iFEED food production calibrated statements

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Overview

Each country section describes the model results for each of the four scenarios in turn. Each scenario begins with a description, which gives an overview of the management and land use inputs for the modelling. Calibrated statements, based on model results, follow for: aggregated crop production changes, livestock meat and dairy production changes, and irrigation water percentage changes relative to the baseline.

See the appendix for details of the literature used to assess agreement with the broader literature, and the rationale behind the medium level of confidence which was ultimately assigned to all food production and irrigation calibrated statements.

Malawi

Low climate risk (RCP2.6) / ineffective agricultural policies (LT)

Scenario description

This scenario is characterised by no changes to the agricultural land use pattern. No increase to irrigation areas is assumed.

Crop diversity remains unchanged in this scenario, meaning that maize is still the crop associated with the largest growing area. No technology trend on crop yields is assumed – i.e. yield change (and production) is driven by climate change only. Crop adaptation allows planting dates to vary, and crop varieties to vary, but these varieties are restricted to those available in the baseline.

CS1: crop production

The mean percentage change to crop production with RCP2.6, scenario lt is -1% (range across climate models -16 to 11%; 0/18 climate models are outliers).

Robustness:
Medium robustness. Highly robust with respect to the range of climate model uncertainty as there are no outliers. The underlying yield projections are associated with high confidence. However, for the majority of crops, average projections across these four crops are used, and therefore the productions projections for other crops are less certain. This suggests medium robustness.

Agreement:
Medium agreement. The production changes in this scenario are based on yield change only (no land use changes); the yield change literature has high agreement with iFEED projections. However, there is less literature available for the vast majority of crops; therefore we are downgrading agreement to “medium” in the absence of more specific information on all crops (and resulting production).

Medium Confidence (medium robustness and medium agreement).

CS2: livestock production

The mean percentage change to livestock meat production with RCP2.6, scenario lt is -1% (range across climate models -17 to 9%; 1/18 climate models are outliers). This becomes mean -1%, range -13 to 9% after removing the lower limit outliers.

The mean percentage change to livestock dairy production with RCP2.6, scenario lt is 2% (range across climate models -8 to 11%; 1/18 climate models are outliers). This becomes mean 3%, range -8 to 11% after removing the lower limit outliers.

Robustness:
Medium robustness. Highly robust with respect to climate model uncertainty as 1 outlier. The underlying yield and crop production projections are associated with medium confidence. Simple methods have been used to translate future crop and pasture production to future livestock production, assuming historical relationships between the two persist. This suggests medium robustness.

Agreement:
Medium agreement. There is literature to suggest that livestock production efficiency could increase in future; however, climate change could also make certain livestock production more difficult due to diseases and heat stress. Overall, there is little to suggest that livestock production could not continue to be related to the available amounts of livestock feed. However, the lack of specific projections with which to compare to iFEED suggests medium agreement.

Medium Confidence (medium robustness and medium agreement).

CS3: irrigation water use

The mean percentage change to irrigation water with RCP2.6, scenario lt is 13% (range across climate models -20 to 33%; 1/18 climate models are outliers). This becomes mean 15%, range -17 to 33% after removing the lower limit outliers.

High climate risk (RCP8.5) / ineffective agricultural policies (LT)

Scenario description:

This scenario is characterised by a 10% reduction in all arable and livestock pasture areas. Irrigation areas are reduced by 10%, along with all other agricultural lands.

Crop diversity remains unchanged in this scenario, meaning that maize is still the crop associated with the largest growing area. No technology trend on crop yields is assumed – i.e. yield change is driven by climate change only. Crop adaptation allows planting dates to vary, and crop varieties to vary, but these varieties are restricted to those available in the baseline.

CS1: crop production

The mean percentage change to crop production with RCP8.5, scenario lt is -14% (range across climate models -26 to -7%; 0/18 climate models are outliers).

Robustness:
Medium robustness. Highly robust with respect to the range of climate model uncertainty as there are no outliers. The underlying yield projections are associated with high confidence. For the majority of crops, average projections across these four crops are used, and therefore the productions projections for other crops are less certain. This suggests medium robustness.

Agreement:
Medium agreement. The production changes in this scenario are based on yield change largely (also a 10% reduction in agricultural area is assumed); the yield change literature has high agreement with iFEED projections. There is less literature available for the vast majority of crops; therefore we are downgrading agreement to “medium” in the absence of more specific information on all crops (and resulting production).

Medium Confidence (medium robustness and medium agreement).

CS2: livestock production:

The mean percentage change to livestock meat production with RCP8.5, scenario lt is -13% (range across climate models -25 to -7%; 1/18 climate models are outliers). This becomes mean -13%, range -24 to -7% after removing the lower limit outliers.

The mean percentage change to livestock dairy production with RCP8.5, scenario lt is -6% (range across climate models -15 to -3%; 1/18 climate models are outliers). This becomes mean -6%, range -12 to -3% after removing the lower limit outliers.

Robustness:
Medium robustness. Highly robust with respect to climate model uncertainty as 1 outlier. The underlying yield and crop production projections are associated with medium confidence. Simple methods have been used to translate future crop and pasture production to future livestock production, assuming historical relationships between the two persist. This suggests medium robustness.

Agreement:
Medium agreement. There is literature to suggest that livestock production efficiency could increase in future; however, climate change could also make certain livestock production more difficult due to diseases and heat stress. Overall, there is little to suggest that livestock production could not continue to be related to the available amounts of livestock feed. However, the lack of specific projections with which to compare to iFEED suggests medium agreement.

Medium Confidence (medium robustness and medium agreement).

CS3 irrigation water use:

The mean percentage change to irrigation water with RCP8.5, scenario lt is 5% (range across climate models -17 to 38%; 0/18 climate models are outliers).

Low climate risk (RCP2.6) / effective agricultural policies (HT)

Scenario description:

This scenario is characterised by a large increase in arable and pasture areas – using up any areas that are not forested, designated as protected or urban land. This amounts to a 57% increase in both arable crop land and livestock pasture land. All arable crop areas are irrigated to a small extent in future.

Crop diversity increases substantially in this scenario, with arable areas approximately evenly divided between all food crops – i.e. a large diversification away from maize. Additionally, crop areas are optimised to maximise production – in other words, the mixture of crops that returns the highest possible crop production is used in future (although the total national area of each crop is approximately equal, where each crop is placed within the country is optimised to maximise production).

It is assumed that the same percentage change to crop yields experienced from 1961 to 2010 (i.e. management and technology improvements to yields) will continue to 2050 – i.e. a substantial yield improvement compared to the baseline. This amounts to more than a doubling of crop yields on average. Crop adaptation allows planting dates to vary, and crop varieties to vary, and where there is a significant trend for warming to reduce the length of crop growing seasons, varieties are assumed to be available that can compensate for this. All of these factors combined result in large increases to crop and livestock production.

CS1: crop production

The mean percentage change to crop production with RCP2.6, scenario ht is 728% (range across climate models 676 to 759%; 1/18 climate models are outliers). This becomes mean 731%, range 676 to 759% after removing the lower limit outliers.

Robustness:
Medium robustness. Highly robust with respect to the range of climate model uncertainty as there is 1 outlier. The underlying yield projections are associated with medium confidence for one of the four modelled crops. The other three crop yield projections are associated with high confidence. For the majority of crops, average projections across these four crops are used, and therefore the productions projections for other crops are less certain. Overall, this suggests medium robustness.

Agreement:
Medium agreement. The production changes in this scenario are based on an optimistic future where yield trends are maintained and crop areas expand. Literature suggests yields can improve drastically given the correct agricultural inputs. The climate change impact literature has high agreement with iFEED projections for three of four crops. The other crop is associated with medium agreement. There is less literature available for the majority of other crops included in the analysis. Overall, this suggests medium agreement, given uncertainties in the literature concerning future food production and yields for all crops.

Medium Confidence (medium robustness and medium agreement).

CS2: livestock production

The mean percentage change to livestock meat production with RCP2.6, scenario ht is 151% (range across climate models 130 to 160%; 1/18 climate models are outliers). This becomes mean 152%, range 137 to 160% after removing the lower limit outliers.

The mean percentage change to livestock dairy production with RCP2.6, scenario ht is 237% (range across climate models 227 to 249%; 3/18 climate models are outliers). This becomes mean 237%, range 230 to 245% after removing both upper and lower limit outliers.

Robustness:
Medium robustness. Medium robustness with respect to climate model uncertainty as 3 outliers for dairy production. The underlying yield and crop production projections are associated with medium confidence. Simple methods have been used to translate future crop and pasture production to future livestock production, assuming historical relationships between the two persist. This suggests medium robustness.

Agreement:
Medium agreement. There is literature to suggest that livestock production efficiency could increase in future; however, climate change could also make certain livestock production more difficult due to diseases and heat stress. Overall, there is little to suggest that livestock production could not continue to be related to the available amounts of livestock feed. However, the lack of specific projections with which to compare to iFEED suggests medium agreement.

Medium Confidence (medium robustness and medium agreement).

CS3: irrigation water use:

The mean percentage change to irrigation water with RCP2.6, scenario ht is 1136% (range across climate models 756 to 1506%; 0/18 climate models are outliers).

High climate risk (RCP8.5) / effective agricultural policies (HT)

Scenario description:

This scenario is characterised by a large increase in arable and pasture areas – using up any areas that are not forested, designated as protected or urban land. This amounts to a 58% increase in both arable crop land and livestock pasture land. Irrigation areas have expanded to include all arable crop areas.

Crop diversity increases substantially in this scenario, with arable areas approximately evenly divided between all crops – i.e. a large diversification away from maize. Crop areas are optimised to maximise production – in other words, the mixture of crops that returns the highest possible crop production is used in future (although the total national area of each crop is approximately equal, where each crop is placed within the country is optimised to maximise production).

It is assumed that the same percentage change to crop yields experienced from 1961 to 2010 (i.e. management and technology improvements to yields) will continue to 2050 – i.e. a substantial yield improvement compared to the baseline. This amounts to more than a doubling of crop yields on average. Crop adaptation allows planting dates to vary, and crop varieties to vary, and where there is a significant trend for warming to reduce the length of crop growing seasons, varieties are assumed to be available that can compensate for this. All of these factors combined result in large increases to crop and livestock production.

CS1: crop production

The mean percentage change to crop production with RCP8.5, scenario ht is 719% (range across climate models 675 to 745%; 1/18 climate models are outliers). This becomes mean 722%, range 681 to 745% after removing the lower limit outliers.

Robustness:
Medium robustness. Highly robust with respect to the range of climate model uncertainty as there is 1 outlier. The underlying yield projections are associated with medium confidence for two of the four modelled crops. The other two crop yield projections are associated with high confidence. For the majority of crops, average projections across these four crops are used, and therefore the productions projections for other crops are less certain. Overall, this suggests medium robustness.

Agreement:
Medium agreement. The production changes in this scenario are based on an optimistic future where yield trends are maintained and crop areas expand. Literature suggests yields can improve drastically given the correct policy interventions. The climate change impact literature has high agreement with iFEED projections for two of four crops. The other two crops are associated with medium agreement. There is less

literature available for the majority of other crops included in the analysis. Overall, this suggests medium agreement, given uncertainties in the literature concerning future food production and yields for all crops.

Medium Confidence (medium robustness and medium agreement).

CS2: livestock production

The mean percentage change to livestock meat production with RCP8.5, scenario ht is 152% (range across climate models 133 to 160%; 2/18 climate models are outliers). This becomes mean 154%, range 143 to 160% after removing the lower limit outliers.

The mean percentage change to livestock dairy production with RCP8.5, scenario ht is 243% (range across climate models 234 to 254%; 0/18 climate models are outliers).

Robustness:
Medium robustness. Medium robustness with respect to climate model uncertainty as 2 outliers for meat production. The underlying yield and crop production projections are associated with medium confidence. Simple methods have been used to translate future crop and pasture production to future livestock production, assuming historical relationships between the two persist. This suggests medium robustness.

Agreement:
Medium agreement. There is literature to suggest that livestock production efficiency could increase in future; however, climate change could also make certain livestock production more difficult due to diseases and heat stress. Overall, there is little to suggest that livestock production could not continue to be related to the available amounts of livestock feed. However, the lack of specific projections with which to compare to iFEED suggests medium agreement.

Medium Confidence (medium robustness and medium agreement).

CS3: irrigation water use:

The mean percentage change to irrigation water with RCP8.5, scenario ht is 1130% (range across climate models 817 to 1668%; 1/18 climate models are outliers). This becomes mean 1098%, range 817 to 1584% after removing the upper limit outliers.

Tanzania

Low climate risk (RCP2.6) / low technology (LT)

Scenario description:

Crop diversity increases in this scenario, with maize areas halving proportionately, with this land evenly distributed to all other crops. This means that maize is no longer the crop associated with the greatest growing area, with cassava, sorghum and beans all having more area in future. No technology trend on crop yields is assumed – i.e. yield change is driven by climate change only. Crop adaptation allows planting dates to vary, and crop varieties to vary, but these varieties are restricted to those available in the baseline.

CS1: crop production

The mean percentage change to crop production with RCP2.6, scenario lt is 65% (range across climate models 42 to 106%; 3/18 climate models are outliers). This becomes mean 64%, range 50 to 79% after removing both upper and lower limit outliers.

Robustness:
Medium robustness. Medium robustness with respect to the range of climate model uncertainty as there are 3 outliers. The underlying yield projections are associated with high confidence. For the majority of crops, average projections across these four crops are used, and therefore the productions projections for other crops are less certain. This suggests medium robustness.

Agreement:
Medium agreement. The literature suggests that substantial yield and area increases are possible, and the yield change literature has high agreement with underlying iFEED projections. There is little literature available for the vast majority of crops;

therefore we are downgrading agreement to “medium” in the absence of more specific information on all crops in the region and for a lack of comparable production projections.

Medium Confidence (medium robustness and medium agreement).

CS2: livestock production:

The mean percentage change to livestock meat production with RCP2.6, scenario lt is 62% (range across climate models 52 to 73%; 0/18 climate models are outliers).

The mean percentage change to livestock dairy production with RCP2.6, scenario lt is 67% (range across climate models 60 to 76%; 0/18 climate models are outliers).

Robustness:
Medium robustness. High robustness with respect to climate model uncertainty as 0 outliers. The underlying yield and crop production projections are associated with medium confidence. Simple methods have been used to translate future crop and pasture production to future livestock production, assuming historical relationships between the two persist. This suggests medium robustness.

Agreement:
Medium agreement. There is literature to suggest that livestock production efficiency could increase in future; however, climate change could also make certain livestock production more difficult due to diseases and heat stress. Overall, there is little to suggest that livestock production could not continue to be related to the available amounts of livestock feed. However, the lack of specific projections with which to compare to iFEED suggests medium agreement.

Medium Confidence (medium robustness and medium agreement).

CS3: Irrigation change:

The mean percentage change to irrigation water with RCP2.6, scenario lt is 30% (range across climate models -1 to 73%; 1/18 climate models are outliers). This becomes mean 27%, range -1 to 68% after removing the upper limit outliers.

High climate risk (RCP8.5) / low technology (LT)

Scenario description:

This scenario is characterised by increases to agricultural land, using up all areas that are not forested, designated as protected or urban land. This amounts to a 58% increase of arable crop land and livestock pasture. All arable areas become rainfed in 2050 in this scenario.

Crop diversity decreases in this scenario, with maize areas doubling proportionately. No technology trend on crop yields is assumed – i.e. yield change is driven by climate change only. Crop adaptation allows planting dates to vary, and crop varieties to vary, but these varieties are restricted to those available in the baseline.

CS1: crop production

The mean percentage change to crop production with RCP8.5, scenario lt is 38% (range across climate models 25 to 56%; 1/18 climate models are outliers). This becomes mean 36%, range 25 to 55% after removing the upper limit outliers.

Robustness:
Medium robustness. Highly robust with respect to the range of climate model uncertainty as there is 1 outliers. The underlying yield projections are associated with high confidence. For the majority of crops, average projections across these four crops are used, and therefore the productions projections for other crops are less certain. This suggests medium robustness.

Agreement:
Medium agreement. The literature suggests that substantial yield and area increases are possible, and the yield change literature has high agreement with underlying iFEED projections. There is little literature available for the vast majority of crops; therefore we are downgrading agreement to “medium” in the absence of more specific information on all crops in the region and for a lack of comparable production projections.

Medium Confidence (medium robustness and medium agreement).

CS2: livestock production:

The mean percentage change to livestock meat production with RCP8.5, scenario lt is 73% (range across climate models 65 to 80%; 1/18 climate models are outliers). This becomes mean 74%, range 65 to 80% after removing the lower limit outliers.

The mean percentage change to livestock dairy production with RCP8.5, scenario lt is 77% (range across climate models 71 to 84%; 0/18 climate models are outliers).

Robustness:
Medium robustness. High robustness with respect to climate model uncertainty as 1 outlier for meat production. The underlying yield and crop production projections are associated with medium confidence. Simple methods have been used to translate future crop and pasture production to future livestock production, assuming historical relationships between the two persist. This suggests medium robustness.

Agreement:
Medium agreement. There is literature to suggest that livestock production efficiency could increase in future; however, climate change could also make certain livestock production more difficult due to diseases and heat stress. Overall, there is little to

suggest that livestock production could not continue to be related to the available amounts of livestock feed. However, the lack of specific projections with which to compare to iFEED suggests medium agreement.

Medium Confidence (medium robustness and medium agreement).

CS3: irrigation changes:

The mean percentage change to irrigation water with RCP8.5, scenario lt is -100% (range across climate models -100 to -100%; 0/18 climate models are outliers).

Low climate risk (RCP2.6) / high technology (HT)

Scenario description:

This scenario is characterised by a large increase in arable and pasture areas – using up any areas that are not forested, designated as protected or urban land. This amounts to a 58% increase in both arable crop land and livestock pasture land. Irrigation areas have expanded to include all arable crop areas.

Crop diversity increases substantially in this scenario, with arable areas approximately evenly divided between all crops, and maize areas halving proportionately – although maize remains the crop with the largest growing area.

Crop areas are optimised to maximise production – in other words, the mixture of crops that returns the highest possible crop production is used in future (although the total national area of each crop is approximately equal, where each crop is placed within the country is optimised to maximise production).

It is assumed that the same percentage change to crop yields experienced from 1961 to 2010 (i.e. management and technology improvements to yields) will continue to 2050 – i.e. a substantial yield improvement compared to the baseline. This amounts to more than a doubling of crop yields on average. Crop adaptation allows planting dates to vary, and crop varieties to vary, and where there is a significant trend for warming to reduce the length of crop growing seasons, varieties are assumed to be available that can compensate for this. All of these factors combined result in large increases to crop and livestock production.

CS1: crop production:

The mean percentage change to crop production with RCP2.6, scenario ht is 685% (range across climate models 613 to 832%; 2/18 climate models are outliers). This becomes mean 680%, range 631 to 733% after removing both upper and lower limit outliers.

Robustness:

Medium robustness. Medium robustness with respect to the range of climate model uncertainty as there are 2 outliers. The underlying yield projections are associated with medium confidence for one of the four modelled crops. The other three crop yield projections are associated with high confidence. For the majority of crops, average projections across these four crops are used, and therefore the productions projections for other crops are less certain. Overall, this suggests medium robustness.

Agreement:
Medium agreement. The production changes in this scenario are based on an optimistic future where yield trends are maintained and crop areas expand. Literature suggests yields can improve drastically given the correct policy interventions. The climate change impact literature has high agreement with iFEED projections for three of four crops. The other crop is associated with medium agreement. There is less literature available for the majority of other crops included in the analysis. Overall, this suggests medium agreement, given uncertainties in the literature concerning future food production and yields for all crops, and in particular a lack of studies to compare to food production projections.

Medium Confidence (medium robustness and medium agreement).

CS2: livestock production:

The mean percentage change to livestock meat production with RCP2.6, scenario ht is 289% (range across climate models 276 to 316%; 1/18 climate models are outliers). This becomes mean 288%, range 276 to 303% after removing the upper limit outliers.

The mean percentage change to livestock dairy production with RCP2.6, scenario ht is 227% (range across climate models 217 to 248%; 1/18 climate models are outliers). This becomes mean 226%, range 217 to 238% after removing the upper limit outliers.

Robustness:
Medium robustness. High robustness with respect to climate model uncertainty as 1 outlier. The underlying yield and crop production projections are associated with medium confidence. Simple methods have been used to translate future crop and pasture production to future livestock production, assuming historical relationships between the two persist. This suggests medium robustness.

Agreement:
Medium agreement. There is literature to suggest that livestock production efficiency could increase in future; however, climate change could also make certain livestock production more difficult due to diseases and heat stress. Overall, there is little to suggest that livestock production could not continue to be related to the available amounts of livestock feed. However, the lack of specific projections with which to compare to iFEED suggests medium agreement.

Medium Confidence (medium robustness and medium agreement).

CS3: irrigation:

The mean percentage change to irrigation water with RCP2.6, scenario ht is 607% (range across climate models 309 to 860%; 0/18 climate models are outliers).

High climate risk (RCP8.5) / high technology (HT)

Scenario description:

This scenario is characterised by a large increase in arable and pasture areas – using up any areas that are not forested, designated as protected or urban land. This amounts to a 58% increase in both arable crop land and a 29% increase in livestock pasture land. Irrigation areas have expanded to include all arable crop areas.

Crop diversity decreases substantially in this scenario, with maize area proportionately doubling. 15 crops make up more than 99% of arable areas in 2050, compared with 36 crops in 2000. Crop areas are optimised to maximise production – and in this scenario, the highest yielding crops (such as sugarcane, cassava, potatoes, and certain fruit and vegetables) are prioritised, resulting in even larger production gains.

It is assumed that the same percentage change to crop yields experienced from 1961 to 2010 (i.e. management and technology improvements to yields) will continue to 2050 – i.e. a substantial yield improvement compared to the baseline. This amounts to more than a doubling of crop yields on average. Crop adaptation allows planting dates to vary, and crop varieties to vary, and where there is a significant trend for warming to reduce the length of crop growing seasons, varieties are assumed to be available that can compensate for this. All of these factors combined result in large increases to crop and livestock production.

CS1: crop production:

The mean percentage change to crop production with RCP8.5, scenario ht is 1676% (range across climate models 1592 to 1806%; 0/18 climate models are outliers).

Robustness:
Medium robustness. Highly robust with respect to the range of climate model uncertainty as there are 0 outliers. The underlying yield projections are associated with medium confidence for two of the four modelled crops. The other two crop yield projections are associated with high confidence. For the majority of crops, average projections across these four crops are used, and therefore the productions projections for other crops are less certain. Overall, this suggests medium robustness.

Agreement:
Medium agreement. The production changes in this scenario are based on an optimistic future where yield trends are maintained and crop areas expand. Literature suggests yields can improve drastically given the correct policy interventions. The climate change impact literature has high agreement with iFEED projections for two of four crops. The other two crops are associated with medium agreement. There is less literature available for the majority of other crops included in the analysis. Overall, this

suggests medium agreement, given uncertainties in the literature concerning future food production and yields for all crops, and in particular a lack of studies to compare to food production projections.

Medium Confidence (medium robustness and medium agreement).

CS2: livestock production:

The mean percentage change to livestock meat production with RCP8.5, scenario ht is 530% (range across climate models 514 to 546%; 0/18 climate models are outliers).

The mean percentage change to livestock dairy production with RCP8.5, scenario ht is 375% (range across climate models 358 to 390%; 0/18 climate models are outliers).

Robustness:
Medium robustness. Medium robustness with respect to climate model uncertainty as 0 outliers. The underlying yield and crop production projections are associated with medium confidence. Simple methods have been used to translate future crop and pasture production to future livestock production, assuming historical relationships between the two persist. This suggests medium robustness.

Agreement:
Medium agreement. There is literature to suggest that livestock production efficiency could increase in future; however, climate change could also make certain livestock production more difficult due to diseases and heat stress. Overall, there is little to suggest that livestock production could not continue to be related to the available amounts of livestock feed. However, the lack of specific projections with which to compare to iFEED suggests medium agreement.

Medium Confidence (medium robustness and medium agreement).

CS3: irrigation:

The mean percentage change to irrigation water with RCP8.5, scenario ht is 608% (range across climate models 358 to 787%; 0/18 climate models are outliers).

Zambia

Low climate risk (RCP2.6) / low market efficacy (LT)

Scenario description:

This scenario is characterised by no changes to the agricultural land use pattern. No increase to irrigation areas is assumed.

Crop diversity increases in this scenario, with non-maize crop areas increasing by 20%, although maize remains the crop with most growing area. No technology trend on crop yields is assumed – i.e. yield change is driven by climate change only. Crop adaptation allows planting dates to vary, and crop varieties to vary, but these varieties are restricted to those available in the baseline.

CS1: crop production

The mean percentage change to crop production with RCP2.6, scenario lt is 8% (range across climate models -4 to 16%; 0/18 climate models are outliers).

Robustness:
Medium robustness. High robustness with respect to the range of climate model uncertainty as there are 0 outliers. The underlying yield projections are associated with high confidence. For the majority of crops, average projections across these four crops are used, and therefore the productions projections for other crops are less certain. This suggests medium robustness.

Agreement:
Medium agreement. The yield change literature has high agreement with underlying iFEED projections. There is little literature available for the vast majority of crops however; therefore we are downgrading agreement to “medium” in the absence of more specific information on all crops in the region.

Medium Confidence (medium robustness and medium agreement).

CS2: livestock production

The mean percentage change to livestock meat production with RCP2.6, scenario lt is 4% (range across climate models -10 to 13%; 0/18 climate models are outliers).

The mean percentage change to livestock dairy production with RCP2.6, scenario lt is 5% (range across climate models -5 to 11%; 0/18 climate models are outliers).

Robustness:
Medium robustness. High robustness with respect to climate model uncertainty as 1 outlier for meat production. The underlying yield and crop production projections are associated with medium confidence. Simple methods have been used to translate future crop and pasture production to future livestock production, assuming historical relationships between the two persist. This suggests medium robustness.

Agreement:
Medium agreement. There is literature to suggest that livestock production efficiency could increase in future; however, climate change could also make certain livestock production more difficult due to diseases and heat stress. Overall, there is little to suggest that livestock production could not continue to be related to the available amounts of livestock feed. However, the lack of specific projections with which to compare to iFEED suggests medium agreement.

Medium Confidence (medium robustness and medium agreement).

CS3: irrigation

The mean percentage change to irrigation water with RCP2.6, scenario lt is 40% (range across climate models 25 to 72%; 1/18 climate models are outliers). This becomes mean 38%, range 25 to 71% after removing the upper limit outliers.

High climate risk (RCP8.5) / low market efficacy (LT)

Scenario description:

This scenario is characterised by a 10% decrease in arable crop land and livestock pasture. Irrigation areas increase so that all arable areas are irrigated in 2050.

Crop diversity increases in this scenario, with non-maize crop areas increasing by 20%, although maize remains the crop with the highest growing area. No technology trend on crop yields is assumed – i.e. yield change is driven by climate change only. Crop adaptation allows planting dates to vary, and crop varieties to vary, but these varieties are restricted to those available in the baseline.

CS1: crop production

The mean percentage change to crop production with RCP8.5, scenario lt is -1% (range across climate models -11 to 6%; 0/18 climate models are outliers).

Robustness:
Medium robustness. High robustness with respect to the range of climate model uncertainty as there are 0 outliers. The underlying yield projections are associated with high confidence. For the majority of crops, average projections across these four crops are used, and therefore the productions projections for other crops are less certain. This suggests medium robustness.

Agreement:
Medium agreement. The yield change literature has high agreement with underlying iFEED projections. However, there is little literature available for the vast majority of crops; therefore we are downgrading agreement to “medium” in the absence of more specific information on all crops in the region.

Medium Confidence (medium robustness and medium agreement).

CS2: livestock production

The mean percentage change to livestock meat production with RCP8.5, scenario lt is -5% (range across climate models -16 to 5%; 0/18 climate models are outliers).

The mean percentage change to livestock dairy production with RCP8.5, scenario lt is -2% (range across climate models -11 to 6%; 0/18 climate models are outliers).

Robustness:
Medium robustness. High robustness with respect to climate model uncertainty as 0 outliers. The underlying yield and crop production projections are associated with medium confidence. Simple methods have been used to translate future crop and pasture production to future livestock production, assuming historical relationships between the two persist. This suggests medium robustness.

Agreement:
Medium agreement. There is literature to suggest that livestock production efficiency could increase in future; however, climate change could also make certain livestock production more difficult due to diseases and heat stress. Overall, there is little to suggest that livestock production could not continue to be related to the available amounts of livestock feed. However, the lack of specific projections with which to compare to iFEED suggests medium agreement.

Medium Confidence (medium robustness and medium agreement).

CS3: irrigation

The mean percentage change to irrigation water with RCP8.5, scenario lt is 1959% (range across climate models 1360 to 2500%; 1/18 climate models are outliers). This becomes mean 1994%, range 1397 to 2500% after removing the lower limit outliers.

Low climate risk (RCP2.6) / high market efficacy (HT)

Scenario description:

This scenario is characterised by an increase in arable areas of 5%, and an increase in livestock pasture areas of 25%. Irrigation areas have expanded to include all arable crop areas.

Crop diversity increases substantially in this scenario, with maize areas falling by 15% proportionately, and other arable areas approximately evenly divided between the other crops. Maize remains the crop associated with the highest growing area however. Crop areas are optimised to maximise production – in other words, the mixture of crops that returns the highest possible crop production is used in future (although the total national area of each crop is approximately equal, where each crop is placed within the country is optimised to maximise production).

It is assumed that the same percentage change to crop yields experienced from 1961 to 2010 (i.e. management and technology improvements to yields) will continue to 2050 – i.e. a substantial yield improvement compared to the baseline. This amounts to more than a doubling of crop yields on average. Crop adaptation allows planting dates to vary, and crop varieties to vary, and where there is a significant trend for warming to reduce the length of crop growing seasons, varieties are assumed to be available that can compensate for this. All of these factors combined result in large increases to crop and livestock production.

CS1: crop production

The mean percentage change to crop production with RCP2.6, scenario ht is 252% (range across climate models 233 to 271%; 0/18 climate models are outliers).

Robustness:
Medium robustness. Highly robust with respect to the range of climate model uncertainty as there are 0 outliers. The underlying yield projections are associated with medium confidence for one of the four modelled crops. The other three crop yield projections are associated with high confidence. For the majority of crops, average projections across these four crops are used, and therefore the productions projections for other crops are less certain. Overall, this suggests medium robustness.

Agreement:
Medium agreement. The production changes in this scenario are based on an optimistic future where yield trends are maintained and crop areas expand. Literature suggests yields can improve drastically given the correct policy interventions. The climate change impact literature has high agreement with iFEED projections for three of four crops. The other crop is associated with medium agreement. There is less literature available for the majority of other crops included in the analysis. Overall, this suggests medium agreement, given uncertainties in the literature concerning future food production and yields for all crops, and in particular a lack of studies to compare to food production projections.

Medium Confidence (medium robustness and medium agreement).

CS2: livestock production

The mean percentage change to livestock meat production with RCP2.6, scenario ht is 250% (range across climate models 230 to 266%; 0/18 climate models are outliers).

The mean percentage change to livestock dairy production with RCP2.6, scenario ht is 183% (range across climate models 169 to 193%; 0/18 climate models are outliers).

Robustness:
Medium robustness. High robustness with respect to climate model uncertainty as 0 outliers. The underlying yield and crop production projections are associated with medium confidence. Simple methods have been used to translate future crop and

pasture production to future livestock production, assuming historical relationships between the two persist. This suggests medium robustness.

Agreement:
Medium agreement. There is literature to suggest that livestock production efficiency could increase in future; however, climate change could also make certain livestock production more difficult due to diseases and heat stress. Overall, there is little to suggest that livestock production could not continue to be related to the available amounts of livestock feed. However, the lack of specific projections with which to compare to iFEED suggests medium agreement.

Medium Confidence (medium robustness and medium agreement).

CS3: irrigation

The mean percentage change to irrigation water with RCP2.6, scenario ht is 2582% (range across climate models 1828 to 3609%; 0/18 climate models are outliers).

High climate risk (RCP8.5) / high market efficacy (HT)

Scenario description:

This scenario is characterised by an increase of 5% in arable and livestock pasture areas. Irrigation areas have expanded to include all arable crop areas.

Crop diversity decreases in this scenario, with maize remaining as the dominant crop. Crop areas are optimised to maximise production – with production increases being especially large, given that the highest yielding crops (such as cassava, potato, wheat, bananas and sugarcane) are prioritised.

It is assumed that the same percentage change to crop yields experienced from 1961 to 2010 (i.e. management and technology improvements to yields) will continue to 2050 – i.e. a substantial yield improvement compared to the baseline. This amounts to more than a doubling of crop yields on average. Crop adaptation allows planting dates to vary, and crop varieties to vary, and where there is a significant trend for warming to reduce the length of crop growing seasons, varieties are assumed to be available that can compensate for this. All of these factors combined result in large increases to crop and livestock production.

CS1: crop production

The mean percentage change to crop production with RCP8.5, scenario ht is 564% (range across climate models 522 to 584%; 0/18 climate models are outliers).

Robustness:
Medium robustness. Highly robust with respect to the range of climate model uncertainty as there are 0 outliers. The underlying yield projections are associated with medium confidence for one of the four modelled crops. The other three crop yield

projections are associated with high confidence. For the majority of crops, average projections across these four crops are used, and therefore the productions projections for other crops are less certain. Overall, this suggests medium robustness.

Agreement:
Medium agreement. The production changes in this scenario are based on an optimistic future where yield trends are maintained and crop areas expand. Literature suggests yields can improve drastically given the correct policy interventions. The climate change impact literature has high agreement with iFEED projections for three of four crops. The other crop is associated with medium agreement. There is less literature available for the majority of other crops included in the analysis. Overall, this suggests medium agreement, given uncertainties in the literature concerning future food production and yields for all crops, and in particular a lack of studies to compare to food production projections.

Medium Confidence (medium robustness and medium agreement).

CS2: livestock production

The mean percentage change to livestock meat production with RCP8.5, scenario ht is 135% (range across climate models 126 to 146%; 0/18 climate models are outliers).

The mean percentage change to livestock dairy production with RCP8.5, scenario ht is 114% (range across climate models 107 to 122%; 0/18 climate models are outliers).

Robustness:
Medium robustness. High robustness with respect to climate model uncertainty as 0 outliers. The underlying yield and crop production projections are associated with medium confidence. Simple methods have been used to translate future crop and pasture production to future livestock production, assuming historical relationships between the two persist. This suggests medium robustness.

Agreement:
Medium agreement. There is literature to suggest that livestock production efficiency could increase in future; however, climate change could also make certain livestock production more difficult due to diseases and heat stress. Overall, there is little to suggest that livestock production could not continue to be related to the available amounts of livestock feed. However, the lack of specific projections with which to compare to iFEED suggests medium agreement.

Medium Confidence (medium robustness and medium agreement).

CS3: irrigation

The mean percentage change to irrigation water with RCP8.5, scenario ht is 2595% (range across climate models 1708 to 3159%; 0/18 climate models are outliers).

South Africa

Low climate risk (RCP2.6) / low land reform (LT)

Scenario description:

This scenario is characterised by no changes to the arable crop land, but a 10% increase in livestock pasture area. No increase to irrigation areas is assumed.

Crop diversity increases slightly in this scenario, meaning that maize is still the main crop, but other crop areas expand by 10% at the expense of maize area. A moderate technology trend on crop yields is assumed, based on half of historical crop yield trends. This results in yields increasing by more than 50% on average, even after taking into account climate impacts. Crop adaptation allows planting dates to vary, and crop varieties to vary, but these varieties are restricted to those available in the baseline.

CS1: crop production

The mean percentage change to crop production with RCP2.6, scenario lt is 117% (range across climate models 94 to 136%; 0/18 climate models are outliers).

Robustness:
Medium robustness. High robustness with respect to the range of climate model uncertainty as there are 0 outliers. The underlying yield projections are associated with high confidence. For the majority of crops, average projections across these four crops are used, and therefore the productions projections for other crops are less certain. This suggests medium robustness.

Agreement:
Medium agreement. The yield change literature has high agreement with underlying iFEED projections. However, there is little literature available for the vast majority of crops; therefore we are downgrading agreement to “medium” in the absence of more specific information on all crops in the region.

Medium Confidence (medium robustness and medium agreement).

CS2: livestock production

The mean percentage change to livestock meat production with RCP2.6, scenario lt is 122% (range across climate models 98 to 136%; 0/18 climate models are outliers).

The mean percentage change to livestock dairy production with RCP2.6, scenario lt is 115% (range across climate models 91 to 129%; 0/18 climate models are outliers).

Robustness:

Medium robustness. High robustness with respect to climate model uncertainty as 0 outliers. The underlying yield and crop production projections are associated with medium confidence. Simple methods have been used to translate future crop and pasture production to future livestock production, assuming historical relationships between the two persist. This suggests medium robustness.

Agreement:
Medium agreement. There is literature to suggest that livestock production efficiency could increase in future; however, climate change could also make certain livestock production more difficult due to diseases and heat stress. Overall, there is little to suggest that livestock production could not continue to be related to the available amounts of livestock feed. However, the lack of specific projections with which to compare to iFEED suggests medium agreement.

Medium Confidence (medium robustness and medium agreement).

CS3: irrigation

The mean percentage change to irrigation water with RCP2.6, scenario lt is 3% (range across climate models -2 to 10%; 0/18 climate models are outliers).

High climate risk (RCP8.5) / low land reform (LT)

Scenario description:

This scenario is characterised by a 10% increase in arable crop land, and a 10% decrease in livestock pasture area. Irrigation areas are increased, so all future arable crop areas are irrigated.

Crop diversity increases in this scenario, meaning that maize is still the main crop, but other crop areas expand by 25% at the expense of maize area. A moderate technology trend on crop yields is assumed, based on half of historical crop yield trends. This results in yields increasing by more than 50% on average, even after taking into account climate impacts. Crop adaptation allows planting dates to vary, and crop varieties to vary, but these varieties are restricted to those available in the baseline.

CS1: crop production

The mean percentage change to crop production with RCP8.5, scenario lt is 178% (range across climate models 150 to 192%; 0/18 climate models are outliers).

Robustness:
Medium robustness. High robustness with respect to the range of climate model uncertainty as there are 0 outliers. The underlying yield projections are associated with high confidence. For the majority of crops, average projections across these four crops are used, and therefore the productions projections for other crops are less certain. This suggests medium robustness.

Agreement:
Medium agreement. The yield change literature has high agreement with underlying iFEED projections. However, there is little literature available for the vast majority of crops; therefore we are downgrading agreement to “medium” in the absence of more specific information on all crops in the region.

Medium Confidence (medium robustness and medium agreement).

CS2: livestock production

The mean percentage change to livestock meat production with RCP8.5, scenario lt is 129% (range across climate models 104 to 147%; 1/18 climate models are outliers). This becomes mean 130%, range 106 to 147% after removing the lower limit outliers.

The mean percentage change to livestock dairy production with RCP8.5, scenario lt is 123% (range across climate models 97 to 140%; 1/18 climate models are outliers). This becomes mean 124%, range 98 to 140% after removing the lower limit outliers.

Robustness:
Medium robustness. High robustness with respect to climate model uncertainty as 1 outlier. The underlying yield and crop production projections are associated with medium confidence. Simple methods have been used to translate future crop and pasture production to future livestock production, assuming historical relationships between the two persist. This suggests medium robustness.

Agreement:
Medium agreement. There is literature to suggest that livestock production efficiency could increase in future; however, climate change could also make certain livestock production more difficult due to diseases and heat stress. Overall, there is little to suggest that livestock production could not continue to be related to the available amounts of livestock feed. However, the lack of specific projections with which to compare to iFEED suggests medium agreement.

Medium Confidence (medium robustness and medium agreement).

CS3: irrigation

The mean percentage change to irrigation water with RCP8.5, scenario lt is 84% (range across climate models 65 to 115%; 0/18 climate models are outliers).

Low climate risk (RCP2.6) / high land reform (HT)

Scenario description:

This scenario is characterised by a 10% decrease to the arable crop land, but a 10% increase in livestock pasture area. No increase to irrigation areas is assumed.

Crop diversity increases slightly in this scenario, meaning that maize is still the main crop, but other crop areas expand by 10% at the expense of maize area. A moderate technology trend on crop yields is assumed, based on half of historical crop yield trends. This results in yields increasing by more than 50% on average, even after taking into account climate impacts. Crop adaptation allows planting dates to vary, and crop varieties to vary, and where there is a significant trend for warming to reduce the length of crop growing seasons, varieties are assumed to be available that can compensate for this.

CS1: crop production

The mean percentage change to crop production with RCP2.6, scenario ht is 101% (range across climate models 81 to 116%; 0/18 climate models are outliers).

Robustness:
Medium robustness. High robustness with respect to the range of climate model uncertainty as there are 0 outliers. The underlying yield projections are associated with high confidence for three of the four modelled crops; the other crop has medium confidence. For the majority of crops, average projections across these four crops are used, and therefore the productions projections for other crops are less certain. This suggests medium robustness.

Agreement:
Medium agreement. The yield change literature has high agreement with underlying iFEED projections for three of four crops. However, there is little literature available for the vast majority of crops; therefore we are downgrading agreement to “medium” in the absence of more specific information on all crops in the region.

Medium Confidence (medium robustness and medium agreement).

CS2: livestock production

The mean percentage change to livestock meat production with RCP2.6, scenario ht is 122% (range across climate models 103 to 135%; 0/18 climate models are outliers).

The mean percentage change to livestock dairy production with RCP2.6, scenario ht is 113% (range across climate models 95 to 126%; 0/18 climate models are outliers).

Robustness:
Medium robustness. High robustness with respect to climate model uncertainty as 0 outliers. The underlying yield and crop production projections are associated with medium confidence. Simple methods have been used to translate future crop and pasture production to future livestock production, assuming historical relationships between the two persist. This suggests medium robustness.

Agreement:
Medium agreement. There is literature to suggest that livestock production efficiency could increase in future; however, climate change could also make certain livestock

production more difficult due to diseases and heat stress. Overall, there is little to suggest that livestock production could not continue to be related to the available amounts of livestock feed. However, the lack of specific projections with which to compare to iFEED suggests medium agreement.

Medium Confidence (medium robustness and medium agreement).

CS3: irrigation

The mean percentage change to irrigation water with RCP2.6, scenario ht is -6% (range across climate models -10 to 0%; 0/18 climate models are outliers).

High climate risk (RCP8.5) / high land reform (HT)

Scenario description:

This scenario is characterised by a 10% fall in arable crop land, and a 15% fall in livestock pasture area. Irrigation areas are increased, so all future arable crop areas are irrigated.

Crop diversity increases in this scenario, meaning that maize is still the main crop, but other crop areas expand by 25% at the expense of maize area. A moderate technology trend on crop yields is assumed, based on half of historical crop yield trends. This results in yields increasing by more than 50% on average, even after taking into account climate impacts. Crop adaptation allows planting dates to vary, and crop varieties to vary, and where there is a significant trend for warming to reduce the length of crop growing seasons, varieties are assumed to be available that can compensate for this.

CS1: crop production

The mean percentage change to crop production with RCP8.5, scenario ht is 139% (range across climate models 122 to 157%; 0/18 climate models are outliers).

Robustness:
Medium robustness. High robustness with respect to the range of climate model uncertainty as there are 0 outliers. The underlying yield projections are associated with high confidence for three of the four modelled crops; the other crop has medium confidence. For the majority of crops, average projections across these four crops are used, and therefore the productions projections for other crops are less certain. This suggests medium robustness.

Agreement:
Medium agreement. The yield change literature has high agreement with underlying iFEED projections for three of four crops. However, there is little literature available for the vast majority of crops; therefore we are downgrading agreement to “medium” in the absence of more specific information on all crops in the region.

Medium Confidence (medium robustness and medium agreement).

CS2: livestock production

The mean percentage change to livestock meat production with RCP8.5, scenario ht is 124% (range across climate models 107 to 142%; 0/18 climate models are outliers).

The mean percentage change to livestock dairy production with RCP8.5, scenario ht is 116% (range across climate models 99 to 132%; 0/18 climate models are outliers).

Robustness:
Medium robustness. High robustness with respect to climate model uncertainty as 0 outliers. The underlying yield and crop production projections are associated with medium confidence. Simple methods have been used to translate future crop and pasture production to future livestock production, assuming historical relationships between the two persist. This suggests medium robustness.

Agreement:
Medium agreement. There is literature to suggest that livestock production efficiency could increase in future; however, climate change could also make certain livestock production more difficult due to diseases and heat stress. Overall, there is little to suggest that livestock production could not continue to be related to the available amounts of livestock feed. However, the lack of specific projections with which to compare to iFEED suggests medium agreement.

Medium Confidence (medium robustness and medium agreement).

CS3: irrigation

The mean percentage change to irrigation water with RCP8.5, scenario ht is 67% (range across climate models 42 to 97%; 0/18 climate models are outliers).

Appendix 1: Confidence assessment rationale and literature used

Food production – summary

Note that a list of all crops included in this analysis is below.

The same medium level of confidence is associated with the crop and livestock production projections; this is due to the same underlying uncertainties being of primary importance in all countries and scenarios.

Assumptions concerning land use, irrigation, technology trends on yields and crop diversity are taken as a given for the purposes of the robustness assessments. Therefore, robustness is assessed based on the yield projection inputs and associated confidence in these. There tends to be high confidence in specific crop model projections for the four crops modelled in iFEED, but these same projections are used as the basis for all other crop production projections, hence medium robustness is preferred. Medium agreement is preferred also, as little literature exists for the full range of crop yield responses and comparable crop production projections. Broadly speaking, large changes to area and yields are highlighted as possible in the literature, but there are not specific projections to compare to iFEED, and little evidence about changes to all crops in terms of production is available in the literature.

Irrigation - summary

Note that all irrigation percentage changes are associated with the same medium level of confidence. This is made up of medium robustness, i.e. the same robustness as the underlying crop model simulations, and medium agreement with the literature. Some studies show substantial projected increases to irrigation, but there are not studies to compare to the specific scenarios simulated in iFEED, which given optimistic assumptions for high technology scenarios and a demand-driven approach projects very large increases in irrigation water use in some scenarios.

Crop production and yield trends literature

- Sanchez 2015: “Sub-Saharan Africa can move from 1 to 3 t ha–1 by increasing access to improved seeds and fertilizers. Going from 3 to 5 t ha–1 will require interventions across the agricultural value chain. Achieving 10 t ha–1 is agronomically possible, but beyond the scope of current interventions.” From 1 to 5 t/ha cereal yields could “certainly happen” by 2050.
- Van Ittersum et al., 2016, need to close yield gap along with expand crop area to feed SSA by 2050: “"it is clear that with improved cultivars, hybrids, and seed, coupled with increased use of fertilizers, modern pest management practices, and good agronomy, it is possible to achieve accelerated rates of yield gain". "Actual rainfed maize yields (the dominant crop in SSA) during the period 2003–2012 range from 1.2 to 2.2 t/ha (Table 1 and ref.24), which represents only 15–27% of the water-limited yield potential" – i.e. large yield gap and potential to improve maize yields. Crop area expansions also likely a part of the solution – note that there are limits to area expansion, but substantial increases in area are also possible.
- Grassini et al., 2013, important to take into account historical yield trends and biophysical yield plateaus.
- Ray et al., 2012, with the right socio-economoic conditions and inputs, e.g. field trials have demonstrated e.g. doubling of maize yields in Africa. The recent trend towards yields stagnation can be changed for this reason.

- Deininger et al., 2011, area expansion of c. 200 million ha or more possible, depending on assumptions.

Irrigation projections literature – large increases in literature possible. Water availability could increase in East Africa and decrease in Southern Africa.

- Rockstrom et al. 2007, water required for irrigation that is described as "optimistic" - total water use from irrigation projected that is needed to achieve the 2030 MDG for eradication of hunger. From 2002 to 2050, the percentage increase is over 200%. > (725-226.8908)/226.8908 = 2.19537.
- FAO, 2003, "To estimate irrigation water withdrawal in 2030, an assumption had to be made about possible developments in the irrigation efficiency of each country. Unfortunately, there is little empirical evidence on which to base such an assumption." Taking into account irrigation efficiency and water scarcity, FAO projection for 2030 is lower than the above study: 80 to 115 km^3 per year from 97/98 to 2030 = a 43.75% increase from 1997/98 to 2030.
- Rosa et al. 2020. Large potential for expanding irrigation areas in SSA.
- Gerten and Heinke, 2011: Malawi, Zambia and Tanzania projected increases in water availability; South Africa projected decreases.

Livestock and climate change literature: gains to production can continue thanks to breeding and scientific progress, but climate change remains an uncertain risk.

- Rust and Rust, 2013: climate change impacts on livestock are uncertain. Disease risk could increase, but another important impact is simply how much food will be available.
- Thornton 2010: Livestock production has increased substantially since the 1960s, e.g. beef production more than doubling and chicken production a 10-fold increase (due to both feed and productivity increases). Developments in breeding, nutrition and animal health will continue to contribute to increasing potential production and further efficiency and genetic gain. In Africa, livestock production likely to increase with cereal productivity gains. Climate change may increase disease risk. Increasing climate variability could also increase livestock risk.
- Enahoro et al. 2019 explore different livestock production scenarios from 2010 to 2050. Livestock production more than doubles in most scenarios.

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11. Ray et al., 2012, Recent patterns of crop yield growth and stagnation, Nature Comunications
12. Deininger, Klaus, and Derek Byerlee. *Rising global interest in farmland: can it yield sustainable and equitable benefits?*. World Bank Publications, 2011.
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Full list of crops included in analysis (these are all food crops that have growing area in baseline period according to FAOSTAT):

Malawi:
Maize
Millet
Sorghum
Sugar cane
Anise, badian, fennel, coriander
Cabbages and other brassicas
Cassava
Chillies and peppers, dry
Groundnuts, with shell
Okra
Onions, dry
Potatoes
Rice, paddy
Seed cotton
Sunflower seed
Tomatoes
Vegetables, fresh nes
Watermelons

Wheat
Bananas
Coffee, green
Fruit, citrus nes
Fruit, fresh nes
Fruit, tropical fresh nes
Mangoes, mangosteens, guavas
Nutmeg, mace and cardamoms
Nuts nes
Pepper (piper spp.)
Pineapples
Plantains and others
Spices nes
Tea
Vanilla
Beans, dry
Chick peas
Cow peas, dry
Lentils
Peas, dry
Pigeon peas
Soybeans

South Africa:
Maize
Maize, green
Millet
Sorghum
Sugar cane
Barley
Buckwheat
Cabbages and other brassicas
Carrots and turnips
Castor oil seed
Cauliflowers and broccoli
Cereals nes
Chicory roots
Chillies and peppers, dry
Cucumbers and gherkins
Groundnuts, with shell
Lettuce and chicory
Melons, other (inc.cantaloupes)

Oats
Oilseeds nes
Onions, dry
Potatoes
Pumpkins, squash and gourds
Rapeseed
Rice, paddy
Rye
Seed cotton
Sunflower seed
Sweet potatoes
Tomatoes
Vegetables, fresh nes
Watermelons
Wheat
Apples
Apricots
Avocados
Bananas
Berries nes
Cherries
Figs
Fruit, citrus nes
Fruit, fresh nes
Grapefruit (inc. pomelos)
Grapes
Lemons and limes
Mangoes, mangosteens, guavas
Nuts nes
Oranges
Papayas
Peaches and nectarines
Pears
Pineapples
Plums and sloes
Quinces
Strawberries
Tangerines, mandarins, clementines, satsumas
Tea
Beans, dry
Beans, green
Cow peas, dry

Lupins
Peas, dry
Peas, green
Soybeans

Tanzania:
Maize
Maize, green
Millet
Sorghum
Sugar cane
Anise, badian, fennel, coriander
Barley
Buckwheat
Cabbages and other brassicas
Cassava
Castor oil seed
Cereals nes
Chillies and peppers, dry
Chillies and peppers, green
Garlic
Ginger
Groundnuts, with shell
Oilseeds nes
Onions, dry
Potatoes
Rice, paddy
Roots and tubers nes
Safflower seed
Seed cotton
Sesame seed
Sunflower seed
Sweet potatoes
Tomatoes
Vegetables, fresh nes
Vegetables, leguminous nes
Watermelons
Wheat
Yams
Bananas
Cashew nuts, with shell
Cloves
Cocoa, beans

Coconuts
Coffee, green
Fruit, citrus nes
Fruit, fresh nes
Fruit, tropical fresh nes
Grapes
Lemons and limes
Mangoes, mangosteens, guavas
Nutmeg, mace and cardamoms
Nuts nes
Oil palm fruit
Oranges
Pears
Pepper (piper spp.)
Pineapples
Plantains and others
Plums and sloes
Tea
Beans, dry
Beans, green
Chick peas
Cow peas, dry
Peas, dry
Peas, green
Pigeon peas
Pulses nes
Soybeans

Zambia:
Maize
Millet
Sorghum
Sugar cane
Barley
Cassava
Chillies and peppers, dry
Groundnuts, with shell
Onions, dry
Potatoes
Rice, paddy
Seed cotton
Sunflower seed

Sweet potatoes
Tomatoes
Vegetables, fresh nes
Wheat
Bananas
Coffee, green
Fruit, fresh nes
Fruit, tropical fresh nes
Oranges
Pepper (piper spp.)
Spices nes
Tea
Pulses nes
Soybeans