

Appendix A – Adjustment of the land cover database

In order to keep constant the total land cover database per AEZ and region we did the following adjustments to savannah and shrubland:

1) We calculated the changes in forest land (F), pasture (PL) and cropland (CL) per region and AEZ to obtain the total change (T):

$$\Delta T = \Delta F + \Delta PL + \Delta CL$$

where symbol Δ represents the absolute changes from 2007 (obtained from land use database version 8) to 2011.

2) We distributed these changes into the shrubland (Sh) and savannah (Sv) respectively through the following formulation:

$$AREA_{Sv_2011} = AREA_{Sv_2007} - \Delta T \left(\frac{AREA_{Sv}}{AREA_{Sv} + AREA_{Sh}} \right)$$

$$AREA_{Sh_2011} = AREA_{Sh_2007} - \Delta T \left(\frac{AREA_{Sh}}{AREA_{Sv} + AREA_{Sh}} \right)$$

respectively for every region and AEZ.

It was also assumed that the categories of builtupland and other land were constant during the period of 2004 and 2011.

Appendix B – Aggregating the crop sectors

Mapping from the 175 FAO crops to the 8 aggregated GTAP sectors

Long name	GTAP Sector
Barley	Coarse grain
Buckwheat	Coarse grain
CanarySeed	Coarse grain
Cerealsnes	Coarse grain
Fonio	Coarse grain
Maize	Coarse grain
Millet	Coarse grain
MixedGrain	Coarse grain
Oats	Coarse grain
PopCorn	Coarse grain
Quinoa	Coarse grain
PaddyRice	Paddy Rice
Rye	Coarse grain
Sorghum	Coarse grain
Triticale	Coarse grain
Wheat	Wheat
Abaca_M_H	Plant-based fiber
AgaveFibrNES	Plant-based fiber
Coir	Plant-based fiber
FibreCropNES	Plant-based fiber
FlaxFibr_Tow	Plant-based fiber
HempFibr_Tow	Plant-based fiber
Jute	Plant-based fiber
JuteLikeFibr	Plant-based fiber
KapokFibre	Plant-based fiber
KapksdShell	Plant-based fiber
Ramie	Plant-based fiber
SeedCotton	Plant-based fiber
Sisal	Plant-based fiber
Alff4FrgSlg	Other crops
Beets4Fodder	Other crops
Cabbage4Fddr	Other crops
Carrots4Fddr	Other crops
Clovr4FrgSlg	Other crops
FrgProdNES	Other crops
GrsNESFrgSlg	Other crops
GmOlsd4Fddr	Other crops
LgmNESFrgSlg	Other crops

Maize4FrgSlg	Other crops
MxGrss_Lgm	Other crops
RyeGrsFrgSlg	Other crops
Srgm4FrgSlg	Other crops
Swedes4Fddr	Other crops
Turnips4Fddr	Other crops
Vgt_RootFddr	Other crops
Apples	Vegetables and fruits
Apricots	Vegetables and fruits
Avocados	Vegetables and fruits
Bananas	Vegetables and fruits
Berriesnes	Vegetables and fruits
Blueberries	Vegetables and fruits
Carobs	Vegetables and fruits
Cashewapple	Vegetables and fruits
Cherries	Vegetables and fruits
CitrusFrtNES	Vegetables and fruits
Cranberries	Vegetables and fruits
Currants	Vegetables and fruits
Dates	Vegetables and fruits
Figs	Vegetables and fruits
FrtFrshNES	Vegetables and fruits
FrtTrpFrNES	Vegetables and fruits
Gooseberries	Vegetables and fruits
Grpfrt_Pmlos	Vegetables and fruits
Grapes	Vegetables and fruits
KiwiFruit	Vegetables and fruits
Lmn_Lme	Vegetables and fruits
Mangoes	Vegetables and fruits
Oranges	Vegetables and fruits
Papayas	Vegetables and fruits
Peach_Nctrn	Vegetables and fruits
Pears	Vegetables and fruits
Persimmons	Vegetables and fruits
Pineapples	Vegetables and fruits
Plantains	Vegetables and fruits
Plums	Vegetables and fruits
Quinces	Vegetables and fruits
Raspberries	Vegetables and fruits
SourCherries	Vegetables and fruits
StnFrtNESFrh	Vegetables and fruits
Strawberries	Vegetables and fruits
TngMndClmnt	Vegetables and fruits

CastorBeans	Oilseeds
Coconuts	Oilseeds
GrndntWShll	Oilseeds
Hempseed	Oilseeds
KrtNtSheant	Oilseeds
Linseed	Oilseeds
Melonseed	Oilseeds
MustardSeed	Oilseeds
OilPalmFruit	Oilseeds
Oilseedsnes	Oilseeds
Olives	Oilseeds
PoppySeed	Oilseeds
Rapeseed	Oilseeds
SfflwrSeed	Oilseeds
SesameSeed	Oilseeds
Soybeans	Oilseeds
SnflwrSeed	Oilseeds
TungNuts	Oilseeds
Ans_bdn_fnnl	Other crops
ArcNtBtl	Vegetables and fruits
ChicoryRoots	Vegetables and fruits
CnnmnCnlla	Other crops
cloves	Other crops
CocoaBeans	Other crops
CoffeeGreen	Other crops
ginger	Other crops
Hops	Other crops
Kolanuts	Vegetables and fruits
Mate	Other crops
NaturalGums	Other crops
NatRubber	Other crops
Ntmg_Mc_Crdm	Other crops
Pepper	Other crops
Peppermint	Other crops
Pimento	Other crops
PrthrmDrdFlw	Other crops
spicesnes	Other crops
Tea	Other crops
TbccLeaves	Other crops
Vanilla	Other crops
BambaraBeans	Vegetables and fruits
BeansDry	Vegetables and fruits
BrdBeansDry	Vegetables and fruits

ChickPeas	Vegetables and fruits
CowPeasDry	Vegetables and fruits
Lentils	Vegetables and fruits
Lupins	Other crops
PeasDry	Vegetables and fruits
PigeonPeas	Vegetables and fruits
Pulsesnes	Vegetables and fruits
Vetches	Other crops
Cassava	Vegetables and fruits
Potatoes	Vegetables and fruits
Root_TbrNES	Other crops
SweetPotato	Vegetables and fruits
TaroCocoYam	Vegetables and fruits
Yams	Vegetables and fruits
YautiaCcYam	Vegetables and fruits
SugarBeets	Sugar crops
SugarCane	Sugar crops
SugarCrpNES	Sugar crops
Almonds	Vegetables and fruits
BrazilNuts	Vegetables and fruits
CashewNuts	Vegetables and fruits
Chestnuts	Vegetables and fruits
HxlntFlbrt	Vegetables and fruits
Nutsnes	Vegetables and fruits
Pistachios	Vegetables and fruits
Walnuts	Vegetables and fruits
Artichokes	Vegetables and fruits
Asparagus	Vegetables and fruits
BeanGreen	Vegetables and fruits
BrdBeanGreen	Vegetables and fruits
Cabbages	Vegetables and fruits
Cntlp_othMln	Vegetables and fruits
Carrots	Vegetables and fruits
Cauliflower	Vegetables and fruits
Chll_PpprGrn	Vegetables and fruits
Ccmbr_Ghrkn	Vegetables and fruits
Eggplants	Vegetables and fruits
Garlic	Vegetables and fruits
GrnCornMaize	Vegetables and fruits
Lettuce	Vegetables and fruits
Mushrooms	Other crops
Okra	Vegetables and fruits
OnionDry	Vegetables and fruits

OnionShlItGn	Vegetables and fruits
PeasGreen	Vegetables and fruits
PmpknSqshGrd	Vegetables and fruits
Spinach	Vegetables and fruits
StringBeans	Vegetables and fruits
Tomatoes	Vegetables and fruits
VgtbFrshNES	Vegetables and fruits
Watermelons	Vegetables and fruits

Appendix C – Further adjustments on the crop production

The adjustments by Avestiyan et al. (2011) for special cases when there was a non-zero value of area or production in FAOSTAT database but zero AEZ shares in GTAP database version 8 are described in Baldos and Hertel (2012). Additionally, the following adjustments were made to the database:

1) For the production of alfalfa, FAO data showed an inconsistency for United States in 2011. In order to fix this value, we took as reference the productivity of 2007 and assumed to be the same for 2011. Then we multiplied this value with the harvested area for alfalfa in 2011 in order to obtain the production of alfalfa in 2011 which was equal to 269 Mt.

2) The categories of Grass and ray grass for silage and forage were set equal to zero.

3) Some of the crops provide production but not harvested area available in some regions in the FAOSTAT database. For those region-crop cases (i.e. oilseeds NES, mushroom, coir, forage NES, sugar beet, kapokseed in shell, fiber crop NES, Brazil nut and pumpkin, squash and ground) the production is dropped.

4) We kept constant the value of Mixed Grass and Leguminous for all regions.

5) We need to do some modifications to add some countries that do not have any AEZ values, which could be troublesome. Therefore, we have approximate the following countries with their neighbors/closest regions

- Jam: In the case of Jamaica, because it covers islands, the approximation for AEZs come from its close neighbor Dominican Republic (Dom), because they have similar crops and tropical weather.
- Pri (Puerto Rico): we used as proxy Cuba for being one of the close countries.
- Cpv (Cape Verde): the proxy was Senegal
- Lux (Luxembourg): as proxy we used Belgium
- Mlt (Malta): Italian southern part, which is almost $\frac{1}{2}$ AEZ10 and AEZ11
- Bhr (Buhair) & Qatar (qat): Saudi Arabia eastern map was used as an approach using AEZ1.
- Mus (Mauritius): AEZ 6 according to the map was used.
- Twn: In this case, AEZ12 was used as proxy.

Posteriorly they are added in the aggregation as the following regions:

- Jamaica is added to XCB
- Puerto Rico is added to XCB
- Cape Verde is added to XWF
- Luxembourg is still in LUX
- Malta is still in MLT
- Bahrein is in BAH

- Qatar is in QAT
- Mauritius is still in MUS
- Taiwan is still TWN

6) The production of Jute like fiber was set equal to zero, because this is a sub product and therefore it has no area. Same for Pop Corn and Natural Gum.

Suggestions:

The following categories are not included in the GTAP versions: Leekoth_all (which could be included in Veg. & Leguminous), Chilli Pepper Dry (could be included together with green into a category called Difference in Chilli Pepper), “Other bast fibre” for jute for fiber, Tea NES in Tea, Tallowtree Seeds and Jojoba Seeds in Oilseed.

Appendix D – Production, harvested area and crop yield in 2004

Table D1. Production by crop and region in 2004 (in Mt)

Region	Paddy Rice	Wheat	Coarse Grain	Vegetable and food	Oilseeds	Sugar crops	Plant-based fiber	Other crops
USA	10.5	58.7	319.8	93.8	89.0	59.0	12.5	677.7
European Union	2.9	149.3	172.9	215.3	36.1	132.8	1.7	632.2
Brazil	13.3	5.8	44.9	76.9	53.7	415.2	4.0	5.0
Canada	0.0	24.8	26.0	12.7	11.6	0.7	0.0	102.1
Japan	10.9	0.9	0.2	19.4	0.2	5.8	0.0	39.3
China	180.5	92.0	140.7	685.4	49.4	96.9	20.0	57.5
India	124.7	72.2	33.0	164.5	31.4	233.9	10.2	95.3
Central America	2.2	2.3	33.5	56.4	5.3	121.5	0.5	28.9
South America	11.1	19.7	30.1	69.1	47.6	98.8	1.2	180.5
East Asia	9.1	0.3	2.3	23.8	0.5	0.0	0.0	0.9
Malaysia and Indonesia	56.4	0.0	11.3	47.2	149.5	27.9	0.0	5.8
South East Asia	110.6	0.1	14.8	87.2	26.6	122.0	0.5	12.4
South Asia	51.4	24.5	6.3	29.9	3.6	64.2	8.1	3.6
Russia	0.5	45.4	30.3	56.0	5.7	21.8	0.1	217.1
Central Europe	1.2	66.6	59.2	119.0	8.6	39.4	8.4	140.8
Other European countries	0.0	0.9	1.6	2.0	0.1	1.5	0.0	15.1
Middle and North Africa	9.2	41.4	20.0	108.5	4.8	35.3	2.4	91.3
Sub Saharan Africa	12.6	5.3	79.6	278.2	31.9	65.2	4.6	34.0
Oceania	0.6	22.2	12.6	13.8	3.6	37.4	0.8	205.3
Total	607.7	632.5	1039.1	2159.1	559.5	1579.5	75.3	2544.7

Table D2. Harvested area by crop and region in 2004 (in Mha)

Region	Paddy Rice	Wheat	Coarse Grain	Vegetable and food	Oilseeds	Sugar crops	Plant-based fiber	Other crops
USA	1.3	20.2	35.2	4.3	31.8	0.9	5.3	28.9
European Union	0.4	26.6	33.8	14.4	13.9	2.2	0.6	23.7
Brazil	3.7	2.8	13.9	9.5	22.3	5.6	1.4	3.7
Canada	0.0	9.4	6.8	2.5	6.9	0.0	0.0	7.9
Japan	1.7	0.2	0.1	0.9	0.1	0.1	0.0	1.1
China	28.6	21.6	29.4	44.9	24.2	1.6	6.0	5.0
India	41.9	26.6	29.3	36.0	27.5	3.9	9.7	12.2
Central America	0.7	0.5	12.3	6.7	1.1	2.0	0.2	3.3
South America	2.1	7.4	7.6	5.9	20.3	1.2	0.9	11.1
East Asia	1.6	0.2	0.7	1.7	0.4	0.0	0.0	0.1
Malaysia and Indonesia	12.6	0.0	3.4	4.8	11.0	0.4	0.0	7.7
South East Asia	31.0	0.1	5.5	11.3	7.9	2.0	0.5	4.2
South Asia	15.3	11.4	3.6	5.2	2.2	1.3	3.7	1.2
Russia	0.1	22.9	17.4	5.7	5.7	0.8	0.1	28.4
Central Europe	0.3	32.2	21.2	11.4	7.1	1.3	3.4	18.1
Other European countries	0.0	0.2	0.3	0.1	0.0	0.0	0.0	0.5
Middle and North Africa	1.3	18.1	10.7	10.1	4.2	0.5	0.8	4.3
Sub Saharan Africa	7.7	2.9	72.3	53.0	21.6	1.2	5.4	12.4
Oceania	0.1	13.4	6.9	1.8	1.8	0.5	0.2	17.5
Total	150.5	216.8	310.4	230.2	210.2	25.6	38.3	191.3

Table D3. Productivity by crop and region in 2004 (in ton/ha)

Region	Paddy Rice	Wheat	Coarse Grain	Vegetable and food	Oilseeds	Sugar crops	Plant- based fiber	Other crops
USA	7.8	2.9	9.1	22.0	2.8	65.0	2.4	23.4
European Union	6.7	5.6	5.1	14.9	2.6	59.5	2.8	26.7
Brazil	3.6	2.1	3.2	8.1	2.4	73.7	2.9	1.3
Canada	0.0	2.6	3.8	5.1	1.7	52.4	1.2	12.9
Japan	6.4	4.0	2.1	22.2	1.3	64.1	0.0	37.2
China	6.3	4.3	4.8	15.3	2.0	61.2	3.3	11.6
India	3.0	2.7	1.1	4.6	1.1	59.4	1.1	7.8
Central America	3.2	4.4	2.7	8.5	4.9	62.2	2.3	8.8
South America	5.2	2.7	4.0	11.7	2.3	80.0	1.4	16.2
East Asia	5.7	1.3	3.3	13.8	1.2	0.0	1.3	7.4
Malaysia and Indonesia	4.5	0.0	3.3	9.7	13.6	64.6	1.4	0.8
South East Asia	3.6	1.3	2.7	7.7	3.4	62.1	0.9	3.0
South Asia	3.4	2.1	1.8	5.7	1.7	47.8	2.2	3.1
Russia	3.8	2.0	1.7	9.8	1.0	27.7	0.9	7.6
Central Europe	4.0	2.1	2.8	10.5	1.2	30.5	2.5	7.8
Other European countries	0.0	5.5	5.0	25.0	3.0	78.2	0.0	27.5
Middle and North Africa	6.8	2.3	1.9	10.8	1.1	68.8	3.1	21.2
Sub Saharan Africa	1.6	1.8	1.1	5.2	1.5	52.4	0.9	2.7
Oceania	8.3	1.7	1.8	7.6	2.0	82.1	4.1	11.7
Global average yield	4.0	2.9	3.3	9.4	2.7	61.7	2.0	13.3