Climate change impacts and adaptation Calibrated Statements

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Overview

This document contains crop-specific information for the impacts of climate change on four crops - maize, soybean, potato and groundnut – given the adaptation options that are applicable to each scenario in each country. Each scenario section contains calibrated statements for each of the four crops simulated.

Summary calibrated statement for each scenario are given firstly, providing an overview of all the information in this document. These assess typical climate impacts on yields given the adaptation options that are assumed for each scenario, and taking the most common confidence level as applicable to this summary calibrated statement.

Note that when applying the continuation of historical technology trends to improve mean yields (as is done in the subsequent food production analysis, in the high technology scenarios, as well as half of this trend in all South Africa scenarios - see Appendix for details), all mean yield changes are positive, even with the impacts of climate change. Calibrated Statements in this document focus on providing information on climate change impacts with adaptation.

See the appendix for details of the literature used to assess agreement with the broader literature and for details of the simulations and confidence statements.

Summary Climate Impacts Calibrated Statements

Malawi

- RCP2.6 LT: Without adaptation, climate change results in mean yields decreasing in this scenario. The impacts of climate change on C3 crop yields (soybean, potato and groundnut) are close to no change with autonomous adaptation. Maize yields are projected to fall in contrast by about 10%, even with autonomous adaptation. High Confidence.
- RCP2.6 HT: With adaptation of new varieties and irrigation, crop yields will most likely increase slightly - by around 10% in the case of maize and groundnut, with more modest increases for potato and soybean likely. High Confidence.
- RCP8.5 LT: Without adaptation, climate change results in mean yields decreasing in this scenario. The impacts of climate change with autonomous adaptation result in yield losses for maize, groundnut and potato, although soybean shows little change to mean yields. High Confidence.
- RCP8.5 HT: With adaptation of new varieties and irrigation, crop yields will most likely increase - by more than 10% in the case of maize and groundnut. Modest increases are also likely for soybean, however potato could see decreasing yields. High Confidence.

Tanzania

- RCP2.6 LT: Without adaptation, climate change results in mean yields decreasing in this scenario. The impacts of climate change on C3 crop yields (soybean, potato and groundnut) are close to no change with autonomous adaptation, with some small gains for soybean projected. Maize yields are projected to fall in contrast by about 7%, even with autonomous adaptation. High Confidence.
- RCP2.6 HT: With adaptation of new varieties and irrigation, crop yields will most likely increase slightly - by just under 10% in the case of maize and groundnut, with more modest increases for soybean and little change for potato. High Confidence.
- RCP8.5 LT: Without adaptation, climate change results in mean yields decreasing in this scenario. The impacts of climate change with autonomous

adaptation result in yield losses for maize, groundnut and potato, although soybean shows little change to mean yields. High Confidence.

- RCP8.5 HT: With adaptation of new varieties and irrigation, crop yields will most likely increase - by more than 10% in the case of maize and groundnut. Modest increases are likely for soybean, however potato could see decreasing yields. High Confidence.

Zambia

- RCP2.6 LT: Without adaptation, climate change results in mean yields decreasing in this scenario. The impacts of climate change on maize, soybean and groundnut still result in yield losses of around 10% even with autonomous adaptation, but some small gains for potato are projected. High Confidence.
- RCP2.6 HT: With adaptation of new varieties and irrigation, crop yields will most likely increase slightly for maize, potato and groundnut, with little change for soybean. High Confidence.
- RCP8.5 LT: Without adaptation, climate change results in mean yields decreasing in this scenario. The impacts of climate change with autonomous adaptation result in yield losses of more than 10% for maize, soybean and groundnut, although potato shows little change to mean yields. High Confidence.
- RCP8.5 HT: With adaptation of new varieties and irrigation, crop yields will most likely increase. More modest increases are likely for potato compared to maize and groundnut, however soybean yields could still decrease. High Confidence.

South Africa

- RCP2.6 LT: Without adaptation, climate change results in mean yields decreasing in this scenario. The impacts of climate change on maize, soybean and potato still result in small yield losses (< 5%) even with autonomous adaptation, with little change to groundnut yields projected. High Confidence.
- RCP2.6 HT: With adaptation of new varieties and irrigation, crop yields will most likely increase by around 10% for maize, groundnut and soybean, with little change for potato. High Confidence.
- RCP8.5 LT: Without adaptation, climate change results in mean yields decreasing in this scenario. The impacts of climate change with autonomous adaptation result in yield losses of 4-14% for maize, soybean and potato, although groundnut shows little change to mean yields. High Confidence.
- RCP8.5 HT: With adaptation of new varieties and irrigation, crop yields will most likely increase by around 10% for maize, groundnut and soybean. Yields could still decrease slightly for potato however. High Confidence.

Summary Tables – by crop

Table A: summary of calibrated statement results and confidence assessments for maize. Yield changes are averages across climate models, with mean and range shown excluding any outliers. Confidence assessment has robustness and agreement assessments in brackets respectively; L = low, M = medium, H = high confidence / robustness / agreement. Note that adaptation benefit is expressed as percentage point difference, in reference to baseline yields.

Country, Scenario, Adaptation	**Yield Change (%)**	**Confidence**
Malawi, RCP2.6		
Maize, no adaptation	-19 (-37, -8)	H (M, H)
Maize, auto. adaptation	-10 (-25, 4)	H (M, H)
Maize, adaptation benefit	10 (4, 18)	H (M, H)
Maize, duration fix	9 (-1, 21)	M (M, M)
Maize, irrigation	-10 (-31, 0)	H (M, H)
Malawi, RCP8.5		
Maize, no adaptation	-30 (-41, -20)	M (M, M)
Maize, auto. adaptation	-18 (-30, 9)	H (M, H)
Maize, adaptation benefit	11 (5, 17)	H (M, H)
Maize, duration fix	17 (5, 30)	M (M, M)
Maize, irrigation	-23 (-35, 12)	M (M, M)
Tanzania, RCP2.6		
Maize, no adaptation	-15 (-31, -3)	H (M, H)
Maize, auto. adaptation	-7 (-22, 3)	H (M, H)
Maize, adaptation benefit	6 (3, 11)	M (M, M)
Maize, duration fix	9 (4, 16)	M (M, M)
Maize, irrigation	-7 (-25, 8)	H (M, H)
Tanzania, RCP8.5		
Maize, no adaptation	-28 (-38, -20)	M (M, M)
Maize, auto. adaptation	-17 (-26, -6)	H (M, H)
Maize, adaptation benefit	11 (7, 15)	H (M, H)
Maize, duration fix	15 (10, 20)	M (M, M)
Maize, irrigation	-21 (-30, -11)	M (M, M)
Zambia, RCP2.6		
Maize, no adaptation	-21 (-37, -10)	M (M, M)
Maize, auto. adaptation	-14 (-28, -4)	H (M, H)
Maize, adaptation benefit	7 (3, 11)	H (M, H)
Maize, duration fix	5 (-1, 13)	M (M, M)
Maize, irrigation	-10 (-25, 3)	H (M, H)
Zambia, RCP8.5		
Maize, no adaptation	-33 (-45, -21)	M (M, M)
Maize, auto. adaptation	-23 (-32, -13)	M (M, M)
Maize, adaptation benefit	10 (5, 16)	H (M, H)
Maize, duration fix	15 (5, 22)	M (M, M)
Maize, irrigation	-22 (-32, -12)	M (M, M)
South Africa, RCP2.6		
Maize, no adaptation	-28 (-47, -14)	M (M, M)

Maize, auto. adaptation	-2 (-13, 11)	H (M, H)
Maize, adaptation benefit	24 (17, 34)	M (M, M)
Maize, duration fix	12 (0, 26)	M (M, M)
Maize, irrigation	-10 (-31, 7)	H (M, H)
South Africa, RCP8.5		
Maize, no adaptation	-43 (-59, -31)	M (M, M)
Maize, auto. adaptation	-4 (-23, 8)	H (M, H)
Maize, adaptation benefit	37 (31, 52)	L (M, L)
Maize, duration fix	14 (0, 29)	M (M, M)
Maize, irrigation	-27 (-43, -14)	M (M, M)

Table B: summary of calibrated statement results and confidence assessments for groundnut. Yield changes are averages across climate models, with mean and range shown excluding any outliers. Confidence assessment has robustness and agreement assessments in brackets respectively; L = low, M = medium, H = high confidence / robustness / agreement. Note that adaptation benefit is expressed as percentage point difference, in reference to baseline yields.

Country, Scenario, Adaptation	Yield Change (%)	Confidence
Malawi, RCP2.6		
Groundnut, no adaptation	-12 (-30, -3)	H (M, H)
Groundnut, auto. adaptation	-1 (-14, 9)	H (M, H)
Groundnut, adaptation benefit	11 (7, 15)	H (M, H)
Groundnut, duration fix	6 (-5, 14)	H (M, H)
Groundnut, irrigation	-10 (-29, -1)	H (M, H)
Malawi, RCP8.5		
Groundnut, no adaptation	-22 (-35, -13)	H (M, H)
Groundnut, auto. adaptation	-6 (-19, 6)	H (M, H)
Groundnut, adaptation benefit	16 (11, 19)	H (M, H)
Groundnut, duration fix	13 (3, 22)	M (M, M)
Groundnut, irrigation	-20 (-34, -11)	H (M, H)
Tanzania, RCP2.6		
Groundnut, no adaptation	-11 (-26, 0)	H (M, H)
Groundnut, auto. adaptation	0 (-14, 13)	H (M, H)
Groundnut, adaptation benefit	9 (4, 15)	H (M, H)
Groundnut, duration fix	7 (-3, 16)	H (M, H)
Groundnut, irrigation	-8 (-24, 3)	H (M, H)
Tanzania, RCP8.5		
Groundnut, no adaptation	-21 (-31, -10)	H (M, H)
Groundnut, auto. adaptation	-9 (-18, 6)	H (M, H)
Groundnut, adaptation benefit	13 (9, 18)	H (M, H)
Groundnut, duration fix	11 (3, 18)	M (M, M)
Groundnut, irrigation	-18 (-28, -8)	H (M, H)
Zambia, RCP2.6		
Groundnut, no adaptation	-15 (-27, -4)	H (M, H)
Groundnut, auto. adaptation	-7 (-21, 4)	H (M, H)
Groundnut, adaptation benefit	8 (3, 14)	H (M, H)
Groundnut, duration fix	4 (-5, 9)	H (M, H)

Groundnut, irrigation	-12 (-25, -2)	H (M, H)
Zambia, RCP8.5		
Groundnut, no adaptation	-23 (-32, -15)	H (M, H)
Groundnut, auto. adaptation	-13 (-23, -5)	H (M, H)
Groundnut, adaptation benefit	9 (6, 16)	H (M, H)
Groundnut, duration fix	9 (4, 17)	H (M, H)
Groundnut, irrigation	-20 (-30, -12)	H (M, H)
South Africa, RCP2.6		
Groundnut, no adaptation	-24 (-38, -11)	H (M, H)
Groundnut, auto. adaptation	2 (-10, 13)	H (M, H)
Groundnut, adaptation benefit	26 (14, 37)	M (M, M)
Groundnut, duration fix	8 (-3, 18)	H (M, H)
Groundnut, irrigation	-14 (-28, -2)	H (M, H)
South Africa, RCP8.5		
Groundnut, no adaptation	-34 (-48, -22)	M (M, M)
Groundnut, auto. adaptation	2 (-17, 11)	H (M, H)
Groundnut, adaptation benefit	35 (24, 47)	L (M, L)
Groundnut, duration fix	10 (-7, 19)	H (M, H)
Groundnut, irrigation	-24 (-38, -11)	H (M, H)

Table C: summary of calibrated statement results and confidence assessments for soybean. Yield changes are averages across climate models, with mean and range shown excluding any outliers. Confidence assessment has robustness and agreement assessments in brackets respectively; L = low, M = medium, H = high confidence / robustness / agreement. Note that adaptation benefit is expressed as percentage point difference, in reference to baseline yields.

Country, Scenario, Adaptation	**Yield Change (%)**	**Confidence**
Malawi, RCP2.6		
Soybean, auto. adaptation	0 (-24, 20)	H (M, H)
Malawi, RCP8.5		
Soybean, auto. adaptation	0 (-22, 22)	H (M, H)
Tanzania, RCP2.6		
Soybean, auto. adaptation	6 (-10, 31)	H (M, H)
Tanzania, RCP8.5		
Soybean, auto. adaptation	1 (-10, 19)	H (M, H)
Zambia, RCP2.6		
Soybean, auto. adaptation	-6 (-20, 9)	H (M, H)
Zambia, RCP8.5		
Soybean, auto. adaptation	-11 (-21, 11)	H (M, H)
South Africa, RCP2.6		
Soybean, auto. adaptation	-3 (-18, 6)	H (M, H)
South Africa, RCP8.5		
Soybean, auto. adaptation	-6 (-20, 2)	H (M, H)

Table D: summary of calibrated statement results and confidence assessments for potato. Yield changes are averages across climate models, with mean and range shown excluding any outliers. Confidence assessment has robustness and agreement assessments in brackets respectively; L = low, M = medium, H = high confidence / robustness / agreement. Note that adaptation benefit is expressed as percentage point difference, in reference to baseline yields.

Country, Scenario, Adaptation	Yield Change (%)	Confidence
Malawi, RCP2.6		
Potato, auto. adaptation	0 (-16, 15)	H (M, H)
Malawi, RCP8.5		
Potato, auto. adaptation	-9 (-29, 9)	H (M, H)
Tanzania, RCP2.6		
Potato, auto. adaptation	-4 (-18, 23)	H (M, H)
Tanzania, RCP8.5		
Potato, auto. adaptation	-9 (-15, 5)	H (M, H)
Zambia, RCP2.6		
Potato, auto. adaptation	4 (-22, 29)	H (M, H)
Zambia, RCP8.5		
Potato, auto. adaptation	2 (-26, 20)	H (M, H)
South Africa, RCP2.6		
Potato, auto. adaptation	-3 (-13, 7)	H (M, H)
South Africa, RCP8.5		
Potato, auto. adaptation	-14 (-27, -2)	H (M, H)

Summary Tables – by country

Malawi

Table 1: summary of calibrated statement results and confidence assessments for Malawi, RCP2.6. Yield changes are averages across climate models, with mean and range shown excluding any outliers. Confidence assessment has robustness and agreement assessments in brackets respectively; L = low, M = medium, H = high confidence / robustness / agreement. Note that adaptation benefit is expressed as percentage point difference, in reference to baseline yields.

Crop and adaptation	Yield Change (%)	Confidence
Maize, no adaptation	-19 (-37, -8)	H (M, H)
Maize, auto. adaptation	-10 (-25, 4)	H (M, H)
Maize, adaptation benefit	10 (4, 18)	H (M, H)
Maize, duration fix	9 (-1, 21)	M (M, M)
Maize, irrigation	-10 (-31, 0)	H (M, H)
Soybean, auto. adaptation	0 (-24, 20)	H (M, H)
Potato, auto. adaptation	0 (-16, 15)	H (M, H)
Groundnut, no adaptation	-12 (-30, -3)	H (M, H)
Groundnut, auto. adaptation	-1 (-14, 9)	H (M, H)

Groundnut, adaptation benefit	11 (7, 15)	H (M, H)
Groundnut, duration fix	6 (-5, 14)	H (M, H)
Groundnut, irrigation	-10 (-29, -1)	H (M, H)

Table 2: summary of calibrated statement results and confidence assessments for Malawi, RCP8.5. Yield changes are averages across climate models, with mean and range shown excluding any outliers. Confidence assessment has robustness and agreement assessments in brackets respectively; L = low, M = medium, H = high confidence / robustness / agreement. Note that adaptation benefit is expressed as percentage point difference, in reference to baseline yields.

Crop and adaptation	**Yield Change (%)**	**Confidence**
Maize, no adaptation	-30 (-41, -20)	M (M, M)
Maize, auto. adaptation	-18 (-30, 9)	H (M, H)
Maize, adaptation benefit	11 (5, 17)	H (M, H)
Maize, duration fix	17 (5, 30)	M (M, M)
Maize, irrigation	-23 (-35, 12)	M (M, M)
Soybean, auto. adaptation	0 (-22, 22)	H (M, H)
Potato, auto. adaptation	-9 (-29, 9)	H (M, H)
Groundnut, no adaptation	-22 (-35, -13)	H (M, H)
Groundnut, auto. adaptation	-6 (-19, 6)	H (M, H)
Groundnut, adaptation benefit	16 (11, 19)	H (M, H)
Groundnut, duration fix	13 (3, 22)	M (M, M)
Groundnut, irrigation	-20 (-34, -11)	H (M, H)

Tanzania

Table 3: summary of calibrated statement results and confidence assessments for Tanzania, RCP2.6. Yield changes are averages across climate models, with mean and range shown excluding any outliers. Confidence assessment has robustness and agreement assessments in brackets respectively; L = low, M = medium, H = high confidence / robustness / agreement. Note that adaptation benefit is expressed as percentage point difference, in reference to baseline yields.

Crop and adaptation	**Yield Change (%)**	**Confidence**
Maize, no adaptation	-15 (-31, -3)	H (M, H)
Maize, auto. adaptation	-7 (-22, 3)	H (M, H)
Maize, adaptation benefit	6 (3, 11)	M (M, M)
Maize, duration fix	9 (4, 16)	M (M, M)
Maize, irrigation	-7 (-25, 8)	H (M, H)
Soybean, auto. adaptation	6 (-10, 31)	H (M, H)

Potato, auto. adaptation	-4 (-18, 23)	H (M, H)
Groundnut, no adaptation	-11 (-26, 0)	H (M, H)
Groundnut, auto. adaptation	0 (-14, 13)	H (M, H)
Groundnut, adaptation benefit	9 (4, 15)	H (M, H)
Groundnut, duration fix	7 (-3, 16)	H (M, H)
Groundnut, irrigation	-8 (-24, 3)	H (M, H)

Table 4: summary of calibrated statement results and confidence assessments for Tanzania, RCP8.5. Yield changes are averages across climate models, with mean and range shown excluding any outliers. Confidence assessment has robustness and agreement assessments in brackets respectively; L = low, M = medium, H = high confidence / robustness / agreement. Note that adaptation benefit is expressed as percentage point difference, in reference to baseline yields.

Crop and adaptation	**Yield Change (%)**	**Confidence**
Maize, no adaptation	-28 (-38, -20)	M (M, M)
Maize, auto. adaptation	-17 (-26, -6)	H (M, H)
Maize, adaptation benefit	11 (7, 15)	H (M, H)
Maize, duration fix	15 (10, 20)	M (M, M)
Maize, irrigation	-21 (-30, -11)	M (M, M)
Soybean, auto. adaptation	1 (-10, 19)	H (M, H)
Potato, auto. adaptation	-9 (-15, 5)	H (M, H)
Groundnut, no adaptation	-21 (-31, -10)	H (M, H)
Groundnut, auto. adaptation	-9 (-18, 6)	H (M, H)
Groundnut, adaptation benefit	13 (9, 18)	H (M, H)
Groundnut, duration fix	11 (3, 18)	M (M, M)
Groundnut, irrigation	-18 (-28, -8)	H (M, H)

Zambia

Table 5: summary of calibrated statement results and confidence assessments for Zambia, RCP2.6. Yield changes are averages across climate models, with mean and range shown excluding any outliers. Confidence assessment has robustness and agreement assessments in brackets respectively; L = low, M = medium, H = high confidence / robustness / agreement. Note that adaptation benefit is expressed as percentage point difference, in reference to baseline yields.

Crop and adaptation	**Yield Change (%)**	**Confidence**
Maize, no adaptation	-21 (-37, -10)	M (M, M)
Maize, auto. adaptation	-14 (-28, -4)	H (M, H)
Maize, adaptation benefit	7 (3, 11)	H (M, H)

Maize, duration fix	5 (-1, 13)	M (M, M)
Maize, irrigation	-10 (-25, 3)	H (M, H)
Soybean, auto. adaptation	-6 (-20, 9)	H (M, H)
Potato, auto. adaptation	4 (-22, 29)	H (M, H)
Groundnut, no adaptation	-15 (-27, -4)	H (M, H)
Groundnut, auto. adaptation	-7 (-21, 4)	H (M, H)
Groundnut, adaptation benefit	8 (3, 14)	H (M, H)
Groundnut, duration fix	4 (-5, 9)	H (M, H)
Groundnut, irrigation	-12 (-25, -2)	H (M, H)

Table 6: summary of calibrated statement results and confidence assessments for Zambia, RCP8.5. Yield changes are averages across climate models, with mean and range shown excluding any outliers. Confidence assessment has robustness and agreement assessments in brackets respectively; L = low, M = medium, H = high confidence / robustness / agreement. Note that adaptation benefit is expressed as percentage point difference, in reference to baseline yields.

Crop and adaptation	**Yield Change (%)**	**Confidence**
Maize, no adaptation	-33 (-45, -21)	M (M, M)
Maize, auto. adaptation	-23 (-32, -13)	M (M, M)
Maize, adaptation benefit	10 (5, 16)	H (M, H)
Maize, duration fix	15 (5, 22)	M (M, M)
Maize, irrigation	-22 (-32, -12)	M (M, M)
Soybean, auto. adaptation	-11 (-21, 11)	H (M, H)
Potato, auto. adaptation	2 (-26, 20)	H (M, H)
Groundnut, no adaptation	-23 (-32, -15)	H (M, H)
Groundnut, auto. adaptation	-13 (-23, -5)	H (M, H)
Groundnut, adaptation benefit	9 (6, 16)	H (M, H)
Groundnut, duration fix	9 (4, 17)	H (M, H)
Groundnut, irrigation	-20 (-30, -12)	H (M, H)

South Africa

Table 7: summary of calibrated statement results and confidence assessments for South Africa, RCP2.6. Yield changes are averages across climate models, with mean and range shown excluding any outliers. Confidence assessment has robustness and agreement assessments in brackets respectively; L = low, M = medium, H = high confidence / robustness / agreement. Note that adaptation benefit is expressed as percentage point difference, in reference to baseline yields.

Crop and adaptation	**Yield Change (%)**	**Confidence**

Maize, no adaptation	-28 (-47, -14)	M (M, M)
Maize, auto. adaptation	-2 (-13, 11)	H (M, H)
Maize, adaptation benefit	24 (17, 34)	M (M, M)
Maize, duration fix	12 (0, 26)	M (M, M)
Maize, irrigation	-10 (-31, 7)	H (M, H)
Soybean, auto. adaptation	-3 (-18, 6)	H (M, H)
Potato, auto. adaptation	-3 (-13, 7)	H (M, H)
Groundnut, no adaptation	-24 (-38, -11)	H (M, H)
Groundnut, auto. adaptation	2 (-10, 13)	H (M, H)
Groundnut, adaptation benefit	26 (14, 37)	M (M, M)
Groundnut, duration fix	8 (-3, 18)	H (M, H)
Groundnut, irrigation	-14 (-28, -2)	H (M, H)

Table 8: summary of calibrated statement results and confidence assessments for South Africa, RCP8.5. Yield changes are averages across climate models, with mean and range shown excluding any outliers. Confidence assessment has robustness and agreement assessments in brackets respectively; L = low, M = medium, H = high confidence / robustness / agreement. Note that adaptation benefit is expressed as percentage point difference, in reference to baseline yields.

Crop and adaptation	Yield Change (%)	Confidence
Maize, no adaptation	-43 (-59, -31)	M (M, M)
Maize, auto. adaptation	-4 (-23, 8)	H (M, H)
Maize, adaptation benefit	37 (31, 52)	L (M, L)
Maize, duration fix	14 (0, 29)	M (M, M)
Maize, irrigation	-27 (-43, -14)	M (M, M)
Soybean, auto. adaptation	-6 (-20, 2)	H (M, H)
Potato, auto. adaptation	-14 (-27, -2)	H (M, H)
Groundnut, no adaptation	-34 (-48, -22)	M (M, M)
Groundnut, auto. adaptation	2 (-17, 11)	H (M, H)
Groundnut, adaptation benefit	35 (24, 47)	L (M, L)
Groundnut, duration fix	10 (-7, 19)	H (M, H)
Groundnut, irrigation	-24 (-38, -11)	H (M, H)

Malawi Calibrated Statements

Table 1: summary of calibrated statement results and confidence assessments for Malawi, RCP2.6. Yield changes are averages across climate models, with mean and range shown excluding any outliers. Confidence assessment has robustness and agreement assessments in brackets respectively; L = low, M = medium, H = high confidence / robustness / agreement. Note that adaptation benefit is expressed as percentage point difference, in reference to baseline yields.

Crop and adaptation	Yield Change (%)	Confidence
Maize, no adaptation	-19 (-37, -8)	H (M, H)
Maize, auto. adaptation	-10 (-25, 4)	H (M, H)
Maize, adaptation benefit	10 (4, 18)	H (M, H)
Maize, duration fix	9 (-1, 21)	M (M, M)
Maize, irrigation	-10 (-31, 0)	H (M, H)
Soybean, auto. adaptation	0 (-24, 20)	H (M, H)
Potato, auto. adaptation	0 (-16, 15)	H (M, H)
Groundnut, no adaptation	-12 (-30, -3)	H (M, H)
Groundnut, auto. adaptation	-1 (-14, 9)	H (M, H)
Groundnut, adaptation benefit	11 (7, 15)	H (M, H)
Groundnut, duration fix	6 (-5, 14)	H (M, H)
Groundnut, irrigation	-10 (-29, -1)	H (M, H)

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

Maize

Calibrated Statement 1:

The mean percentage change to maize yield with no adaptation for RCP2.6 is -19% (range across climate models -37 to -8%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means highly robust with respect to climate model uncertainty; however, there is some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore, the robustness assessment has been downgraded to “medium”.

Agreement assessment:
High agreement. Many studies in the literature suggest that maize yields are likely to decline with climate change, and this decline is greater without any form of adaptation. Compared to the Challinor et al. (2014) meta-analysis of maize yield changes in tropical regions, the iFEED range overlaps, and the average change is in agreement with the meta-analysis range.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 2:

The mean percentage change to maize yield with autonomous adaptation for RCP2.6 is -10% (range across climate models -25 to 4%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means highly robust with respect to climate model uncertainty; however, there is some uncertainty associated with crop model parameterisation (e.g. CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore, the robustness assessment has been downgraded to "medium".

Agreement assessment:
High agreement. Many studies in the literature suggest that maize yields are likely to decline with climate change, even with some adaptation. The Challinor et al. (2014) meta-analysis shows a range of yield losses with adaptation that are entirely commensurate with the range produced by iFEED, hence high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 3:

The mean benefit of adaptation for maize for RCP2.6 is 10% of baseline yields (range across climate models 4 to 18%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means high robustness with respect to climate model uncertainty; there is also some uncertainty associated with crop model parameterisation (e.g. CO2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:
High agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation; there is uncertainty over how large this benefit is, but e.g. the Challinor et al. 2014 meta-analysis shows figures very similar to those stated here.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Soybean

Calibrated Statement 1:

The mean percentage change to soybean yield with autonomous adaptation for RCP2.6 is 0% (range across climate models -24 to 20%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that soybean yields could increase or decrease, largely depending on the uncertainty due to rainfall and the impact of CO_2 fertilisation. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Potato

Calibrated Statement 1:

The mean percentage change to potato yield with autonomous adaptation for RCP2.6 is 0% (range across climate models -16 to 15%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that potato yields will most likely decrease, with some studies suggesting small yield increases being possible with CO_2 fertilisation and adaptation both taken into account. There is substantial uncertainty over the size

(and in some cases direction) of the yield change. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Groundnut

Calibrated Statement 1:

The mean percentage change to groundnut yield with no adaptation for RCP2.6 is -13% (range across climate models -33 to -3%; 1/18 climate models are outliers). This becomes mean -12%, range -30 to -3% after removing the lower limit outliers.

Robustness assessment:
Medium robustness. 1/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the change ranges from about -30 to 10%. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 2:

The mean percentage change to groundnut yield with autonomous adaptation for RCP2.6 is -2% (range across climate models -21 to 9%; 2/18 climate models are outliers). This becomes mean -1%, range -14 to 9% after removing the lower limit outliers.

Robustness assessment:
Medium robustness. 2/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the change ranges from about -30 to 10%. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 3:

The mean benefit of adaptation for groundnut for RCP2.6 is 11% of baseline yields (range across climate models 7 to 15%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, and there is some uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g. CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Few groundnut studies quantify the benefit of adaptation on yields. The Challinor et al. 2014 meta-analysis suggests that in general, adaptation benefits could range from 7-15%, although this is not specific to groundnut. Groundnut-specific studies suggest a range of 0-16%. This overlaps with the range shown by iFEED.

Confidence Assessment:
High confidence (medium robustness and high agreement).

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

Maize

Calibrated Statement 1:

The mean percentage change to maize yield with irrigation increases in future for RCP2.6 is -10% (range across climate models -31 to 0%; 0/18 climate models are outliers).

Robustness assessment:

Medium robustness. 0/18 climate models are outliers, which means highly robust with respect to climate model uncertainty; however, there is some uncertainty associated with crop model parameterisation (e.g. CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore, the robustness assessment has been downgraded to “medium”.

Agreement assessment:
High agreement. Many studies in the literature suggest that maize yields are likely to decline with climate change, even with some adaptation. The Challinor et al. (2014) meta-analysis shows a range of yield losses with adaptation that are entirely commensurate with the range produced by iFEED, hence high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 2:

The mean percentage change to maize yield with adaptation to negate warming-induced growing season reduction for RCP2.6 is 9% (range across climate models -1 to 21%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means high robustness with respect to climate model uncertainty; there is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:
Medium agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation; there is uncertainty over how large this benefit is. E.g. the Challinor et al. 2014 meta-analysis shows figures of 7-15% in general for adaptation, but for cultivar adjustment in particular the benefit could be higher than 20%. The positive yield change with this adaptation is also seen in many studies in the meta-analysis, although the mean change is negative. The cultivar adjustment adaptation benefit range in Challinor et al. 2014 overlaps with the range from iFEED, although iFEED projections indicate that the benefit (upwards of 30%), is on the high side of other studies, therefore medium agreement.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Soybean

Calibrated Statement 1:

The mean percentage change to soybean yield with autonomous adaptation for RCP2.6 is 0% (range across climate models -24 to 20%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that soybean yields could increase or decrease, largely depending on the uncertainty due to rainfall and the impact of CO2 fertilisation. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Potato

Calibrated Statement 1:

The mean percentage change to potato yield with autonomous adaptation for RCP2.6 is 0% (range across climate models -16 to 15%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that potato yields will most likely decrease, with some studies suggesting small yield increases being possible with CO2 fertilisation and adaptation both taken into account. There is substantial uncertainty over the size (and in some cases direction) of the yield change. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Groundnut

Calibrated Statement 1:

The mean percentage change to groundnut yield with irrigation increases in future for RCP2.6 is -11% (range across climate models -32 to -1%; 1/18 climate models are outliers). This becomes mean -10%, range -29 to -1% after removing the lower limit outliers.

Robustness assessment:
Medium robustness. 1/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the change ranges from about -30 to 10%. This uncertainty is reflected in iFEED results. Irrigation benefits are also projected to be smaller than those associated with cultivar adjustment. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 2:

The mean percentage change to groundnut yield with adaptation to negate warming-induced growing season reduction for RCP2.6 is 6% (range across climate models -5 to 14%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, and there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g. CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the change ranges from about -30 to 10%, although larger increases are sometimes projected. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Table 2: summary of calibrated statement results and confidence assessments for Malawi, RCP8.5. Yield changes are averages across climate models, with mean and range shown excluding any outliers. Confidence assessment has robustness and agreement assessments in brackets respectively; L = low, M = medium, H = high confidence / robustness / agreement. Note that adaptation benefit is expressed as percentage point difference, in reference to baseline yields.

Crop and adaptation	Yield Change (%)	Confidence
Maize, no adaptation	-30 (-41, -20)	M (M, M)
Maize, auto. adaptation	-18 (-30, 9)	H (M, H)
Maize, adaptation benefit	11 (5, 17)	H (M, H)
Maize, duration fix	17 (5, 30)	M (M, M)
Maize, irrigation	-23 (-35, 12)	M (M, M)
Soybean, auto. adaptation	0 (-22, 22)	H (M, H)
Potato, auto. adaptation	-9 (-29, 9)	H (M, H)
Groundnut, no adaptation	-22 (-35, -13)	H (M, H)
Groundnut, auto. adaptation	-6 (-19, 6)	H (M, H)
Groundnut, adaptation benefit	16 (11, 19)	H (M, H)
Groundnut, duration fix	13 (3, 22)	M (M, M)
Groundnut, irrigation	-20 (-34, -11)	H (M, H)

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

Maize

Calibrated Statement 1:

The mean percentage change to maize yield with no adaptation for RCP8.5 is -30% (range across climate models is -20 to -41% %; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means highly robust with respect to climate model uncertainty; however, there is some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore, the robustness assessment has been downgraded to “medium”.

Agreement assessment:
Medium agreement. Many studies in the literature suggest that maize yields are likely to decline with climate change, and this decline is greater without any form of adaptation. The yield decrease here is larger than the typical yield decreases reported in the Challinor et al. 2014 meta-analysis. Overall, this suggests medium agreement.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Calibrated Statement 2:

The mean percentage change to maize yield with autonomous adaptation for RCP8.5 is -18% (range across climate models -30 to -9%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means highly robust with respect to climate model uncertainty; however, there is some uncertainty associated with crop model parameterisation (e.g. CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore, the robustness assessment has been downgraded to “medium”.

Agreement assessment:
High agreement. Many studies in the literature suggest that maize yields are likely to decline with climate change, even with some adaptation. The Challinor et al. (2014) meta-analysis shows a range of yield losses with adaptation that are entirely commensurate with the range produced by iFEED, hence high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 3:

The mean benefit of adaptation for maize for RCP8.5 is 12% of baseline yields (range across climate models 5 to 24%; 4/18 climate models are outliers). This becomes mean 11%, range 5 to 17% after removing both upper and lower limit outliers.

Robustness assessment:
Medium robustness. 4/18 climate models are outliers, which means medium robustness with respect to climate model uncertainty; there is also some uncertainty associated with crop model parameterisation (e.g. CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:
High agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation; there is uncertainty over how large this benefit is, but e.g. the Challinor et al. 2014 meta-analysis shows figures very similar to those stated here.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Soybean

Calibrated Statement 1:

The mean percentage change to soybean yield with autonomous adaptation for RCP8.5 is 0% (range across climate models -22 to 22%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that soybean yields could increase or decrease, largely depending on the uncertainty due to rainfall and the impact of CO_2 fertilisation. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Potato

Calibrated Statement 1:

The mean percentage change to potato yield with autonomous adaptation for RCP8.5 is -9% (range across climate models -29 to 9%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that potato yields will most likely decrease, with some studies suggesting small yield increases being possible with CO2 fertilisation and adaptation both taken into account. There is substantial uncertainty over the size (and in some cases direction) of the yield change. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Groundnut

Calibrated Statement 1:

The mean percentage change to groundnut yield with no adaptation RCP8.5 is -22% (range across climate models -35 to -13%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the change ranges from about -30 to 10%, although larger increases are sometimes projected. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 2:

The mean percentage change to groundnut yield with autonomous adaptation for RCP8.5 is -6% (range across climate models -19 to 6%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the change ranges from about -30 to 10%, although larger increases are sometimes projected. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 3:

The mean benefit of adaptation for groundnut for RCP8.5 is 16% of baseline yields (range across climate models 9 to 19%; 1/18 climate models are outliers). This becomes mean 16%, range 11 to 19% after removing the lower limit outliers.

Robustness assessment:
Medium robustness. 1/18 climate models are outliers, and there is some uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g. CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Few groundnut studies quantify the benefit of adaptation on yields. The Challinor et al. 2014 meta-analysis suggests that in general, adaptation benefits could range from 7-15%, although this is not specific to groundnut. Groundnut-specific studies suggest a range from 0-16%, although the Challinor et al. meta-analysis also suggests that crop cultivar adjustment could result in even larger benefits. This overlaps with the range shown by iFEED.

Confidence Assessment:
High confidence (medium robustness and high agreement).

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

Maize

Calibrated Statement 1:

The mean percentage change to maize yield with irrigation increases in future for RCP8.5 is -23% (range across climate models -35 to -12%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means high robustness with respect to climate model uncertainty; there is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:
Medium agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation but still decline. The Challinor et al. 2014 meta-analysis shows 7-15% adaptation benefit, and smaller benefits for irrigation than changing varieties, as iFEED project. However, the average change is slightly more negative than is typically reported, hence medium agreement.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Calibrated Statement 2:

The mean percentage change to maize yield with adaptation to negate warming-induced growing season reduction for RCP8.5 is 17% (range across climate models 5 to 30%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means high robustness with respect to climate model uncertainty; there is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:
Medium agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation; there is uncertainty over how large this benefit is. E.g. the

Challinor et al. 2014 meta-analysis shows figures of 7-15% in general for adaptation, but for cultivar adjustment in particular the benefit cold be higher than 20%. The positive yield change with this adaptation is also seen in many studies in the meta-analysis, although the mean change is negative. The cultivar adjustment adaptation benefit range in Challinor et al. 2014 overlaps with the range from iFEED, although iFEED projections indicate that the benefit (upwards of 30%), is on the high side of other studies, therefore medium agreement.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Soybean

Calibrated Statement 1:

The mean percentage change to soybean yield with autonomous adaptation for RCP8.5 is 0% (range across climate models -22 to 22%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that soybean yields could increase or decrease, largely depending on the uncertainty due to rainfall and the impact of CO2 fertilisation. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Potato

Calibrated Statement 1:

The mean percentage change to potato yield with autonomous adaptation for RCP8.5 is -9% (range across climate models -29 to 9%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that potato yields will most likely decrease, with some studies suggesting small yield increases being possible with CO_2 fertilisation and adaptation both taken into account. There is substantial uncertainty over the size (and in some cases direction) of the yield change. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

<u>Groundnut</u>

<u>Calibrated Statement 1:</u>

The mean percentage change to groundnut yield with irrigation increases in future for RCP8.5 is -20% (range across climate models -34 to -11%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the decrease ranges from not much change to -30%. This uncertainty is reflected in iFEED results. Challinor et al. 2014 report a benefit from irrigation that is in agreement with the iFEED projections (i.e. < 10%). Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 2:

The mean percentage change to groundnut yield with adaptation to negate warming-induced growing season reduction for RCP8.5 is 13% (range across climate models 3 to 22%; 1/18 climate models are outliers). This becomes mean 13%, range 3 to 22% after removing the lower limit outliers.

Robustness assessment:
Medium robustness. 1/18 climate models are outliers, and there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g. CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
Medium agreement. Few groundnut studies quantify the benefit of adaptation on yields. The Challinor et al. 2014 meta-analysis suggests that in general, adaptation benefits could range from 7-15%, although this is not specific to groundnut. This overlaps with the range shown by iFEED, although the iFEED adaptation benefit is probably larger than that shown for other crops in the meta-analysis. The projected changes are on the high side of the majority of projections, therefore medium agreement.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Tanzania Calibrated Statements

Table 3: summary of calibrated statement results and confidence assessments for Tanzania, RCP2.6. Yield changes are averages across climate models, with mean and range shown excluding any outliers. Confidence assessment has robustness and agreement assessments in brackets respectively; L = low, M = medium, H = high confidence / robustness / agreement. Note that adaptation benefit is expressed as percentage point difference, in reference to baseline yields.

Crop and adaptation	Yield Change (%)	Confidence
Maize, no adaptation	-15 (-31, -3)	H (M, H)
Maize, auto. adaptation	-7 (-22, 3)	H (M, H)
Maize, adaptation benefit	6 (3, 11)	M (M, M)
Maize, duration fix	9 (4, 16)	M (M, M)
Maize, irrigation	-7 (-25, 8)	H (M, H)
Soybean, auto. adaptation	6 (-10, 31)	H (M, H)
Potato, auto. adaptation	-4 (-18, 23)	H (M, H)
Groundnut, no adaptation	-11 (-26, 0)	H (M, H)
Groundnut, auto. adaptation	0 (-14, 13)	H (M, H)
Groundnut, adaptation benefit	9 (4, 15)	H (M, H)
Groundnut, duration fix	7 (-3, 16)	H (M, H)
Groundnut, irrigation	-8 (-24, 3)	H (M, H)

Low Climate Risk (RCP2.6) / low technology (LT)

Maize

Calibrated Statement 1:

The mean percentage change to maize yield with no adaptation for RCP2.6 is -15% (range across climate models -31 to -3%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means highly robust with respect to climate model uncertainty; however, there is some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore, the robustness assessment has been downgraded to “medium”.

Agreement assessment:
High agreement. Many studies in the literature suggest that maize yields are likely to decline with climate change, and this decline is greater without any form of adaptation. Compared to the Challinor et al. (2014) meta-analysis of maize yield changes in tropical regions, the iFEED range overlaps, and the average change is well within that typically reported.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 2:

The mean percentage change to maize yield with autonomous adaptation for RCP2.6 is -8% (range across climate models -22 to 3%; 1/18 climate models are outliers). This becomes mean -7%, range -22 to 3% after removing the lower limit outliers.

Robustness assessment:
Medium robustness. 1/18 climate models are outliers, which means highly robust with respect to climate model uncertainty; however, there is some uncertainty associated with crop model parameterisation (e.g. CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore, the robustness assessment has been downgraded to "medium".

Agreement assessment:
High agreement. Many studies in the literature suggest that maize yields are likely to decline with climate change, even with some adaptation. The Challinor et al. (2014) meta-analysis shows a range of yield losses with adaptation that are entirely commensurate with the range produced by iFEED, hence high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 3:

The mean benefit of adaptation for maize for RCP2.6 is 6% of baseline yields (range across climate models 3 to 11%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means high robustness with respect to climate model uncertainty; there is also some uncertainty associated with crop model parameterisation (e.g. CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:
Medium agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation; there is uncertainty over how large this benefit is, but e.g. the Challinor et al. 2014 meta-analysis shows figures similar to those stated here, although the average change in iFEED projections is slightly lower than those typically reported for maize in the meta-analysis.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Soybean

Calibrated Statement 1:

The mean percentage change to soybean yield with autonomous adaptation for RCP2.6 is 8% (range across climate models -10 to 42%; 1/18 climate models are outliers). This becomes mean 6%, range -10 to 31% after removing the upper limit outliers.

Robustness assessment:
Medium robustness. 1/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
Medium agreement. Literature suggests that soybean yields could increase or decrease, largely depending on the uncertainty due to rainfall and the impact of CO2 fertilisation. This uncertainty is reflected in iFEED results. The iFEED projections in some cases are larger than most other published studies, although the range mostly overlaps. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Potato

Calibrated Statement 1:

The mean percentage change to potato yield with autonomous adaptation for RCP2.6 is -2% (range across climate models -18 to 31%; 1/18 climate models are outliers). This becomes mean -4%, range -18 to 23% after removing the upper limit outliers.

Robustness assessment:
Medium robustness. 1/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across

crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that potato yields will most likely decrease, with some studies suggesting small yield increases being possible with CO2 fertilisation and adaptation both taken into account. There is substantial uncertainty over the size (and in some cases direction) of the yield change, although more studies project decreases than increases. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Groundnut

Calibrated Statement 1:

The mean percentage change to groundnut yield with no adaptation for RCP2.6 is -11% (range across climate models -26 to 0%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 1/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the decrease ranges from about -30 to 10%. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 2:
The mean percentage change to groundnut yield with autonomous adaptation for RCP2.6 is -2% (range across climate models -17 to 13%; 2/18 climate models are

outliers). This becomes mean 0%, range -14 to 13% after removing the lower limit outliers.

Robustness assessment:
Medium robustness. 2/18 climate models are outliers, and there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the decrease ranges from about -30 to 10%. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 3:

The mean benefit of adaptation for groundnut for RCP2.6 is 9% of baseline yields (range across climate models 4 to 15%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, and there is some uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g. CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Few groundnut studies quantify the benefit of adaptation on yields. The Challinor et al. 2014 meta-analysis suggests that in general, adaptation benefits could range from 7-15%, although this is not specific to groundnut. This overlaps with the range shown by iFEED, and other groundnut-specific literature suggests adaptation benefits could be from 0-16%.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Low Climate Risk (RCP2.6) / high technology (HT)

Maize

Calibrated Statement 1:

The mean percentage change to maize yield with irrigation increases in future for RCP2.6 is -7% (range across climate models -25 to 8%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means highly robust with respect to climate model uncertainty; however, there is some uncertainty associated with crop model parameterisation (e.g. CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore, the robustness assessment has been downgraded to “medium”.

Agreement assessment:
High agreement. Many studies in the literature suggest that maize yields are likely to decline with climate change, even with some adaptation. The Challinor et al. (2014) meta-analysis shows a range of yield losses with adaptation that are entirely commensurate with the range produced by iFEED, hence high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 2:

The mean percentage change to maize yield with adaptation to negate warming-induced growing season reduction for RCP2.6 is 9% (range across climate models 4 to 16%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means high robustness with respect to climate model uncertainty; there is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:
Medium agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation; there is uncertainty over how large this benefit is. E.g. the Challinor et al. 2014 meta-analysis shows figures of 7-15% in general for adaptation, but for cultivar adjustment in particular the benefit could be higher than 20%. The positive yield change with this adaptation is also seen in many studies in the meta-analysis, although the mean change is negative. The cultivar adjustment adaptation benefit range in Challinor et al. 2014 overlaps with the range from iFEED, although iFEED projections indicate that the benefit (upwards of 30%), is on the high side of other studies, therefore medium agreement.

Confidence Assessment:

Medium confidence (medium robustness and medium agreement).

Soybean

Calibrated Statement 1:

The mean percentage change to soybean yield with autonomous adaptation for RCP2.6 is 8% (range across climate models -10 to 42%; 1/18 climate models are outliers). This becomes mean 6%, range -10 to 31% after removing the upper limit outliers.

Robustness assessment:
Medium robustness. 1/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
Medium agreement. Literature suggests that soybean yields could increase or decrease, largely depending on the uncertainty due to rainfall and the impact of CO2 fertilisation. This uncertainty is reflected in iFEED results. The iFEED projections in some cases are larger than most other published studies, although the range mostly overlaps. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Potato

Calibrated Statement 1:

The mean percentage change to potato yield with autonomous adaptation for RCP2.6 is -2% (range across climate models -18 to 31%; 1/18 climate models are outliers). This becomes mean -4%, range -18 to 23% after removing the upper limit outliers.

Robustness assessment:
Medium robustness. 1/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that potato yields will most likely decrease, with some studies suggesting small yield increases being possible with CO2 fertilisation and adaptation both taken into account. There is substantial uncertainty over the size (and in some cases direction) of the yield change, although more studies project decreases than increases. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Groundnut

Calibrated Statement 1:

The mean percentage change to groundnut yield with irrigation increases in future for RCP2.6 is -8% (range across climate models -24 to 3%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the decrease ranges from about -30 to 10%. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 2:

The mean percentage change to groundnut yield with adaptation to negate warming-induced growing season reduction for RCP2.6 is 7% (range across climate models -3 to 16%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, and there is large uncertainty across climate models. There is also some uncertainty associated with crop model

parameterisation (e.g. CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the decrease ranges from about -30 to 10%, with some higher projections also available. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Table 4: summary of calibrated statement results and confidence assessments for Tanzania, RCP8.5. Yield changes are averages across climate models, with mean and range shown excluding any outliers. Confidence assessment has robustness and agreement assessments in brackets respectively; L = low, M = medium, H = high confidence / robustness / agreement. Note that adaptation benefit is expressed as percentage point difference, in reference to baseline yields.

Crop and adaptation	**Yield Change (%)**	**Confidence**
Maize, no adaptation	-28 (-38, -20)	M (M, M)
Maize, auto. adaptation	-17 (-26, -6)	H (M, H)
Maize, adaptation benefit	11 (7, 15)	H (M, H)
Maize, duration fix	15 (10, 20)	M (M, M)
Maize, irrigation	-21 (-30, -11)	M (M, M)
Soybean, auto. adaptation	1 (-10, 19)	H (M, H)
Potato, auto. adaptation	-9 (-15, 5)	H (M, H)
Groundnut, no adaptation	-21 (-31, -10)	H (M, H)
Groundnut, auto. adaptation	-9 (-18, 6)	H (M, H)
Groundnut, adaptation benefit	13 (9, 18)	H (M, H)
Groundnut, duration fix	11 (3, 18)	M (M, M)
Groundnut, irrigation	-18 (-28, -8)	H (M, H)

High Climate Risk (RCP8.5) / low technology (LT)

Maize

Calibrated Statement 1:

The mean percentage change to maize yield with no adaptation for RCP8.5 is -28% (range across climate models -38 to -20%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means highly robust with respect to climate model uncertainty; however, there is some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore, the robustness assessment has been downgraded to “medium”.

Agreement assessment:
Medium agreement. Many studies in the literature suggest that maize yields are likely to decline with climate change, and this decline is greater without any form of adaptation. The yield decrease here is larger than the typical yield decreases reported in the Challinor et al. 2014 meta-analysis. Overall, this suggests medium agreement.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Calibrated Statement 2:

The mean percentage change to maize yield with autonomous adaptation for RCP8.5 is -17% (range across climate models -26 to -6%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means highly robust with respect to climate model uncertainty; however, there is some uncertainty associated with crop model parameterisation (e.g. CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore, the robustness assessment has been downgraded to “medium”.

Agreement assessment:
High agreement. Many studies in the literature suggest that maize yields are likely to decline with climate change, even with some adaptation. The Challinor et al. (2014) meta-analysis shows a range of yield losses with adaptation that are entirely commensurate with the range produced by iFEED, hence high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 3:

The mean benefit of adaptation for maize for RCP8.5 is 11% of baseline yields, (range across climate models 7 to 15%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 4/18 climate models are outliers, which means medium robustness with respect to climate model uncertainty; there is also some uncertainty

associated with crop model parameterisation (e.g. CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:
High agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation; there is uncertainty over how large this benefit is, but e.g. the Challinor et al. 2014 meta-analysis shows figures very similar to those stated here.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Soybean

Calibrated Statement 1:

The mean percentage change to soybean yield with autonomous adaptation for RCP8.5 is 1% (range across climate models -10 to 19%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that soybean yields could increase or decrease, largely depending on the uncertainty due to rainfall and the impact of CO_2 fertilisation. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Potato

Calibrated Statement 1:

The mean percentage change to potato yield with autonomous adaptation for RCP8.5 is -8% (range across climate models -15 to 7%; 1/18 climate models are outliers). This becomes mean -9%, range -15 to 5% after removing the upper limit outliers.

Robustness assessment:
Medium robustness. 1/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that potato yields will most likely decrease, with some studies suggesting small yield increases being possible with CO2 fertilisation and adaptation both taken into account. There is substantial uncertainty over the size (and in some cases direction) of the yield change. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Groundnut

Calibrated Statement 1:

The mean percentage change to groundnut yield with no adaptation for RCP8.5 is -21% (range across climate models -31 to -10%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the decrease ranges from not much change to -30%. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 2:

The mean percentage change to groundnut yield with autonomous adaptation for RCP8.5 is -8% (range across climate models -18 to 7%; 1/18 climate models are outliers). This becomes mean -9%, range -18 to 6% after removing the upper limit outliers.

Robustness assessment:
Medium robustness. 1/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the decrease ranges from about -30 to 10%. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 3:

The mean benefit of adaptation for groundnut for RCP8.5 is 13% of baseline yields (range across climate models 9 to 18%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, and there is some uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g. CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Few groundnut studies quantify the benefit of adaptation on yields. The Challinor et al. 2014 meta-analysis suggests that in general, adaptation benefits could range from 7-15%, with cultivar adjustment responsible for potentially larger benefits. This overlaps with the range shown by iFEED.

Confidence Assessment:
High confidence (medium robustness and high agreement).

High Climate Risk (RCP8.5) / high technology (HT)

Maize

Calibrated Statement 1:

The mean percentage change to maize yield with irrigation increases in future for RCP8.5 is -21% (range across climate models -30 to -11%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means high robustness with respect to climate model uncertainty; there is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:
Medium agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation but still decline. The Challinor et al. 2014 meta-analysis shows 7-15% adaptation benefit, and smaller benefits for irrigation than changing varieties, as iFEED project. The average projection is on the lower side of the typical change in the literature however, hence medium agreement.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Calibrated Statement 2:

The mean percentage change to maize yield with adaptation to negate warming-induced growing season reduction for RCP8.5 is 15% (range across climate models 10 to 20%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means high robustness with respect to climate model uncertainty; there is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:
Medium agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation; there is uncertainty over how large this benefit is. E.g. the Challinor et al. 2014 meta-analysis shows figures of 7-15% in general for adaptation, but for cultivar adjustment in particular the benefit cold be higher than 20%. The positive yield change with this adaptation is also seen in many studies in the meta-analysis, although the mean change is negative. The cultivar adjustment adaptation benefit range in Challinor et al. 2014 overlaps with the range from iFEED, although iFEED projections indicate that the benefit (upwards of 30%), is on the high side of other studies, therefore medium agreement.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Soybean

Calibrated Statement 1:

The mean percentage change to soybean yield with autonomous adaptation for RCP8.5 is 1% (range across climate models -10 to 19%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that soybean yields could increase or decrease, largely depending on the uncertainty due to rainfall and the impact of CO_2 fertilisation. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Potato

Calibrated Statement 1:

The mean percentage change to potato yield with autonomous adaptation for RCP8.5 is -8% (range across climate models -15 to 7%; 1/18 climate models are outliers). This becomes mean -9%, range -15 to 5% after removing the upper limit outliers.

Robustness assessment:
Medium robustness. 1/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across

crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that potato yields will most likely decrease, with some studies suggesting small yield increases being possible with CO2 fertilisation and adaptation both taken into account. There is substantial uncertainty over the size (and in some cases direction) of the yield change. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Groundnut

Calibrated Statement 1:

The mean percentage change to groundnut yield with irrigation increases in future for RCP8.5 is -18% (range across climate models -28 to -8%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the decrease ranges from not much change to -30%. This uncertainty is reflected in iFEED results. Challinor et al. 2014 report a benefit from irrigation that is in agreement with the iFEED projections (i.e. < 10%). Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 2:

The mean percentage change to groundnut yield with adaptation to negate warming-induced growing season reduction for RCP8.5 is 11% (range across climate models 3 to 18%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, and there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g. CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
Medium agreement. Few groundnut studies quantify the benefit of adaptation on yields. The Challinor et al. 2014 meta-analysis suggests that in general, adaptation benefits could range from 7-15%, although this is not specific to groundnut. This overlaps with the range shown by iFEED, although the iFEED adaptation benefit is probably larger than that shown for other crops in the meta-analysis. The cultivar adjustment adaptation benefit range in Challinor et al. 2014 overlaps with the range from iFEED, although iFEED projections indicate that the benefit (upwards of 30%), is on the high side of other studies, therefore medium agreement.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Zambia Calibrated Statements

Table 5: summary of calibrated statement results and confidence assessments for Zambia, RCP2.6. Yield changes are averages across climate models, with mean and range shown excluding any outliers. Confidence assessment has robustness and agreement assessments in brackets respectively; L = low, M = medium, H = high confidence / robustness / agreement. Note that adaptation benefit is expressed as percentage point difference, in reference to baseline yields.

Crop and adaptation	Yield Change (%)	Confidence
Maize, no adaptation	-21 (-37, -10)	M (M, M)
Maize, auto. adaptation	-14 (-28, -4)	H (M, H)
Maize, adaptation benefit	7 (3, 11)	H (M, H)
Maize, duration fix	5 (-1, 13)	M (M, M)
Maize, irrigation	-10 (-25, 3)	H (M, H)

Soybean, auto. adaptation	-6 (-20, 9)	H (M, H)
Potato, auto. adaptation	4 (-22, 29)	H (M, H)
Groundnut, no adaptation	-15 (-27, -4)	H (M, H)
Groundnut, auto. adaptation	-7 (-21, 4)	H (M, H)
Groundnut, adaptation benefit	8 (3, 14)	H (M, H)
Groundnut, duration fix	4 (-5, 9)	H (M, H)
Groundnut, irrigation	-12 (-25, -2)	H (M, H)

Low Climate Risk (RCP2.6) / low market efficacy (LT)

Maize

Calibrated Statement 1:

The mean percentage change to maize yield with no adaptation for RCP2.6 is -21% (range across climate models -37 to -10%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means highly robust with respect to climate model uncertainty; however, there is some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore, the robustness assessment has been downgraded to “medium”.

Agreement assessment:
Medium agreement. Many studies in the literature suggest that maize yields are likely to decline with climate change, and this decline is greater without any form of adaptation. Compared to the Challinor et al. (2014) meta-analysis of maize yield changes in tropical regions, the iFEED range overlaps, although this range is towards the lower end of the meta-analysis range.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Calibrated Statement 2:

The mean percentage change to maize yield with autonomous adaptation for RCP2.6 is -14% (range across climate models -28 to -4%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means highly robust with respect to climate model uncertainty; however, there is some uncertainty associated

with crop model parameterisation (e.g. CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore, the robustness assessment has been downgraded to “medium”.

Agreement assessment:
High agreement. Many studies in the literature suggest that maize yields are likely to decline with climate change, even with some adaptation. The Challinor et al. (2014) meta-analysis shows a range of yield losses with adaptation that are entirely commensurate with the range produced by iFEED, hence high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 3:

The mean benefit of adaptation for maize for RCP2.6 is 7% of baseline yields (range across climate models 3 to 12%; 2/18 climate models are outliers). This becomes mean 7%, range 3 to 11% after removing both upper and lower limit outliers.

Robustness assessment:
Medium robustness. 2/18 climate models are outliers, which means high robustness with respect to climate model uncertainty; there is also some uncertainty associated with crop model parameterisation (e.g. CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:
High agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation; there is uncertainty over how large this benefit is, but e.g. the Challinor et al. 2014 meta-analysis shows figures very similar to those stated here.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Soybean

Calibrated Statement 1:

The mean percentage change to soybean yield with autonomous adaptation for RCP2.6 is -6% (range across climate models -20 to 9%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across

crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that soybean yields could increase or decrease, largely depending on the uncertainty due to rainfall and the impact of CO_2 fertilisation. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Potato

Calibrated Statement 1:

The mean percentage change to potato yield with autonomous adaptation for RCP2.6 is 4% (range across climate models -24 to 33%; 2/18 climate models are outliers). This becomes mean 4%, range -22 to 29% after removing both upper and lower limit outliers.

Robustness assessment:
Medium robustness. 2/18 climate models are outliers, and there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that potato yields will most likely decrease, with some studies suggesting small yield increases being possible with CO_2 fertilisation and adaptation both taken into account. There is substantial uncertainty over the size (and in some cases direction) of the yield change. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Groundnut

Calibrated Statement 1:

The mean percentage change to groundnut yield with no adaptation for RCP2.6 is -15% (range across climate models -27 to -4%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the changes range from about 10% gains to 30% losses. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 2:

The mean percentage change to groundnut yield with autonomous adaptation for RCP2.6 is -7% (range across climate models -21 to 4%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the changes range from about 10% gains to 30% losses. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 3:

The mean benefit of adaptation for groundnut for RCP2.6 is 8% of baseline yields (range across climate models 3 to 14%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, and there is some uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g. CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Few groundnut studies quantify the benefit of adaptation on yields. The Challinor et al. 2014 meta-analysis suggests that in general, adaptation benefits could range from 7-15%, and other groundnut-specific literature suggests the benefits could be from 0-16%. This overlaps with the range shown by iFEED.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Low Climate Risk (RCP2.6) / high market efficacy (HT)

Maize

Calibrated Statement 1:

The mean percentage change to maize yield with irrigation increases in future for RCP2.6 is -10% (range across climate models -25 to 3%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means highly robust with respect to climate model uncertainty; however, there is some uncertainty associated with crop model parameterisation (e.g. CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore, the robustness assessment has been downgraded to “medium”.

Agreement assessment:
High agreement. Many studies in the literature suggest that maize yields are likely to decline with climate change, even with some adaptation. The Challinor et al. (2014) meta-analysis shows a range of yield losses with adaptation that are entirely commensurate with the range produced by iFEED, hence high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 2:

The mean percentage change to maize yield with adaptation to negate warming-induced growing season reduction for RCP2.6 is 5% (range across climate models -1 to 13%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means high robustness with respect to climate model uncertainty; there is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:
Medium agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation; there is uncertainty over how large this benefit is. E.g. the Challinor et al. 2014 meta-analysis shows figures of 7-15% in general for adaptation, but for cultivar adjustment in particular the benefit could be higher than 20%. The positive yield change with this adaptation is also seen in many studies in the meta-analysis, although the mean change is negative. The cultivar adjustment adaptation benefit range in Challinor et al. 2014 overlaps with the range from iFEED, although iFEED projections indicate that the benefit (upwards of 30%), is on the high side of other studies, therefore medium agreement.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Soybean

Calibrated Statement 1:

The mean percentage change to soybean yield with autonomous adaptation for RCP2.6 is -6% (range across climate models -20 to 9%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that soybean yields could increase or decrease, largely depending on the uncertainty due to rainfall and the impact of CO2 fertilisation. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:

High confidence (medium robustness and high agreement).

Potato

Calibrated Statement 1:

The mean percentage change to potato yield with autonomous adaptation for RCP2.6 is 4% (range across climate models -24 to 33%; 2/18 climate models are outliers). This becomes mean 4%, range -22 to 29% after removing both upper and lower limit outliers.

Robustness assessment:
Medium robustness. 2/18 climate models are outliers, and there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that potato yields will most likely decrease, with some studies suggesting small yield increases being possible with CO2 fertilisation and adaptation both taken into account. There is substantial uncertainty over the size (and in some cases direction) of the yield change. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Groundnut

Calibrated Statement 1:

The mean percentage change to groundnut yield with irrigation increases in future for RCP2.6 is -12% (range across climate models -25 to -2%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the decrease ranges from not much change to -30%. This uncertainty is reflected in iFEED results. Challinor et al. 2014 report a benefit from irrigation that is in agreement with the iFEED projections (i.e. < 10%). Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 2:

The mean percentage change to groundnut yield with adaptation to negate warming-induced growing season reduction for RCP2.6 is 4% (range across climate models -5 to 9%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, and there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g. CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the changes range from about 10% gains to 30% losses. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Table 6: summary of calibrated statement results and confidence assessments for Zambia, RCP8.5. Yield changes are averages across climate models, with mean and range shown excluding any outliers. Confidence assessment has robustness and agreement assessments in brackets respectively; L = low, M = medium, H = high confidence / robustness / agreement. Note that adaptation benefit is expressed as percentage point difference, in reference to baseline yields.

Crop and adaptation	Yield Change (%)	Confidence
Maize, no adaptation	-33 (-45, -21)	M (M, M)
Maize, auto. adaptation	-23 (-32, -13)	M (M, M)
Maize, adaptation benefit	10 (5, 16)	H (M, H)
Maize, duration fix	15 (5, 22)	M (M, M)
Maize, irrigation	-22 (-32, -12)	M (M, M)

Soybean, auto. adaptation	-11 (-21, 11)	H (M, H)
Potato, auto. adaptation	2 (-26, 20)	H (M, H)
Groundnut, no adaptation	-23 (-32, -15)	H (M, H)
Groundnut, auto. adaptation	-13 (-23, -5)	H (M, H)
Groundnut, adaptation benefit	9 (6, 16)	H (M, H)
Groundnut, duration fix	9 (4, 17)	H (M, H)
Groundnut, irrigation	-20 (-30, -12)	H (M, H)

High Climate Risk (RCP8.5) / low market efficacy (LT)

Maize

Calibrated Statement 1:

The mean percentage change to maize yield with no adaptation for RCP8.5 is -33% (range across climate models -45 to -21%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means highly robust with respect to climate model uncertainty; however, there is some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore, the robustness assessment has been downgraded to “medium”.

Agreement assessment:
Medium agreement. Many studies in the literature suggest that maize yields are likely to decline with climate change, and this decline is greater without any form of adaptation. The yield decrease here is larger than the typical yield decreases reported in the Challinor et al. 2014 meta-analysis. Overall, this suggests medium agreement.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Calibrated Statement 2:

The mean percentage change to maize yield with autonomous adaptation for RCP8.5 is -23% (range across climate models -32 to -13%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means highly robust with respect to climate model uncertainty; however, there is some uncertainty associated

with crop model parameterisation (e.g. CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore, the robustness assessment has been downgraded to “medium”.

Agreement assessment:
Medium agreement. Many studies in the literature suggest that maize yields are likely to decline with climate change, even with some adaptation. The Challinor et al. (2014) meta-analysis shows a range of yield losses with adaptation that largely agree with the changes shown by iFEED projections, however the average yield change is slightly lower in iFEED, hence medium agreement.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Calibrated Statement 3:

The mean benefit of adaptation for maize for RCP8.5 is 10% of baseline yields (range across climate models 5 to 16%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means high robustness with respect to climate model uncertainty; there is however some uncertainty associated with crop model parameterisation (e.g. CO2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:
High agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation; there is uncertainty over how large this benefit is, but e.g. the Challinor et al. 2014 meta-analysis shows figures very similar to those stated here.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 4:

The mean percentage change to maize yield with irrigation increases in future for RCP8.5 is -22% (range across climate models -32 to -12%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means high robustness with respect to climate model uncertainty; there is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:

Medium agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation but still decline. The Challinor et al. 2014 meta-analysis shows 7-15% adaptation benefit, and benefits with irrigation similar to iFEED projections. The mean change projected is slightly lower than the meta-analysis average change, hence medium agreement.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Soybean

Calibrated Statement 1:

The mean percentage change to soybean yield with autonomous adaptation for RCP8.5 is -11% (range across climate models -21 to 11%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that soybean yields could increase or decrease, largely depending on the uncertainty due to rainfall and the impact of CO2 fertilisation. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Potato

Calibrated Statement 1:

The mean percentage change to potato yield with autonomous adaptation for RCP8.5 is 0% (range across climate models -33 to 20%; 1/18 climate models are outliers). This becomes mean 2%, range -26 to 20% after removing the lower limit outliers.

Robustness assessment:
Medium robustness. 1/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with

crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that potato yields will most likely decrease, with some studies suggesting yield increases being possible with CO2 fertilisation and adaptation both taken into account. There is substantial uncertainty over the size (and in some cases direction) of the yield change. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Groundnut

Calibrated Statement 1:

The mean percentage change to groundnut yield with no adaptation for RCP8.5 is -23% (range across climate models -32 to -15%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the change ranges from about 10% to -30%. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 2:

The mean percentage change to groundnut yield with autonomous adaptation for RCP8.5 is -13% (range across climate models -23 to -5%; 0/18 climate models are outliers).

Robustness assessment:

Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the decrease ranges from not much change to -30%. iFEED results agree, hence high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

<u>Calibrated Statement 3:</u>

The mean benefit of adaptation for groundnut for RCP8.5 is 10% of baseline yields (range across climate models 6 to 16%; 1/18 climate models are outliers). This becomes mean 9%, range 6 to 16% after removing the upper limit outliers.

Robustness assessment:
Medium robustness. 1/18 climate models are outliers, and there is some uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g. CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Few groundnut studies quantify the benefit of adaptation on yields. The Challinor et al. 2014 meta-analysis suggests that in general, adaptation benefits could range from 7-15%, although this is not specific to groundnut. Some groundnut studies suggest a 0-16% benefit. This overlaps with the range shown by iFEED.

Confidence Assessment:
High confidence (medium robustness and high agreement).

<u>Calibrated Statement 4:</u>

The mean percentage change to groundnut yield with irrigation increases in future for RCP8.5 is -20% (range across climate models -30 to -12%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across

crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the decrease ranges from not much change to -30%. This uncertainty is reflected in iFEED results. Challinor et al. 2014 report a benefit from irrigation that is in agreement with the iFEED projections (i.e. < 10%). Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

High Climate Risk (RCP8.5) / high market efficacy (HT)

Maize

Calibrated Statement 1:

The mean percentage change to maize yield with irrigation increases in future for RCP8.5 is -22% (range across climate models -32 to -12%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means high robustness with respect to climate model uncertainty; there is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:
Medium agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation but still decline. The Challinor et al. 2014 meta-analysis shows 7-15% adaptation benefit, and benefits with irrigation similar to iFEED projections. The mean change projected is slightly lower than the meta-analysis average change, hence medium agreement.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Calibrated Statement 2:

The mean percentage change to maize yield with adaptation to negate warming-induced growing season reduction for RCP8.5 is 13% (range across climate models 3 to 22%; 2/18 climate models are outliers). This becomes mean 15%, range 5 to 22% after removing the lower limit outliers.

Robustness assessment:
Medium robustness. 2/18 climate models are outliers, which means medium robustness with respect to climate model uncertainty; there is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:
Medium agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation; there is uncertainty over how large this benefit is. E.g. the Challinor et al. 2014 meta-analysis shows figures of 7-15% in general for adaptation, but for cultivar adjustment in particular the benefit cold be higher than 20%. The positive yield change with this adaptation is also seen in many studies in the meta-analysis, although the mean change is negative. The cultivar adjustment adaptation benefit range in Challinor et al. 2014 overlaps with the range from iFEED, although iFEED projections indicate that the benefit (upwards of 30%), is on the high side of other studies, therefore medium agreement.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Soybean

Calibrated Statement 1:

The mean percentage change to soybean yield with autonomous adaptation for RCP8.5 is -11% (range across climate models -21 to 11%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:

High agreement. Literature suggests that soybean yields could increase or decrease, largely depending on the uncertainty due to rainfall and the impact of CO2 fertilisation. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Potato

Calibrated Statement 1:

The mean percentage change to potato yield with autonomous adaptation for RCP8.5 is 0% (range across climate models -33 to 20%; 1/18 climate models are outliers). This becomes mean 2%, range -26 to 20% after removing the lower limit outliers.

Robustness assessment:
Medium robustness. 1/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that potato yields will most likely decrease, with some studies suggesting yield increases being possible with CO2 fertilisation and adaptation both taken into account. There is substantial uncertainty over the size (and in some cases direction) of the yield change. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Groundnut

Calibrated Statement 1:

The mean percentage change to groundnut yield with irrigation increases in future for RCP8.5 is -20% (range across climate models -30 to -12%; 0/18 climate models are outliers).

Robustness assessment:

Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the decrease ranges from not much change to -30%. This uncertainty is reflected in iFEED results. Challinor et al. 2014 report a benefit from irrigation that is in agreement with the iFEED projections (i.e. < 10%). Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

<u>Calibrated Statement 2:</u>

The mean percentage change to groundnut yield with adaptation to negate warming-induced growing season reduction for RCP8.5 is 9% (range across climate models 4 to 17%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, and there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g. CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the change ranges from about 10% to -30%. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

South Africa Calibrated Statements

Table 7: summary of calibrated statement results and confidence assessments for South Africa, RCP2.6. Yield changes are averages across climate models, with mean and range shown excluding any outliers. Confidence assessment has robustness and agreement assessments in brackets respectively; L = low, M = medium, H = high confidence / robustness / agreement. Note that adaptation benefit is expressed as percentage point difference, in reference to baseline yields.

Crop and adaptation	Yield Change (%)	Confidence
Maize, no adaptation	-28 (-47, -14)	M (M, M)
Maize, auto. adaptation	-2 (-13, 11)	H (M, H)
Maize, adaptation benefit	24 (17, 34)	M (M, M)
Maize, duration fix	12 (0, 26)	M (M, M)
Maize, irrigation	-10 (-31, 7)	H (M, H)
Soybean, auto. adaptation	-3 (-18, 6)	H (M, H)
Potato, auto. adaptation	-3 (-13, 7)	H (M, H)
Groundnut, no adaptation	-24 (-38, -11)	H (M, H)
Groundnut, auto. adaptation	2 (-10, 13)	H (M, H)
Groundnut, adaptation benefit	26 (14, 37)	M (M, M)
Groundnut, duration fix	8 (-3, 18)	H (M, H)
Groundnut, irrigation	-14 (-28, -2)	H (M, H)

Low Climate Risk (RCP2.6) / low land reform (LT)

Maize

Calibrated Statement 1:

The mean percentage change to maize yield with no adaptation for RCP2.6 is -28% (range across climate models -47 to -14%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means highly robust with respect to climate model uncertainty; however, there is some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore, the robustness assessment has been downgraded to “medium”.

Agreement assessment:
Medium agreement. Many studies in the literature suggest that maize yields are likely to decline with climate change, and this decline is greater without any form of adaptation. Compared to the Challinor et al. (2014) meta-analysis of maize yield changes in tropical regions, the iFEED range overlaps, although this range is towards the lower end of the meta-analysis range.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Calibrated Statement 2:

The mean percentage change to maize yield with autonomous adaptation for RCP2.6 is -2% (range across climate models -13 to 11%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means highly robust with respect to climate model uncertainty; however, there is some uncertainty associated with crop model parameterisation (e.g. CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore, the robustness assessment has been downgraded to “medium”.

Agreement assessment:
High agreement. Many studies in the literature suggest that maize yields are likely to decline with climate change, even with some adaptation. The Challinor et al. (2014) meta-analysis shows a range of yield changes with adaptation that are entirely commensurate with the range produced by iFEED, including some possible yield gains at lower levels of warming, hence high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 3:

The mean benefit of adaptation for maize for RCP2.6 is 26% of baseline yields (range across climate models 17 to 38%; 2/18 climate models are outliers). This becomes mean 24%, range 17 to 34% after removing the upper limit outliers.

Robustness assessment:
Medium robustness. 2/18 climate models are outliers, which means medium robustness with respect to climate model uncertainty; there is also some uncertainty associated with crop model parameterisation (e.g. CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:

Medium agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation; there is uncertainty over how large this benefit is, but e.g. the Challinor et al. 2014 meta-analysis shows figures that overlap although are typically lower than shown here, hence medium agreement.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Soybean

Calibrated Statement 1:

The mean percentage change to soybean yield with autonomous adaptation for RCP2.6 is -3% (range across climate models -18 to 6%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that soybean yields could increase or decrease, largely depending on the uncertainty due to rainfall and the impact of CO_2 fertilisation. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Potato

Calibrated Statement 1:

The mean percentage change to potato yield with autonomous adaptation for RCP2.6 is -3% (range across climate models -13 to 7%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across

crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that potato yields will most likely decrease, with some studies suggesting yield increases being possible with CO2 fertilisation and adaptation both taken into account. There is substantial uncertainty over the size (and in some cases direction) of the yield change. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Groundnut

Calibrated Statement 1:

The mean percentage change to groundnut yield with no adaptation for RCP2.6 is -24% (range across climate models -38 to -11%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the range is from -30% to gains of greater than 10%. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 2:

The mean percentage change to groundnut yield with autonomous adaptation for RCP2.6 is 2% (range across climate models -10 to 13%; 0/18 climate models are outliers).

Robustness assessment:

Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the range is from -30% to gains of greater than 10%. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 3:

The mean benefit of adaptation for groundnut for RCP2.6 is 26% of baseline yields, (range across climate models 14 to 37%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, and there is some uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g. CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
Medium agreement. Few groundnut studies quantify the benefit of adaptation on yields. The Challinor et al. 2014 meta-analysis suggests that in general, adaptation benefits could range from 7-15%, although this is not specific to groundnut. The iFEED range is larger than the meta-analysis suggests, although overlaps with the benefits shown for cultivar adjustment.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Low Climate Risk (RCP2.6) / high land reform (HT)

Maize

Note that irrigation is not increased in the South Africa low climate risk scenarios. This information is included for completeness however.

Calibrated Statement 1:

The mean percentage change to maize yield with irrigation increases in future for RCP2.6 is -10% (range across climate models -31 to 7%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means highly robust with respect to climate model uncertainty; however, there is some uncertainty associated with crop model parameterisation (e.g. CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore, the robustness assessment has been downgraded to “medium”.

Agreement assessment:
High agreement. Many studies in the literature suggest that maize yields are likely to decline with climate change, even with some adaptation. The Challinor et al. (2014) meta-analysis shows a range of yield losses with adaptation that are entirely commensurate with the range produced by iFEED, hence high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 2:

The mean percentage change to maize yield with adaptation to negate warming-induced growing season reduction for RCP2.6 is 12% (range across climate models 0 to 26%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means high robustness with respect to climate model uncertainty; there is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:
Medium agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation; there is uncertainty over how large this benefit is. E.g. the Challinor et al. 2014 meta-analysis shows figures of 7-15% in general for adaptation, but for cultivar adjustment in particular the benefit could be higher than 20%. The positive yield change with this adaptation is also seen in many studies in the meta-analysis, although the mean change is negative. The cultivar adjustment adaptation benefit range in Challinor et al. 2014 overlaps with the range from iFEED, although iFEED projections indicate that the benefit (upwards of 30%), is on the high side of other studies, therefore medium agreement.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Soybean

Calibrated Statement 1:

The mean percentage change to soybean yield with autonomous adaptation for RCP2.6 is -3% (range across climate models -18 to 6%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that soybean yields could increase or decrease, largely depending on the uncertainty due to rainfall and the impact of CO2 fertilisation. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Potato

Calibrated Statement 1:

The mean percentage change to potato yield with autonomous adaptation for RCP2.6 is -3% (range across climate models -13 to 7%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that potato yields will most likely decrease, with some studies suggesting yield increases being possible with CO2 fertilisation and adaptation both taken into account. There is substantial uncertainty over the size (and in some cases direction) of the yield change. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Groundnut

Note that irrigation is not increased in the South Africa low climate risk scenarios. This information is included for completeness however.

Calibrated Statement 1:

The mean percentage change to groundnut yield with irrigation increases in future for RCP2.6 is -14% (range across climate models -28 to -2%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the decrease ranges from not much change to -30%. This uncertainty is reflected in iFEED results. Challinor et al. 2014 report a benefit from irrigation that is in agreement with the iFEED projections (i.e. <= 10%). Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 2:

The mean percentage change to groundnut yield with adaptation to negate warming-induced growing season reduction for RCP2.6 is 8% (range across climate models -3 to 18%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, and there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g. CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:

High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the range is from -30% to gains of greater than 10%. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Table 8: summary of calibrated statement results and confidence assessments for South Africa, RCP8.5. Yield changes are averages across climate models, with mean and range shown excluding any outliers. Confidence assessment has robustness and agreement assessments in brackets respectively; L = low, M = medium, H = high confidence / robustness / agreement. Note that adaptation benefit is expressed as percentage point difference, in reference to baseline yields.

Crop and adaptation	**Yield Change (%)**	**Confidence**
Maize, no adaptation	-43 (-59, -31)	M (M, M)
Maize, auto. adaptation	-4 (-23, 8)	H (M, H)
Maize, adaptation benefit	37 (31, 52)	L (M, L)
Maize, duration fix	14 (0, 29)	M (M, M)
Maize, irrigation	-27 (-43, -14)	M (M, M)
Soybean, auto. adaptation	-6 (-20, 2)	H (M, H)
Potato, auto. adaptation	-14 (-27, -2)	H (M, H)
Groundnut, no adaptation	-34 (-48, -22)	M (M, M)
Groundnut, auto. adaptation	2 (-17, 11)	H (M, H)
Groundnut, adaptation benefit	35 (24, 47)	L (M, L)
Groundnut, duration fix	10 (-7, 19)	H (M, H)
Groundnut, irrigation	-24 (-38, -11)	H (M, H)

High Climate Risk (RCP8.5) / low land reform (LT)

Maize

Calibrated Statement 1:

The mean percentage change to maize yield with no adaptation for RCP8.5 is -43% (range across climate models -59 to -31%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means highly robust with respect to climate model uncertainty; however, there is some uncertainty associated

with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore, the robustness assessment has been downgraded to “medium”.

Agreement assessment:
Many studies in the literature suggest that maize yields are likely to decline with climate change, and this decline is greater without any form of adaptation. However, the lower end of the range (ie -59%) is nearly an outlier when compared to the Challinor et al. (2014) meta-analysis of maize yield changes in tropical regions, which includes yield benefits under climate change. This suggests the wording “losses of upwards of 30%”, rather than the citing of the full range. That meta-analysis also reports yield increases even without adaptation. This is not surprising in itself, since the models in the meta-analysis have their own shortcomings, and span a long history of research and a range of environments. Overall, this suggests medium agreement.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Calibrated Statement 2:

The mean percentage change to maize yield with autonomous adaptation for RCP8.5 is -5% (range across climate models -26 to 8%; 1/18 climate models are outliers). This becomes mean -4%, range -23 to 8% after removing the lower limit outliers.

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means highly robust with respect to climate model uncertainty; however, there is some uncertainty associated with crop model parameterisation (e.g. CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore, the robustness assessment has been downgraded to “medium”.

Agreement assessment:
High agreement. Many studies in the literature suggest that maize yields are likely to decline with climate change, even with some adaptation. The Challinor et al. (2014) meta-analysis shows a range of yield losses with adaptation that are entirely commensurate with the range produced by iFEED, hence high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 3:

The mean benefit of adaptation for maize for RCP8.5 is 38% of baseline yields (range across climate models 31 to 55%; 1/18 climate models are outliers). This becomes mean 37%, range 31 to 52% after removing the upper limit outliers.

Robustness assessment:

Medium robustness. 1/18 climate models are outliers, which means high robustness with respect to climate model uncertainty; there is also some uncertainty associated with crop model parameterisation (e.g. CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:
Low agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation; there is uncertainty over how large this benefit is, but e.g. the Challinor et al. 2014 meta-analysis shows figures typically much lower than those given by the iFEED projections, hence low agreement.

Confidence Assessment:
Low confidence (medium robustness and low agreement).

Calibrated Statement 4:

The mean percentage change to maize yield with irrigation increases in future for RCP8.5 is -27% (range across climate models -43 to -14%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means high robustness with respect to climate model uncertainty; there is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:
Medium agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation but still decline. The Challinor et al. 2014 meta-analysis shows 7-15% adaptation benefit, and smaller benefits for irrigation than changing varieties, as iFEED projects. The mean change is lower than the typical change in the literature however, hence medium agreement.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Soybean

Calibrated Statement 1:

The mean percentage change to soybean yield with autonomous adaptation for RCP8.5 is -7% (range across climate models -21 to 2%; 2/18 climate models are outliers). This becomes mean -6%, range -20 to 2% after removing the lower limit outliers.

Robustness assessment:
Medium robustness. 2/18 climate models are outliers, and there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that soybean yields could increase or decrease, largely depending on the uncertainty due to rainfall and the impact of CO_2 fertilisation. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Potato

Calibrated Statement 1:

The mean percentage change to potato yield with autonomous adaptation for RCP8.5 is -14% (range across climate models -27 to -2%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that potato yields will most likely decrease, with some studies suggesting small yield increases being possible with CO_2 fertilisation and adaptation both taken into account. There is substantial uncertainty over the size (and in some cases direction) of the yield change. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Groundnut

Calibrated Statement 1:

The mean percentage change to groundnut yield with no adaptation for RCP8.5 is -34% (range across climate models -48 to -22%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
Medium agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the decrease ranges from not much change to -30%. This uncertainty is reflected in iFEED results, although some iFEED projections are more negative than the available literature.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Calibrated Statement 2:

The mean percentage change to groundnut yield with irrigation increases in future for RCP8.5 is -24% (range across climate models -38 to -11%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the decrease ranges from not much change to -30%. This uncertainty is reflected in iFEED results. Challinor et al. 2014 report a benefit from irrigation that is in agreement with the iFEED projections (i.e. c. 10%). Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 3:

The mean percentage change to groundnut yield with autonomous adaptation for RCP8.5 is 1% (range across climate models -19 to 11%; 1/18 climate models are outliers). This becomes mean 2%, range -17 to 11% after removing the lower limit outliers.

Robustness assessment:
Medium robustness. 1/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the decrease ranges from -30% to greater than 10% gains. iFEED results overlap with this range.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 4:

The mean benefit of adaptation for groundnut for RCP8.5 is 35% of baseline yields (range across climate models 24 to 47%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is some uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g. CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
Low agreement. Few groundnut studies quantify the benefit of adaptation on yields. The Challinor et al. 2014 meta-analysis suggests that in general, adaptation benefits could range from 7-15%, although this is not specific to groundnut. Groundnut-specific studies suggest gains of 0-16%. The range shown here is considerably larger though – hence low agreement.

Confidence Assessment:
Low confidence (medium robustness and low agreement).

High Climate Risk (RCP8.5) / high land reform (HT)

Maize

Calibrated Statement 1:

The mean percentage change to maize yield with irrigation increases in future for RCP8.5 is -27% (range across climate models -43 to -14%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means high robustness with respect to climate model uncertainty; there is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:
Medium agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation but still decline. The Challinor et al. 2014 meta-analysis shows 7-15% adaptation benefit, and smaller benefits for irrigation than changing varieties, as iFEED projects. The mean change is lower than the typical change in the literature however, hence medium agreement.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Calibrated Statement 2:

The mean percentage change to maize yield with adaptation to negate warming-induced growing season reduction for RCP8.5 is 14% (range across climate models 0 to 29%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, which means high robustness with respect to climate model uncertainty; there is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Overall, this suggests medium robustness.

Agreement assessment:
Medium agreement. Many studies in the literature suggest that maize yields are likely to benefit from adaptation; there is uncertainty over how large this benefit is. E.g. the Challinor et al. 2014 meta-analysis shows figures of 7-15% in general for adaptation,

but for cultivar adjustment in particular the benefit cold be higher than 20%. The positive yield change with this adaptation is also seen in many studies in the meta-analysis, although the mean change is negative. The cultivar adjustment adaptation benefit range in Challinor et al. 2014 overlaps with the range from iFEED, although iFEED projections indicate that the benefit (upwards of 30%), is on the high side of other studies, therefore medium agreement.

Confidence Assessment:
Medium confidence (medium robustness and medium agreement).

Soybean

Calibrated Statement 1:

The mean percentage change to soybean yield with autonomous adaptation for RCP8.5 is -7% (range across climate models -21 to 2%; 2/18 climate models are outliers). This becomes mean -6%, range -20 to 2% after removing the lower limit outliers.

Robustness assessment:
Medium robustness. 2/18 climate models are outliers, and there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that soybean yields could increase or decrease, largely depending on the uncertainty due to rainfall and the impact of CO_2 fertilisation. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Potato

Calibrated Statement 1:

The mean percentage change to potato yield with autonomous adaptation for RCP8.5 is -14% (range across climate models -27 to -2%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with

crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that potato yields will most likely decrease, with some studies suggesting small yield increases being possible with CO_2 fertilisation and adaptation both taken into account. There is substantial uncertainty over the size (and in some cases direction) of the yield change. This uncertainty is reflected in iFEED results. Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Groundnut

Calibrated Statement 1:

The mean percentage change to groundnut yield with irrigation increases in future for RCP8.5 is -24% (range across climate models -38 to -11%; 0/18 climate models are outliers).

Robustness assessment:
Medium robustness. 0/18 climate models are outliers, although there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g CO_2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the decrease ranges from not much change to -30%. This uncertainty is reflected in iFEED results. Challinor et al. 2014 report a benefit from irrigation that is in agreement with the iFEED projections (i.e. c. 10%). Overall, this suggests high agreement.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Calibrated Statement 2:

The mean percentage change to groundnut yield with adaptation to negate warming-induced growing season reduction for RCP8.5 is 9% (range across climate models -11 to 19%; 1/18 climate models are outliers). This becomes mean 10%, range -7 to 19% after removing the lower limit outliers.

Robustness assessment:
Medium robustness. 1/18 climate models are outliers, and there is large uncertainty across climate models. There is also some uncertainty associated with crop model parameterisation (e.g. CO2 and response to duration, which differ across crop models; and only one crop model was run here). Therefore this suggests medium robustness.

Agreement assessment:
High agreement. Literature suggests that groundnut yields will most likely decrease with climate change, although the decrease ranges from -30% to greater than 10% gains. iFEED results overlap with this range.

Confidence Assessment:
High confidence (medium robustness and high agreement).

Appendix 1: Simulation details and literature for agreement with iFEED results

Simulation details

- RCP2.6 = low climate risk; RCP8.5 = high climate risk.
- All yield change calculations use average yields across all grid cells in each country.
- Irrigation levels are constant at baseline levels for the yield change calculations.
- For the yield change calculations with increasing irrigation in future, irrigation in future is 0.1, with the same planting windows and varieties as the baseline assumed.
- Different adaptation options are also explored for maize and groundnut as these crops showed a systematic reduction in growing season length due to warming.
- No adaptation = same planting dates and crop varieties as the baseline.
- Auto. adaptation = autonomous adaptation, meaning allowing shifting planting dates and crop varieties in the future. Crop varieties are restricted to those available in the baseline. Varieties are defined by different maturity times only.
- Duration fix = allowing crop varieties that compensate for any warming-induced fall in the length of the growing season.

In the low technology / ineffective agricultural policy / ineffective markets / low land reform scenarios, simulations assume a form of autonomous adaptation, where crop varieties are allowed to vary but are restricted to those available in the baseline, and planting dates are allowed to vary. Also presented here by way of contrast are results and calibrated statements if no adaptation is allowed – i.e. the same planting dates and varieties are used in 2050. The benefits of this autonomous adaptation are also discussed.

In the high technology / effective agricultural policy / effective markets / high land reform scenarios, simulations are used that compensate for any warming-induced reduction to the length of crop growing seasons. This occurred for maize and groundnut, and these simulations are referred to as “duration fix”. Autonomous adaptation simulations that use the same crop varieties as the baseline are used in all other scenarios (and in all scenarios for potato and soybean).

Irrigation is increased for the high technology / high market efficacy / effective policy futures in Tanzania, Zambia and Malawi respectively. Irrigation is also increased in the Zambia low market efficacy / high climate risk future. In South Africa, irrigation is increased in both of the high climate risk scenarios.

Although not included in the results and calibrated statements in this document, technology trends are applied to yield projections in the food production analysis for the high technology / effective agricultural policy / effective market scenarios in Tanzania, Malawi and Zambia respectively. This assumes the same percentage changes to yields that occurred from 1961 to 2010 happen from 2000 to 2050. This means that an average yield improvement of 164% for maize, 267% for soybean, 240% for potato and 69% for groundnut is applied in these scenarios. Half of this yield improvement is assumed for all scenarios in South Africa. The calibrated statements in this document detail the various climate change impacts for each crop, given the specific adaptation options that are applicable to each scenario, and do not take into account these technology trends.

Note that for the summary calibrated statements, confidence levels are based on the most common confidence level given in the underlying calibrated statements for each crop and adaptation option for each scenario. If an equal number of medium and high confidence assessments the summary calibrated statement for a scenario, expert judgement is used to decide which of the two confidence levels is most appropriate, given the summary conclusions being made.

Yield projection literature summary and ranges used for making agreement assessments

Maize

- 0-20% decline for tropical maize is typical according to Challinor et al. 2014. However the range across studies is very broad, from 30% gains with adapt to -60% decline in some cases
- Adhikari et al. 2015 cite a 6-13% range.
- Based on Challinor et al. 2014, the adaptation benefit is typically 7-15%, although this varies by as much as 0-43% for cultivar adjustment. Irrigation benefits typically 0-10% (see SI figure 9).

Soybean

- Adhikari et al. 2015 cite a possible -20 to +57% range. This highly depends on rainfall - some highland areas could see increases in yields, but most production is in lowland areas, and therefore yield is expected to decline slightly for most scenarios.
- C. -20 to +20% range cited by Foyer et al. 2018.
- Rose et al. 2016 suggests yield losses for soybean (globally) upwards of 30% without adaptation, and not much change with adaptation in some countries. In other countries still negative yield change after adaptation.
- Osborne et al. 2013 suggests global yield change from -43 + 10%, with mean adaptation benefit globally of 26% (24 - 28% range). By country, the adaptation benefit range is from c. 0 to > 40%. In South Africa, yield change without adaptation is c. -50%, and the adaptation benefit is c. 40%.
- Total range across studies is -50 to + 57%. More commonly cited changes range from +/-20%.
- Adaptation benefits range from 0 to 40%.

Groundnut

- Schlenker and Lobell, 2010, suggest mean fall of c. 18%. -30-40% is worst case scenario in South Africa. best case scenario is 0-10% yield increase for certain African countries.
- Waha et al., 2013, suggests without adaptation, -12 to -38% yield decline, and -12 to -32 with adaptation; adaptation benefits from 0-12%.
- Laux et al. 2010 suggests adapt benefits as high as 16%. Yield increase could be 30% by 2020s if adapting and CO_2 fertilisation taken into account.
- Overall range is therefore -40 to +30. More typical range is -30 to + 10% (i.e. the range where multiple studies overlap).
- Adaptation benefit typical range is therefore 0-16%. Supplementing this with Challinor et al. adaptation benefits, given the paucity of groundnut-specific evidence – this suggests a 0-43% increase from cultivar adjustment is possible, and a 0-10% increase for irrigation.

Potato

- Haverkort et al., 2013, suggest that the positive impact of CO_2 fertilisation outweighs negative climate change impacts in South Africa (i.e. positive yield change) - yield increases of > 50% reported.
- Jarvis et al., 2012, project a 15% fall in **SUITABILITY** by 2030. This is from -6.5 to -22.9 (mean -14.7).
- Tatsumi et al., 2011, suggests 42.5% decline in southern Africa by 2090s compared to 2010.
- Hijmas 2003: globally, 18-32% decrease in 2050s without adaptation, 9-18% decrease. By country (none in Africa though), adaptation benefits range from 1% to 68%. By country (none in Africa though), yield changes range from -38 to +77%.

- Jennings et al. 2020, southern Africa mostly sees yield declines, although some difference in South Africa (southern and western areas, i.e. the more marginal areas show increase in yields; better growing areas show decreases). These declines are more than 50% in some areas. 9-20% global increase reported in this paper. Adaptation benefits of 10-17% globally. Most grid cells in southern Africa are in the +25 to -50% range.
- Raymundo et al. 2018, global yield decline of 5.6% by 2050. Most grid cells in southern Africa seem to be in the 0-50% decline range.
- Overall range is therefore somewhere in the region of +/- 50%.
- There isn't really a typical range, as many studies suggest large decreases and large increases in yields.

References

1. Adhikari et al., 2015, Climate change and eastern Africa: a review of impact on major crops, Food and Energy Security.
2. Challinor et al., 2014, A meta-analysis of crop yield under climate change and adaptation, Nature Climate Change
3. Foyer et al., 2018, Modelling predicts that soybean is poised to dominate crop production across Africa, Plant, Cell & Environment.
4. Rose et al., 2016, Impact of progressive global warming on the global-scaleyield of maize and soybean, Climate Change
5. Osborne et al., 2013, Variation in the global-scale impacts of climate change on crop productivity due to climate model uncertainty and adaptation, Ag. & Forest Met.
6. Schlenker and Lobell, 2010, Robust negative impacts of climate change onAfrican agriculture, ERL
7. Waha et al., 2013, Adaptation to climate change through the choice of cropping system and sowing date in sub-Saharan Africa, Global Environmental Change
8. Laux et al., 2010, Impact of climate change on agricultural productivity under rainfed conditions in Cameroon—A method to improve attainable crop yields by planting date adaptations, AFM
9. Haverkort et al. 2013, Climate change and potato production in contrasting South African agro-ecosystems2. Assessing risks and opportunities of adaptation strategies, Potato Research
10. Tatsumi et al., 2011, Estimation of potential changes in cereals production under climate change scenarios, Hydrological Processes.
11. Jarvis et al., 2012, Is cassava the answer to African climate change adaptation? Tropical Plant Biology
12. Jennings et al., 2020, Global potato yields increase under climate change with adaptation and CO2 fertilisation, Frontiers in Sustainable Food Systems
13. Hijmans, 2003, The Effect of Climate Change on Global Potato Production, American Journal of Potato Research
14. Raymundo et al., 2018, Climate change impact on global potato production, European Journal of Agronomy.