec_hw_cstock
   return(result)
 }
Index: CalcFRLSoftwoodPlantations.R
===================================================================
--- CalcFRLSoftwoodPlantations.R    (revision 4457)
+++ CalcFRLSoftwoodPlantations.R    (revision 4641)
@@ -4,7 +4,10 @@
   # Volumes extracted from Softwood Plantations
   sw <- hwsw_volharv[, c(1, 3)] # Softwood data
   names(sw) <- c("year", "vol_m3") # Rename columns
-  if (debug_frl) print(sw) # Print 'sw'
+  if (debug_frl) {
+    print(paste0("==== debug: ", "CalcFRLSoftwoodPlantations.R", ":8"))
+    print(sw) # Print 'sw'
+  }

   volToAgbPine <- 1 / FRLParams$volTovol * FRLParams$wdsw

@@ -71,9 +74,24 @@
     ))

   netStockedArea$c_t  <- FRLParams$maicp * netStockedArea$area
-  print(mean(netStockedArea$c_t))

+  if (debug_frl) {
+    print(paste0("==== debug: ", "CalcFRLSoftwoodPlantations.R", ":79"))
+    print(netStockedArea$c_t)
+    print(mean(netStockedArea$c_t))
+  }

+  if (debug_frl) {
+    print(paste0("==== debug: ", "CalcFRLSoftwoodPlantations.R", ":85"))
+    net_cstock <- growthTotals(
+      FRLParams$Ty, netStockedArea$area,
+      growthMatrix(FRLParams$Ty, netStockedArea$area, FRLParams$rdeltaT)
* FRLParams$maicp
+    )
+    print(net_cstock)
+  }
+
+
+
   A2006 <- 49503
   sw$area_harvested_ha <- sw$carbon_extracted_t / (FRLParams$maicp *
FRLParams$cuttingc)
   sw$area_planted_ha <- sw_hvol_parea[,3]
@@ -84,13 +102,52 @@
   atp <- A2005 - sum(sw$area_harvested_ha)
   # Mean annual C removals on areas that just grow during the Reference
Period
```

```
613     ctp <- atp * FRLParams$maicp
614   +
615   +  if (debug_frl) {
616   +    print(paste0("==== debug: ", "CalcFRLSoftwoodPlantations.R", ":107"))
617   +    print(ctp)
618   +  }
619   +
620     # Accumulation of C on planted areas over the Reference Period
621   -  sw$cgain_t <- sw$area_planted_ha * FRLParams$deltaT * FRLParams$maicp
622   -  # C accumulation on areas that were harvested in year t
623   -  mchp <- mean(sw$area_harvested_ha * FRLParams$rdeltaT * FRLParams$maicp)
624   +  sw$cgainp_t <- sw$area_planted_ha * FRLParams$deltaT * FRLParams$maicp
625     # Average annual C accumulation on planted areas over the Reference ↵
    Period
626   -  mcpp <- mean(sw$cgain_t)
627   +  mcpp <- mean(sw$cgainp_t)
628   
629   +  if (debug_frl) {
630   +    print(paste0("==== debug: ", "CalcFRLSoftwoodPlantations.R", ":117"))
631   +    print(sw$cgainp_t)
632   +    print(mcpp)
633   +  }
634   +
635   +  if (debug_frl) {
636   +    print(paste0("==== debug: ", "CalcFRLSoftwoodPlantations.R", ":123"))
637   +    planted_cstock <- growthTotals(
638   +      FRLParams$Ty, sw$area_planted_ha,
639   +      growthMatrix(FRLParams$Ty, sw$area_planted_ha, FRLParams$rdeltaT) ↵
    * FRLParams$maicp
640   +    )
641   +    print(planted_cstock)
642   +  }
643   +
644   +  # C accumulation on areas that were harvested in year t
645   +  sw$cgainh_t <- sw$area_harvested_ha * FRLParams$rdeltaT * FRLParams$maicp
646   +  # Average annual C accumulation on harvested areas over the Reference ↵
    Period
647   +  mchp <- mean(sw$cgainh_t)
648   +
649   +  if (debug_frl) {
650   +    print(paste0("==== debug: ", "CalcFRLSoftwoodPlantations.R", ":137"))
651   +    print(sw$cgainh_t)
652   +    print(mchp)
653   +  }
654   +
655   +  if (debug_frl) {
656   +    print(paste0("==== debug: ", "CalcFRLSoftwoodPlantations.R", ":143"))
657   +    harvested_cstock <- growthTotals(
658   +      FRLParams$Ty, sw$area_harvested_ha,
659   +      growthMatrix(FRLParams$Ty, sw$area_harvested_ha, FRLParams$deltaT) ↵
    * FRLParams$maicp
660   +    )
661   +    print(harvested_cstock)
662   +  }
663   +
```

```
664     # Total average annual C removals
665     mcrp <- mcpp + ctp + mchp
666
667   @@ -132,6 +189,65 @@
668       resmcrpNew[i] <- mean(netStockedAreai$c_t)
669     }
670
671   +  # Growth tables projection rather than average yearly growth
672   +  yearly_growth <- c(0.5,rep_len(1,FRLParams$Tl-1))
673   +  area <- sw$area_planted_ha
674   +
675   +  swd_planted_cstock <- growthTotals(
676   +        FRLParams$Ty, area,
677   +        growthMatrix(FRLParams$Ty,
678   +                     area,
679   +                     yearly_growth,
680   +                     projection=7, offset = 14) * FRLParams$maicp,
681   +        projection=7, offset = 14)
682   +
683   +  if (debug_frl) {
684   +    print(paste0("==== debug: ", "CalcFRLSoftwaoodPlantations", ":204"))
685   +    print(swd_planted_cstock)
686   +  }
687   +
688   +  # Uncertainty analysis
689   +  vswcstock <- matrix(nrow=0,ncol=length(FRLParams$Ty)+4)
690   +  gm <-                                                                  ↵
      growthMatrix(FRLParams$Ty,rep_len(1,length(FRLParams$Ty)),c(0.5,rep_len(1,l ↵
      ength(FRLParams$Ty)-1)), projection=7, offset = 14)
691   +
692   +  mArea  <- mean(area)
693   +  # MC simulation
694   +  for (i in 1:FRLParams$runs) { # i <- 1
695   +    vAreas <- rtriangle(
696   +      n = 1,
697   +      theta = mArea,
698   +      lower = mArea - mArea * FRLParams$errSwPlantations,
699   +      upper = mArea + mArea * FRLParams$errSwPlantations
700   +    )
701   +    # Random realization of MAI AGB (25% error)
702   +    maicpi <- rtriangle(
703   +      n = FRLParams$Ty+7,
704   +      theta = FRLParams$maicp,
705   +      lower = FRLParams$maicp - FRLParams$maicp * FRLParams$errmaicp,
706   +      upper = FRLParams$maicp + FRLParams$maicp * FRLParams$errmaicp
707   +    )
708   +    r <- colSums(gm * vAreas * maicpi)
709   +    if (i==1) vswcstock <- r
710   +    else vswcstock <- rbind(vswcstock, r)
711   +  }
712   +  colnames(vswcstock) <- colnames(gm)
713   +
714   +  # Yearly removals
715   +  ec_sw_cstock <- swd_planted_cstock[c(-1,-2)] * FRLParams$etacc# Estimate
716   +  mucstock <- apply(vswcstock * FRLParams$etacc,2, quantile, probs =     ↵
```

```
0.5) # Lower confidence limit
+  lciswcstock <- apply(vswcstock * FRLParams$etacc,2, quantile, probs = FRLParams$qlci) # Lower confidence limit
+  uciswcstock <- apply(vswcstock * FRLParams$etacc,2, quantile, probs = FRLParams$quci) # Upper confidence limit
+  v_ec_sw_cstock <- vswcstock * FRLParams$etacc * -1# MC estimates
+  # Result table CStock
+  rs_ec_sw_cstock <- data.frame(
+    rbind(
+      removals_tco2e_yr = ec_sw_cstock * -1,
+      lci_removals_tco2e_yr = lciswcstock * -1,
+      uci_removals_tco2e_yr = uciswcstock * -1,
+      mu_removals_tco2e_yr = mucstock * -1),
+    check.names = F
+  )
+
   # Average annual removals from Softwood Plantations
.....................................
   ec_sw_aar <- mcrp * FRLParams$etacc # Estimate
   lci_ec_sw_aar <- quantile(resmcrp * FRLParams$etacc, probs = FRLParams$qlci) # Lower CI limit
@@ -144,6 +260,7 @@
   v_ec_sw_aarNew <- resmcrpNew * FRLParams$etacc # MC estimate

   if (debug_frl) {
+    print(paste0("==== debug: ", "CalcFRLSoftwoodPlantations.R", ":204"))
     print("original model of softwood growth")
     print(c(
       ec_sw_aar,
@@ -171,6 +288,8 @@
                                probs = FRLParams$quci)

   result <- list()
+  result$sw_h_area <- sw$area_harvested_ha
+  result$sw_p_area <- sw$area_planted_ha
   result$ec_sw_aae <- ec_sw_aae
   result$ec_sw_aar <- ec_sw_aarNew
   result$lci_ec_sw_aae <- lci_ec_sw_aae
@@ -181,5 +300,7 @@
   result$v_ec_sw_aar <- v_ec_sw_aarNew
   result$lciv_ec_sw_aane <- lciv_ec_sw_aane
   result$uciv_ec_sw_aane <- uciv_ec_sw_aane
+  result$rs_ec_sw_cstock <- rs_ec_sw_cstock
+  result$v_ec_sw_cstock <- v_ec_sw_cstock
   return(result)
 }
Index: CalcFRLTable.R
===================================================================
--- CalcFRLTable.R  (revision 4457)
+++ CalcFRLTable.R  (revision 4641)
@@ -32,7 +32,10 @@
   # Contributions (including emissions from fuelwood consumption)
   contributionsfuel <- contributions
   # Contributions of all sources and sinks in percent (including fuelwood)
-  if (debug_frl) print(contributionsfuel)
```

```
+  if (debug_frl) {
+    print(paste0("==== debug: ", "CalcFRLTable.R", ":36"))
+    print(contributionsfuel)
+  }
 }

 #' @export
@@ -110,13 +113,13 @@
       0, # FD fire gross removals
       0, # FD fuelwood gross removals
       0, # FD natural forest removals
-      FRLHardwoodPlantations$rs_ec_ar[1, 1], # EC AR gross removals
+      FRLAfforestation$rs_ec_ar[1, 1], # EC AR gross removals
       FRLPlantations$rs_ec_pl[6, 2]
     )

   # MC estimates
   v_aa_removals_tco2e_yr <- (FRLFelling$v_fd_lg_aar + # MC gross removals FD logging
-    FRLHardwoodPlantations$v_ec_ar_aar + # MC gross removals AR
+    FRLAfforestation$v_ec_ar_aar + # MC gross removals AR
     FRLHardwoodPlantations$v_ec_hw_aar + # MC gross removals Hardwood Plantations
     FRLSoftwoodPlantations$v_ec_sw_aar) * -1 # MC gross removals Softwood Plantations

@@ -170,12 +173,12 @@
       FRLFelling$rs_fd_lg[2, 2], # FD logging gross removals
       0, # FD fire gross removals
       0, # FD natural forest removals
-      FRLHardwoodPlantations$rs_ec_ar[1, 1], # EC AR gross removals
+      FRLAfforestation$rs_ec_ar[1, 1], # EC AR gross removals
       FRLPlantations$rs_ec_pl[6, 2]
     )
   # MC estimates
   v_aa_removals_tco2e_yr <- (FRLFelling$v_fd_lg_aar + # MC gross removals FD logging
-    FRLHardwoodPlantations$v_ec_ar_aar + # MC gross removals AR
+    FRLAfforestation$v_ec_ar_aar + # MC gross removals AR
     FRLHardwoodPlantations$v_ec_hw_aar + # MC gross removals Hardwood Plantations
     FRLSoftwoodPlantations$v_ec_sw_aar) * -1 # MC gross removals Softwood Plantations

@@ -284,7 +287,7 @@
       0, # FD fire gross removals
       0, # FD fuelwood gross removals
       0, # FD natural forest removals
-      FRLHardwoodPlantations$rs_ec_ar[1, 1], # EC AR gross removals
+      FRLAfforestation$rs_ec_ar[1, 1], # EC AR gross removals
       FRLPlantations$rs_ec_pl[6, 2]
     ), # EC Plantations gross removals

@@ -295,7 +298,7 @@
       0,
```

```
816         0,
817         0,
818 -       FRLHardwoodPlantations$rs_ec_ar[1, 2],
819 +       FRLAfforestation$rs_ec_ar[1, 2],
820         FRLPlantations$rs_ec_pl[6, 3]
821       ),
822
823 @@ -306,7 +309,7 @@
824         0,
825         0,
826         0,
827 -       FRLHardwoodPlantations$rs_ec_ar[1, 3],
828 +       FRLAfforestation$rs_ec_ar[1, 3],
829         FRLPlantations$rs_ec_pl[6, 4]
830       ),
831
832 @@ -317,7 +320,7 @@
833         FRLBurning$rs_fd_bb[1, 1], # FD fire net emissions
834         FRLFuelwood$rs_fd_fu[1, 1], # FD fuelwood net emissions
835         FRLNaturalForestDegradation$rs_fd_nf[1,1], # FD natural forest
836 -       FRLHardwoodPlantations$rs_ec_ar[1, 1], # EC AR net emissions
837 +       FRLAfforestation$rs_ec_ar[1, 1], # EC AR net emissions
838         FRLPlantations$rs_ec_pl[9, 2]
839       ), # EC Plantations net emissions
840
841 @@ -328,7 +331,7 @@
842         FRLBurning$rs_fd_bb[1, 2],
843         FRLFuelwood$rs_fd_fu[1, 2],
844         FRLNaturalForestDegradation$rs_fd_nf[1,2],
845 -       FRLHardwoodPlantations$rs_ec_ar[1, 2],
846 +       FRLAfforestation$rs_ec_ar[1, 2],
847         FRLPlantations$rs_ec_pl[9, 3]
848       ),
849
850 @@ -339,7 +342,7 @@
851         FRLBurning$rs_fd_bb[1, 3],
852         FRLFuelwood$rs_fd_fu[1, 3],
853         FRLNaturalForestDegradation$rs_fd_nf[1,3],
854 -       FRLHardwoodPlantations$rs_ec_ar[1, 3],
855 +       FRLAfforestation$rs_ec_ar[1, 3],
856         FRLPlantations$rs_ec_pl[9, 4]
857       )
858     )
859 @@ -347,9 +350,9 @@
860     # Average annual emissions and removals from EC                    ↵
    ========================================
861     # EC = enhancement of forest carbon stocks
862     # Estimate of average annual net emissions
863 -   aaneec <- FRLHardwoodPlantations$rs_ec_ar[1, 1] + # Gross/net removals AR
864 +   aaneec <- FRLAfforestation$rs_ec_ar[1, 1] + # Gross/net removals AR
865       FRLPlantations$rs_ec_pl[9, 2] # Net emissions Forest Plantations
866 -   v_aaneec <- (FRLHardwoodPlantations$v_ec_ar_aar * -1) + # MC gross/net ↵
    emissions AR
867 +   v_aaneec <- (FRLAfforestation$v_ec_ar_aar * -1) + # MC gross/net      ↵
    emissions AR
```

```
868       (FRLSoftwoodPlantations$v_ec_sw_aae +                                 ↵
    FRLHardwoodPlantations$v_ec_hw_aae) - # MC gross emissions Plantations
869       (FRLSoftwoodPlantations$v_ec_sw_aar +                                 ↵
    FRLHardwoodPlantations$v_ec_hw_aar)   # MC gross removals Plantations
870     # Lower confidence limit
871   @@ -420,7 +423,10 @@
872       frl_table_data
873     )
874
875   -  if (debug_frl) print(frl_table_data)
876   +  if (debug_frl) {
877   +    print(paste0("==== debug: ", "CalcFRLTable.R", ":427"))
878   +    print(frl_table_data)
879   +  }
880
881
882     frl_ExFuel <- calcFRLTable_ExFuel()
883   @@ -441,7 +447,10 @@
884       frl_table_data
885     )
886
887   -  if (debug_frl) print(frl_table_data)
888   +  if (debug_frl) {
889   +    print(paste0("==== debug: ", "CalcFRLTable.R", ":451"))
890   +    print(frl_table_data)
891   +  }
892
893     # FRL result table                                                      ↵
    ========================================================================
894     frl <- frl_tableExFuel
895   @@ -529,8 +538,100 @@
896         frl[7, 10] # FRL
897       )
898     )
899   +
900   +
901   +  yearly_growth <- c(0.5,rep_len(1,FRLParams$Tl-1))
902   +
903   +  arcstock <- growthTotals(
904   +        FRLParams$Ty,
905   +        rep(AdjustedAreas$ARareas, FRLParams$Tl),
906   +        growthMatrix(FRLParams$Ty,
907   +                     rep(AdjustedAreas$ARareas, FRLParams$Tl),
908   +                     yearly_growth, projection=7, offset = 14) *          ↵
    FRLParams$maicar * (1 + FRLParams$Rlwk),
909   +        projection=7, offset = 14
910   +  )
911   +
912   +  lgcstock <- growthTotals(
913   +        FRLParams$Ty,
914   +        lnf_area$area_harvested_total_ha,
915   +        growthMatrix(FRLParams$Ty,
916   +                       lnf_area$area_harvested_total_ha,
917   +                       yearly_growth,
918   +                       projection=7, offset = 14)* FRLParams$maiclnf,
```

```
919   +        projection=7, offset = 14)
920   +
921   +
922   +# Mean annual increment (tree biomass)
923   +  maibm <- FRLParams$maivhww * FRLParams$bcefihw + FRLParams$maivhww *
      FRLParams$bcefihw * FRLParams$Rlwk
924   +
925   +# Mean annual increment C [t ha^-1 yr^-1]
926   +  maicm <- maibm * FRLParams$etacf
927   +  hw <- list()
928   +#hw$ahmt <- hw_ahp[, 2] # Areas harvested
929   +  hw$apmt <- hw_ahp[, 3] # Areas planted
930   +
931   +# Average annual area planted areas over the Reference Period
932   +  mapm <- mean(hw$apmt)
933   +
934   +
935   +
936   +  hwd_planted_cstock <- growthTotals(
937   +        FRLParams$Ty, hw$apmt,
938   +        growthMatrix(FRLParams$Ty,
939   +                     hw$apmt,
940   +                     yearly_growth,
941   +                     projection=7, offset = 14) * maicm,
942   +        projection=7, offset = 14)
943   +
944   +  sw<- list()
945   +  sw$area_planted_ha <- sw_hvol_parea[,3]
946   +
947   +
948   +  swd_planted_cstock <- growthTotals(
949   +        FRLParams$Ty, sw$area_planted_ha,
950   +        growthMatrix(FRLParams$Ty,
951   +                     sw$area_planted_ha,
952   +                     yearly_growth,
953   +                     projection=7, offset = 14) * FRLParams$maicp,
954   +        projection=7, offset = 14)
955   +
956   +
957   +
958   +  base_yearly <- data.frame(replicate(5, c(
959   +  FRLDeforestation$rs_df$aa_em_tco2e_yr,
960   +  FRLBurning$rs_fd_bb$aa_em_tco2e_yr,
961   +  FRLFelling$rs_fd_lg$em[1],
962   +  FRLNaturalForestDegradation$rs_fd_nf$aa_em_tco2e_yr,
963   +  FRLHardwoodPlantations$ec_hw_aae,
964   +  FRLSoftwoodPlantations$ec_sw_aae
965   +  )))
966   +
967   +  names(base_yearly) <- c(2019:2023)
968   +
969   +  FRLAfforestation$growth <- arcstock[6,3:7]
970   +  FRLFelling$growth <- lgcstock[6,3:7]
971   +  FRLHardwoodPlantations$growth <- hwd_planted_cstock[6,3:7]
972   +  FRLSoftwoodPlantations$growth <- swd_planted_cstock[6,3:7]
```

```
973  +
974  +
975  +
976  +  overall_frl <- rbind(
977  +    base_yearly,
978  +    FRLAfforestation$growth * -1,
979  +    FRLFelling$growth * -1,
980  +    FRLHardwoodPlantations$growth * -1,
981  +    FRLSoftwoodPlantations$growth * -1
982  +  )
983  +
984  +
985  +  total_frl <- colSums(overall_frl[c(1),])
986  +  total_frl <- rbind(total_frl,colSums(overall_frl[c(2,3,4,8),]))
987  +  total_frl <- rbind(total_frl,colSums(overall_frl[c(5,6,7,9,10),]))
988  +  total_frl <-                                                          ↵
     rbind(total_frl,colSums(overall_frl[c(1,2,3,4,5,6,7,8,9,10),]))
989  +
990     result <- list()
991     result$frltab <- frltab
992  +  result$erpa_yearly <-
993     result$v_aaneec <- v_aaneec
994     result$v_aaefd <- v_aaefd
995     result$v_aarfd <- v_aarfd
996  Index: ER_Calculated_Values.R
997  ===================================================================
998  --- ER_Calculated_Values.R  (revision 4457)
999  +++ ER_Calculated_Values.R  (revision 4641)
1000 @@ -48,8 +48,9 @@
1001    # Estimate of CO2e removals from felling
1002
1003    result$EstRemFell <- CalcEstRemFell(
1004 -    MonitoredValues$FDegFellArea,
1005 -    MAICFell
1006 +    MonitoredValues$FDegFellArea$area_ha,
1007 +    MAICFell,
1008 +    MonitoredValues$FDegFellArea$age_yrs
1009    )
1010
1011
1012 @@ -63,6 +64,7 @@
1013    result$EstEmNFDeg <- CalcEstEmNFDeg(
1014      MonitoredValues$NFDegArea,
1015      EFNFDeg,
1016 +    RootToShootTropRain
1017    )
1018
1019    result$NetEmRemsNFDeg <- CalcNetEmRemsNFDeg(
1020 @@ -93,8 +95,9 @@
1021    # Yearly Removals from Afforestation  (tCO2e)
1022
1023    result$EstRemARefor <- CalcGrossRemARefor(
1024 -    MonitoredValues$AReforArea,
1025 -    MAIVar, BiomassConvExpansionARefor, RootToShootTropRain
1026 +    MonitoredValues$AReforArea$area_ha,
```

```
+    MAIVar, BiomassConvExpansionARefor, RootToShootTropRain,
+    MonitoredValues$AReforArea$age_yrs
   )
   # 3.2 Forest Plantations

@@ -118,9 +121,10 @@

   result$EstRemFPlnHwd <- CalcEstRemFPlnHwd(
     MonitoredValues$FPlnAreaJustGrowsHwd,
-    MonitoredValues$FPlnAreaPlantHwd,
+    MonitoredValues$FPlnAreaPlantHwd$area_ha,
     MonitoredValues$FPlnAreaHarvHwd,
-    MAIVhw, BiomassConvExpansionIncHW, RootToShootTropRain
+    MAIVhw, BiomassConvExpansionIncHW, RootToShootTropRain,
+    MonitoredValues$FPlnAreaPlantHwd$age_yrs
   )

   # Estimate of softwood removals for yr (tCO2e) ####
@@ -128,8 +132,9 @@
   result$EstRemFPlnSwd <- CalcEstRemFPlnSwd(
     MAIBsw,
     MonitoredValues$FPlnAreaJustGrowsSwd,
-    MonitoredValues$FPlnAreaPlantSwd,
-    MonitoredValues$FPlnAreaHarvSwd
+    MonitoredValues$FPlnAreaPlantSwd$area_ha,
+    MonitoredValues$FPlnAreaHarvSwd,
+    MonitoredValues$FPlnAreaPlantSwd$age_yrs
   )

   # ************************************************************
Index: EmissionReductions.R
===================================================================
--- EmissionReductions.R    (revision 4457)
+++ EmissionReductions.R    (revision 4641)
@@ -38,7 +38,7 @@

 #' @export
 CalcMpEstFRL <- function(ErpaYearlyFRL) {
-  return(ErpaYearlyFRL * 2)
+  return(ErpaYearlyFRL)
 }


Index: Felling.R
===================================================================
--- Felling.R   (revision 4457)
+++ Felling.R   (revision 4641)
@@ -32,11 +32,12 @@
 #' @return Removals from regrowth on Felled Areas in Natural Forests -     ↵
tCO2e
 #' @export
 CalcEstRemFell <- function(Area, # area of natural forest logged
-                           MAIC # Mean Annual Increment Carbon
+                           MAIC, # Mean Annual Increment Carbon
+                           Age
```

```
 ) {
   # Convert area to carbon and then emissions
-  Carbon <- Area * MAIC
-  CO2e <- ConvCarbonToCO2e(Carbon) * (-1)
+  Carbon <- Age * Area * MAIC
+  CO2e <- ConvCarbonToCO2e(sum(Carbon)) * (-1)
   # total removals from Logging
   return(CO2e)
 }

Index: Fiji_Constants_from_Reference_Level.R
===================================================================
--- Fiji_Constants_from_Reference_Level.R   (revision 4457)
+++ Fiji_Constants_from_Reference_Level.R   (revision 4641)
@@ -150,18 +150,15 @@
 #' @export
 errMAIVhw <- 0.25 # Relative error in MAIVhw and 'maivhww' (was param.errmaivhww )

-
 # Error on HW growing area has been removed.
 #errAreaJustGrowsHW <- 0.5 # Relative error in Hardwood Area that just grows

 # Mean annual AGB increment in Hardwood plantation [tB ha^-1 yr^-1] (not a parameter in FRL)

-#' @export
-MAIAGBhw <- MAIVhw * BiomassConvExpansionIncHW
+# MAIAGBhw <- MAIVhw * BiomassConvExpansionIncHW
 # MAIAGBhw                      <- 6.435  # Mean annual AGB increment in Hardwood plantation [tB ha^-1 yr^-1]



-#' @export
-MAIChw <- (MAIAGBhw * (1 + RootToShootTropRain) * BiomassToCarbonConv)
+# MAIChw <- (MAIAGBhw * (1 + RootToShootTropRain) * BiomassToCarbonConv)
 # MAIChw                        <- 4.14350 # Mean annual increment C for volume m^3 [t ha^-1 yr^-1]
Index: ForestPlantations.R
===================================================================
--- ForestPlantations.R (revision 4457)
+++ ForestPlantations.R (revision 4641)
@@ -82,17 +82,22 @@
                                AreaHarvested, # Area from area stocked which is harvested during the year
                                MAIV,
                                BioConvExpInc,
-                               RootToShootRatio) {
-  MAIChw <- MAIV * BioConvExpInc * (1 + RootToShootRatio)
+                               RootToShootRatio,
+                               Age) {
+  MAIBhw <- MAIV * BioConvExpInc * (1 + RootToShootRatio)
   # mean annual removals from forest that just grows (existing stock,
```

```
    neither planted nor harvested)
1130 -  Rem1 <- AreaJustGrowsHW * MAIChw
1131 -  # Carbon from area planted over year
1132 -  Rem2 <- (AreaPlanted) * MAIChw
1133 +  # MGG - patch no leggacy
1134 +  # Rem1 <- AreaJustGrowsHW * MAIChw
1135 +  # Biomass from area planted over year
1136 +  Rem2 <- Age * (AreaPlanted) * MAIBhw
1137    # Carbon from area planted over year (make into months?)
1138 -  Rem3 <- (AreaHarvested) * MAIChw
1139 +  # MGG - patch no leggacy
1140 +  # Rem3 <- (AreaHarvested) * MAIChw
1141    # total carbon from forest plantations
1142 -  RemTotal <- Rem1 + Rem2 + Rem3
1143 -  CO2e <- ConvBiomassToCO2e(RemTotal) * (-1)
1144 +  # MGG - patch no leggacy
1145 +  #RemTotal <- Rem1 + Rem2 + Rem3
1146 +  RemTotal <- Rem2
1147 +  CO2e <- ConvBiomassToCO2e(sum(RemTotal)) * (-1)
1148    return(CO2e)
1149  }
1150
1151 @@ -115,19 +120,24 @@
1152  CalcEstRemFPlnSwd <- function(MAIBsw, # Mean annual biomass increment in ↵
    Softwood Plantations
1153                                AreaJustGrowsSW, # Area stocked - area ↵
    harvested in that year
1154                                AreaPlanted, # Area planted during the year
1155 -                              AreaHarvested # Area from area stocked ↵
    which is harvested during the year
1156 +                              AreaHarvested, # Area from area stocked ↵
    which is harvested during the year
1157 +                              Age
1158  ) {
1159    # Calc mean annual increment C for volume m^3
1160    MAICsw <- ConvBiomassToCarbon(MAIBsw)
1161    # mean annual removals from forest that just grows (existing stock, ↵
    neither planted nor harvested)
1162 -  Rem1 <- AreaJustGrowsSW * MAICsw
1163 +  # MGG - patch no leggacy
1164 +  # Rem1 <- AreaJustGrowsSW * MAICsw
1165    # Carbon from area planted over year
1166 -  Rem2 <- (AreaPlanted) * MAICsw
1167 +  Rem2 <- Age * (AreaPlanted) * MAICsw
1168    # Carbon from area planted over year (make into months?)
1169 -  Rem3 <- (AreaHarvested) * MAICsw
1170 +  # MGG - patch no leggacy
1171 +  # Rem3 <- (AreaHarvested) * MAICsw
1172    # total carbon from forest plantations
1173 -  RemTotal <- Rem1 + Rem2 + Rem3
1174 -  CO2e <- ConvCarbonToCO2e(RemTotal) * (-1)
1175 +  # MGG - patch no leggacy
1176 +  #RemTotal <- Rem1 + Rem2 + Rem3
1177 +  RemTotal <- Rem2
1178 +  CO2e <- ConvCarbonToCO2e(sum(RemTotal)) * (-1)
```

```
1179      return(CO2e)
1180    }
1181
1182  Index: GrowthTables.R
1183  ===================================================================
1184  --- GrowthTables.R  (nonexistent)
1185  +++ GrowthTables.R  (revision 4641)
1186  @@ -0,0 +1,41 @@
1187  +
1188  +
1189  +
1190  +#' @export
1191  +growthProjection <- function(cols,n,growth,projection) {
1192  +  r <- c(cols, seq_len(projection)+cols[length(cols)])
1193  +  v <- c(n,rep(mean(n), projection))
1194  +  g <- c(growth,growth[seq_len(projection)] + growth[length(growth)])
1195  +  return(list(cols=r,n=v,growth=g))
1196  +}
1197  +
1198  +#' @export
1199  +growthMatrix <- function(cols, n, growth, projection=4, offset=0) {
1200  +  if (missing(growth)) growthFactor <- 1:length(cols)
1201  +  else growthFactor <- growth
1202  +  args <- growthProjection(cols, n, growthFactor, projection)
1203  +  scale <- c(length(args$cols):1)
1204  +  result <-as.data.frame(
1205  +    sapply(scale,
1206  +           function(x) {
1207  +             rev(c(rep(0,x-1),                                          ↵
      args$growth[seq_len(length(args$cols)-x+1)]))
1208  +           }) * args$n
1209  +  )[offset:length(args$cols), offset:length(args$cols)]
1210  +  names(result) <- as.character(args$cols[offset:length(args$cols)])
1211  +  return(result)
1212  +}
1213  +
1214  +#' @export
1215  +growthTotals <- function(cols,n, values, projection=4, offset=0) {
1216  +  args <- growthProjection(cols, n, 1:length(cols), projection)
1217  +  result <- rbind(values,colSums(values))
1218  +  result <- cbind(
1219  +    data.frame(
1220  +      "cols"=c(as.character(args$cols[offset:length(args$cols)]), "total"),
1221  +                                                                        ↵
      "n"=c(args$n[offset:length(args$n)],sum(args$n[offset:length(args$n)]))
1222  +    ),
1223  +    result
1224  +  )
1225  +  return(result)
1226  +}
1227  +
1228
1229  Index: UC_ER_Values.R
1230  ===================================================================
1231  --- UC_ER_Values.R  (revision 4457)
```

```
+++ UC_ER_Values.R  (revision 4641)
@@ -113,7 +113,7 @@
   # Uncertainty associated with the with MAIC and Area Felled
   # Calculate the arguments
   CalcEstRemFellArgs <- function() {
-    return(list(UC_MV$FDegFellArea, UC$MAICFell))
+    return(list(UC$FDegFellArea, UC$MAICFell, MV$FDegFellArea$age_yrs))
   }


@@ -142,7 +142,7 @@
   # Uncertainty associated with the with EF NFDeg and Area degraded
   # Calculate the arguments
   CalcEstEmNFDegArgs <- function() {
-    return(list(UC_MV$NFDegArea, UC$EFNFDeg))
+    return(list(UC_MV$NFDegArea, UC$EFNFDeg, UC$RootToShootTropRain ))
   }

   ## MGG - UC
@@ -196,7 +196,7 @@
   # Uncertainty with the estimated total MAICAGBar and Root To Shoot Tropical Rain Ratio
   # Calculate arguments
   CalcEstRemAReforArgs <- function() {
-    return(list(UC_MV$AReforArea, UC$MAIVar, UC$BiomassConvExpansionARefor, UC$RootToShootTropRain))
+    return(list(MV$AReforArea$area_ha, UC$MAIVar, UC$BiomassConvExpansionARefor, UC$RootToShootTropRain,MV$AReforArea$age_yrs))
   }


@@ -250,7 +250,7 @@
   # Uncertainty assessment (removals) of MAIV, Biomass Conversion and Expansion Factor,
   # Root To Shoot Tropical Rain, MAIC, Average annual area of forest that just grows
   CalcRemFPHWArgs <- function() {
-    return(list(MV$FPlnAreaJustGrowsHwd, MV$FPlnAreaPlantHwd, MV$FPlnAreaHarvHwd, UC$MAIVhw, UC$BiomassConvExpansionIncHW, UC$RootToShootTropRain))
+    return(list(MV$FPlnAreaJustGrowsHwd, MV$FPlnAreaPlantHwd$area_ha, MV$FPlnAreaHarvHwd, UC$MAIVhw, UC$BiomassConvExpansionIncHW, UC$RootToShootTropRain, MV$FPlnAreaPlantHwd$age_yrs))
   }


@@ -266,7 +266,7 @@
   names(local$EstRemFPlnHwd) <- c("EstRemFPlnHwd")
   # Estimate of softwood removals for yr (tCO2e) ####
   CalcRemFPSWArgs <- function() {
-    return(list(UC$MAIBsw, MV$FPlnAreaJustGrowsSwd, MV$FPlnAreaPlantSwd, MV$FPlnAreaHarvSwd))
+    return(list(UC$MAIBsw, MV$FPlnAreaJustGrowsSwd, MV$FPlnAreaPlantSwd$area_ha, MV$FPlnAreaHarvSwd,
```

```
    MV$FPlnAreaPlantSwd$age_yrs))
1275    }
1276
1277    # Final Estimate for SW Removals with UCI and LCI
1278  Index: UC_MV_Values.R
1279  ===================================================================
1280  --- UC_MV_Values.R  (revision 4457)
1281  +++ UC_MV_Values.R  (revision 4641)
1282  @@ -26,6 +26,7 @@
1283    names(result$DeforAreaUp) <- c("DeforAreaUp")
1284
1285    ## MGG - patch for ARefor survey area to override Adjusted Areas sampled
1286  +  ## TODO: still to be implimented with variance
1287    # result$AReforArea <- ValueWithUncertainty(
1288    #   Value = MV$AReforArea,
1289    #   LowerCI = quantile(MV$McAReforArea,probs=QLCI),
1290  @@ -34,19 +35,12 @@
1291    # )
1292    # names(result$AReforArea) <- c("AReforArea")
1293
1294  -  ## MGG - patch for ARefor survey area to override Adjusted Areas sampled
1295  -  result$AReforArea <- ValueWithUncertainty(
1296  -    Value = MV$AReforArea,
1297  -    LowerCI = MV$AReforArea - MV$AReforArea * ErrAreaARefor,
1298  -    UpperCI = MV$AReforArea + MV$AReforArea * ErrAreaARefor,
1299  -    model = vwuTriangle, fixed = FALSE
1300  -  )
1301  -  names(result$AReforArea) <- c("AReforArea")
1302
1303  +  ## MGG - patch for FDeg growth tables
1304    result$FDegFellArea <- ValueWithUncertainty(
1305  -    Value = MV$FDegFellArea,
1306  -    LowerCI = MV$FDegFellArea - MV$FDegFellArea * ErrAreaFell,
1307  -    UpperCI = MV$FDegFellArea + MV$FDegFellArea * ErrAreaFell,
1308  +    Value = MV$FDegFellArea$area_ha,
1309  +    LowerCI = MV$FDegFellArea$area_ha - MV$FDegFellArea$area_ha *
      ErrAreaFell,
1310  +    UpperCI = MV$FDegFellArea$area_ha + MV$FDegFellArea$area_ha *
      ErrAreaFell,
1311      model = vwuTriangle, fixed = FALSE
1312    )
1313    names(result$FDegFellArea) <- c("FDegFellArea")
1314  @@ -53,8 +47,8 @@
1315
1316    result$NFDegArea <- ValueWithUncertainty(
1317      Value = MV$NFDegArea,
1318  -    LowerCI = MV$NFDegArea - MV$NFDegArea * ErrAreaNFDeg,
1319  -    UpperCI = MV$NFDegArea + MV$NFDegArea * ErrAreaNFDeg,
1320  +    LowerCI = MV$NFDegArea_LCI,
1321  +    UpperCI = MV$NFDegArea_UCI,
1322      model = vwuTriangle, fixed = FALSE
1323    )
1324    names(result$NFDegArea) <- c("NFDegArea")
1325
```