Implication statements – Rural Livelihoods

Malawi

4a Climate and extremes

1. Increased demand on extension services - particularly for climate and weather forecasting information
2. See statements for 4b-4h

4b Climate impacts

Low Climate / Low Tech

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.

1. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
3. Reductions in maize yields will likely lead to diversification to alternative staple starch food sources e.g. cassava, potato, rice, wheat etc.

High Climate / Low Tech

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.

1. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
3. Reductions in maize yields will likely lead to diversification to alternative staple starch food sources e.g. cassava, potato, rice, wheat etc

Low Climate / High Tech

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.

1. If markets are inclusive and sustainable, yield increases may raise incomes
2. If markets are not inclusive or sustainable, yield increases have limited impacts on incomes

High Climate / High Tech

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.

1. If markets are inclusive and sustainable, yield increases may raise incomes
2. If markets are not inclusive or sustainable, yield increases have limited impacts on incomes

4c Crop pests

Low Climate / Low Tech

CS1: 20-40% loss due to pests and diseases (Yengoh 2012), ~25% (±5) mean reduced yield compared to (Kravchenko et al. 2017)

1. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
3. There would be increased demand on extension services, particularly for (chemical) crop pest and disease management practices and/or biocontrol measures
4. There would be increased demand for R&D on biocontrol measures
5. Increase in pests/diseases will lead to an increased reliance/need for pesticides, herbicides and fungicides
6. Increased need for chemical control has multiple implications:
    a. Technologies may not reach all households
    b. Not all households can afford to purchase inputs
    c. Not all farmers are able/prepared to use them
    d. Gendered inequality exacerbated as women typically have less access to inputs than men
7. There is potential for inequality to rise, as upscaling of pest/disease control technologies does not reach all households and/or households cannot access or afford technologies
8. Potentially high levels of pollution associated with of chemical usage which may result in pollution of water bodies affecting communities such as those downstream of irrigation schemes. This may include impacts on fisheries resources and those whose livelihoods depend on that.
9. If agriculture becomes unviable (e.g. too expensive, too labour intensive, or successive pest/disease outbreaks), we may expect an increased need to diversify away either a) from agriculture, or b) to alternative crops
10. Increased use of chemical inputs has negative impacts on human health and the environment/biodiversity which could prompt the need for stringent policy guidance to go with the increase in the demand for chemical technologies (be it the actual chemicals or associated extension services)
11. The risk to human health as a result of (unsafe) use of chemicals may also be gendered given the gender dimension of the agricultural labour structure as well as access to safety measures.
12. Agricultural livelihood outcomes (income, food security) dependent on ability to adapt e.g. availability of / affordability of inputs (pesticides/fungicides, seed varieties, labour requirements for adaptation/adoption), knowledge of new practices
13. Livelihood opportunities generated if pest-resistant crops can be propagated / biocontrol measures can be produced and sold locally

CS2: Increased impact of diseases on livestock production

1. Loss of livestock is likely to lead to income loss, undermining household resilience and increasing financial vulnerability
2. Loss of livestock likely to lead to increased food insecurity
3. There would be increased demand on extension services, particularly for veterinary services
4. Veterinary services and medicines may not reach all households, and/or not all households can afford to purchase services/medicines
5. Gendered inequality exacerbated as women typically have less access to services than men
6. There is potential for inequality to rise, as upscaling of livestock disease control technologies does not reach all households and/or households cannot access or afford technologies

7. If livestock becomes unviable (e.g. too expensive, too labour intensive, or successive pest/disease outbreaks), we may expect an increased need to diversify away either a) from agriculture, or b) to alternative crops
8. Loss of livestock reduces manure, leading to lower crop production (potentially reducing incomes and/or increasing food insecurity)

High Climate / Low Tech

CS1: Increased pest and disease prevalence

1. There would be increased demand on extension services, particularly for (chemical) crop pest and disease management practices
2. Increase in pests/diseases (and limited effectiveness of biocontrol) will lead to an increased reliance/need for pesticides, herbicides and fungicides
3. Increased need for chemical control has multiple implications:
    a. Technologies may not reach all households
    b. Not all households can afford to purchase inputs
    c. Not all farmers are able/prepared to use them
    d. Gendered inequality exacerbated as women typically have less access to inputs than men
4. There is potential for inequality to rise, as upscaling of pest/disease control technologies does not reach all households and/or households cannot access or afford technologies
5. Potentially high levels of pollution associated with of chemical usage which may result in pollution of water bodies affecting communities such as those downstream of irrigation schemes. This may include impacts on fisheries resources and those whose livelihoods depend on that.
6. Increased use of chemical inputs has negative impacts on human health and the environment/biodiversity which could prompt the need for stringent policy guidance to go with the increase in the demand for chemical technologies (be it the actual chemicals or associated extension services)
7. The risk to human health as a result of (unsafe) use of chemicals may also be gendered given the gender dimension of the agricultural labour structure as well as access to safety measures.
8. Agricultural livelihood outcomes (income, food security) dependent on ability to adapt e.g. availability of / affordability of inputs (pesticides/fungicides, seed varieties, labour requirements for adaptation/adoption), knowledge of new practices
9. Livelihood opportunities generated if pest-resistant crops can be propagated / biocontrol measures can be produced and sold locally

CS2: Yield losses due to crop pests and diseases

1. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
3. If agriculture becomes unviable (e.g. too expensive, too labour intensive, or successive pest/disease outbreaks), we may expect an increased need to diversify away either a) from agriculture, or b) to alternative crops

Low Climate / High Tech

CS1: Increased pest prevalence due to reduced biological control.

1. There would be increased demand on extension services, particularly for (chemical) crop pest and disease management practices
2. Increase in pests/diseases (and limited effectiveness of biocontrol) will lead to an increased reliance/need for pesticides, herbicides and fungicides
3. Increased need for chemical control has multiple implications:
    a. Technologies may not reach all households
    b. Not all households can afford to purchase inputs
    c. Not all farmers are able/prepared to use them

    d. Gendered inequality exacerbated as women typically have less access to inputs than men
4. There is potential for inequality to rise, as upscaling of pest/disease control technologies does not reach all households and/or households cannot access or afford technologies
5. Potentially high levels of pollution associated with of chemical usage which may result in pollution of water bodies affecting communities such as those downstream of irrigation schemes. This may include impacts on fisheries resources and those whose livelihoods depend on that.
6. Increased use of chemical inputs has negative impacts on human health and the environment/biodiversity which could prompt the need for stringent policy guidance to go with the increase in the demand for chemical technologies (be it the actual chemicals or associated extension services)
7. The risk to human health as a result of (unsafe) use of chemicals may also be gendered given the gender dimension of the agricultural labour structure as well as access to safety measures.
8. Agricultural livelihood outcomes (income, food security) would become more dependent on ability to adapt e.g. availability of / affordability of inputs (pesticides/fungicides, seed varieties, labour requirements for adaptation/adoption), knowledge of new practices

CS2: 2-5 % yield loss if heterogeneous agriculture-natural landcover is converted to simplified homogenised production systems.

1. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
3. If agriculture becomes unviable (e.g. too expensive, too labour intensive, or successive pest/disease outbreaks), we may expect an increased need to diversify away either a) from agriculture, or b) to alternative crops

High Climate / High Tech

CS1: exacerbated impacts of pests and diseases, The yield losses in this scenario could be: ~32% (20-57) yield loss due to CPD as a result of climate + 2-5 % yield loss due to reduced pest suppression under homogenisation.

1. There would be increased demand on extension services, particularly for (chemical) crop pest and disease management practices
2. Increase in pests/diseases (and limited effectiveness of biocontrol) will lead to an increased reliance/need for pesticides, herbicides and fungicides
3. Increased need for chemical control has multiple implications:
    a. Technologies may not reach all households
    b. Not all households can afford to purchase inputs
    c. Not all farmers are able/prepared to use them
    d. Gendered inequality exacerbated as women typically have less access to inputs than men
4. There is potential for inequality to rise, as upscaling of pest/disease control technologies does not reach all households and/or households cannot access or afford technologies
5. Increased use of chemical inputs has negative impacts on human health and the environment/biodiversity which could prompt the need for stringent policy guidance to go with the increase in the demand for chemical technologies (be it the actual chemicals or associated extension services)
6. The risk to human health as a result of (unsafe) use of chemicals may also be gendered given the gender dimension of the agricultural labour structure as well as access to safety measures.
7. Potentially high levels of pollution associated with of chemical usage which may result in pollution of water bodies affecting communities such as those downstream of irrigation

schemes. This may include impacts on fisheries resources and those whose livelihoods depend on that.

8. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
9. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
10. If agriculture becomes unviable (e.g. too expensive, too labour intensive, or successive pest/disease outbreaks), we may expect an increased need to diversify away either a) from agriculture, or b) to alternative crops
11. Agricultural livelihood outcomes (income, food security) dependent on ability to adapt e.g. availability of / affordability of inputs (pesticides/fungicides, seed varieties, labour requirements for adaptation/adoption), knowledge of new practices
12. Livelihood opportunities generated if pest-resistant crops can be propagated / biocontrol measures can be produced and sold locally

4d Emissions and soils

Applicable to all Scenarios

1.With increased GHG emissions (or to meet the reductions), it is possible that mitigation-focussed CSA may increase, e.g. increase in 'payment for ecosystem services'-type programmes, with potential income for agricultural households/farmers, e.g. to plant trees

2.There would be increased demand on extension services (e.g. forestry/agroforestry).

3.There is potential for inequality to rise, as upscaling of mitigation technologies does not reach all households and/or households cannot access or afford technologies

4. Labour demand/costs increase for farmer to improve soil organic carbon stocks

5. The high tech scenarios are associated with substantial declines in the 'emission intensity'. This high tech may imply 'greener-technology', thus providing access to better storage and agro-processing both of which would be key for cutting postharvest losses and adding value to agricultural products [that could offset some of the negative impacts of the increase in pests and diseases noted above]

4e Food production

Assumption of expansion of land use> huge implications for remaining woodlands and Ecosystem Service (ES) provision> See this paper on miombo woodlands and ES (almost all natural woodlands in Malawi are miombo, but miombo are often not considered 'forestland' as they have a relatively sparse structure, so often fall under the categorisation threshold for forests/woodlands:

https://royalsocietypublishing.org/doi/10.1098/rstb.2015.0312

Low Climate / Low Tech

CS1: The mean percentage change to crop production with RCP2.6, scenario lt is -1% (range across climate models -16 to 11%; 0/18 climate models are outliers).

1. Minor yield losses alongside population growth would still likely result in larger and inequitable per-capita losses.
2. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
3. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
4. Continued dominance of maize may contribute to low diet diversity – with detrimental health impacts expected, particularly for children, mothers and vulnerable and poor populations
5. With continued dominance of maize, we may expect minimal livelihood resilience, owing to less-diverse cropping opportunities (limiting risk spreading)

6. With continued dominance of maize, we may expect minimal opportunities for on-farm income generation (e.g. market saturation with maize hence low prices)

CS2: The mean percentage change to livestock meat production with RCP2.6, scenario lt is -1% (range across climate models -17 to 9%; 1/18 climate models are outliers). This becomes mean -1%, range -13 to 9% after removing the lower limit outliers.

1. Minor production losses alongside population growth would still likely result in larger and inequitable per-capita losses.
2. Increased meat/dairy consumption/demand would need to rely on imports
    a. Imported meat/dairy is unlikely to be affordable for all households, so consumption will be inequitable, with the poorest most affected by high prices, and likely to lead to increased food & nutrition insecurity amongst financially poorer members of society
3. Reductions in meat production for income generation are likely to lead to income loss, undermining household resilience and increasing financial vulnerability

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

1. Increased meat/dairy consumption/demand would need to rely on imports
    a. Imported meat/dairy is unlikely to be affordable for all households, so consumption will be inequitable, with the poorest most affected by high prices, and likely to lead to increased food & nutrition insecurity amongst financially poorer members of society

High Climate / Low Tech

CS1: The mean percentage change to crop production with RCP8.5, scenario lt is -14% (range across climate models -26 to -7%; 0/18 climate models are outliers).

1. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
3. Continued dominance of maize may contribute to low diet diversity – with detrimental health impacts expected, particularly for children, mothers and vulnerable and poor populations
4. With continued dominance of maize, we may expect minimal livelihood resilience, owing to less-diverse cropping opportunities (limiting risk spreading)
5. With continued dominance of maize, we may expect minimal opportunities for on-farm income generation
6. Land conflicts expected to increase with decline of arable/pasture land e.g. between livestock and crop production / between conservation/tourism and agriculture
7. Decline in environmental sustainability/health would be expected alongside the 10% reduction of arable/pasture land, with reductions in ecosystem services (regulating/ provisioning/ cultural/ supporting)
8. With decline of arable/pasture land, inequitable land access and insecure land tenure will result in increased rural vulnerabilities, exacerbate poverty and increase social inequalities
9. Reduced irrigation would limit crop diversification, presumably restricted to areas already under irrigation e.g. Shire basin / Lake Malawi basin (so localised impacts, rather than national)

CS2: The mean percentage change to livestock meat production with RCP8.5, scenario lt is -13% (range across climate models -25 to -7%; 1/18 climate models are outliers). This becomes mean -13%, range -24 to -7% after removing the lower limit outliers.

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

1. Reductions in meat/dairy production for income generation is likely to lead to income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in meat/dairy production for subsistence use/own consumption is likely to lead to increased food & nutrition insecurity
3. Increased need for veterinary services (to deal with potential increase in disease / heat stress)
4. Increased meat/dairy consumption/demand would need to rely on imports
    a. Imported meat/dairy is unlikely to be affordable for all households, so consumption will be inequitable, with the poorest most affected by high prices, and likely to lead to increased food & nutrition insecurity amongst financially poorer members of society

Low Climate / High Tech

IS applicable to all CS in this Scenario Quadrant:

1. Land conflicts expected to increase with expansion of agricultural land e.g. between livestock and crop production / between conservation/tourism and agriculture between agricultural and energy (e.g. hydro)
2. Decline in environmental sustainability/health would be expected, with reductions in ecosystem services (regulating/provisioning/cultural/supporting)
3. There would be increased need for robust cross-sectoral planning and regulation for land and resources (e.g. water, energy, mining/minerals, biodiversity etc.)
4. There would be increased need for infrastructural development, particularly for agricultural services e.g. storage, processing and transportation
5. With expansion of agriculture/pasture, inequitable land access and insecure land tenure will result in increased rural vulnerabilities, exacerbate poverty and increase social inequalities
6. Water conflicts expected to increase between agricultural users and downstream consumers including transboundary escalation (e.g. Lower Shire River Basin and Zambezi river into Mozambique), including conflicts between livestock and crop production needs

CS1: The mean percentage change to crop production with RCP2.6, scenario ht is 728% (range across climate models 676 to 759%; 1/18 climate models are outliers). This becomes mean 731%, range 676 to 759% after removing the lower limit outliers.

1. There would be increased demand on extension services (e.g. agricultural).
2. If market opportunities are inclusive and sustainable, yield increases may increase incomes for small-scale farmers
3. With higher food availability, there is potential for food prices to decline and affordability to increase
4. Increased crop diversity enhances opportunities for on-farm income generation
5. We may expect increased livelihood resilience, owing to diverse cropping opportunities (risk spreading)
6. With increased crop diversity, we may expect an increased availability of nutritionally-diverse food crops
7. There is potential for inequality to rise, as upscaling of agricultural technologies does not reach all households and/or households cannot access or afford technologies
8. Increased food production will require development of infrastructure for storage and processing to cut post-harvest losses and improve the value of agricultural commodities.

9. This could create further inequalities and, on the flip side, create more opportunities for diversifying away from agriculture (essentially still agriculture but more of agro-processing rather than dependence on own farm production)

CS2: The mean percentage change to livestock meat production with RCP2.6, scenario ht is 151% (range across climate models 130 to 160%; 1/18 climate models are outliers). This becomes mean 152%, range 137 to 160% after removing the lower limit outliers.

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

1. There would be increased demand on extension services (e.g. veterinary).
2. If market opportunities are inclusive and sustainable, production increases may increase incomes for small-scale farmers
3. Increased availability of meat and dairy products will enhance nutrition outcomes
4. Income generating opportunities in the meat and dairy sector and value chains increase
5. Increased livestock production would entail an increase in emissions and therefore measures would have to be taken across other sectors to offset the emissions and make the sector less carbon/emission intensive.
6.

High Climate / High Tech

IS applicable to all CS in this Scenario Quadrant:

1. Land conflicts expected to increase with expansion of agricultural land e.g. between livestock and crop production / between conservation/tourism and agriculture between agricultural and energy (e.g. hydro)
2. Decline in environmental sustainability/health would be expected, with reductions in ecosystem services (regulating/provisioning/cultural/supporting)
3. There would be increased need for robust cross-sectoral planning and regulation for land and resources (e.g. water, energy, mining/minerals, biodiversity etc.)
4. There would be increased need for infrastructural development, particularly for agricultural services e.g. storage, processing and transportation
5. With expansion of agriculture/pasture, inequitable land access and insecure land tenure will result in increased rural vulnerabilities, exacerbate poverty and increase social inequalities
6. Water conflicts expected to increase between agricultural users and downstream consumers including transboundary escalation (e.g. Lower Shire River Basin and Zambezi river into Mozambique), including conflicts between livestock and crop production needs

CS1: The mean percentage change to crop production with RCP8.5, scenario ht is 719% (range across climate models 675 to 745%; 1/18 climate models are outliers). This becomes mean 722%, range 681 to 745% after removing the lower limit outliers.

1. There would be increased demand on extension services (e.g. agricultural).
2. If market opportunities are inclusive and sustainable, yield increases may increase incomes for small-scale farmers
3. With higher food availability, there is potential for food prices to decline and affordability to increase
4. Increased crop diversity enhances opportunities for on-farm income generation
5. We may expect increased livelihood resilience, owing to diverse cropping opportunities (risk spreading)
6. With increased crop diversity, we may expect an increased availability of nutritionally-diverse food crops
7. There is potential for inequality to rise, as upscaling of agricultural technologies does not reach all households and/or households cannot access or afford technologies
8. Increased food production will require development of infrastructure for storage and processing to cut post-harvest losses and improve the value of agricultural commodities.

9. This could create further inequalities and, on the flip side, create more opportunities for diversifying away from agriculture (essentially still agriculture but more of agro-processing rather than dependence on own farm production)

CS2: The mean percentage change to livestock meat production with RCP8.5, scenario ht is 152% (range across climate models 133 to 160%; 2/18 climate models are outliers). This becomes mean 154%, range 143 to 160% after removing the lower limit outliers.

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

1. Increased need for veterinary services (e.g., to deal with potential increase in disease / heat stress)
2. If market opportunities are inclusive and sustainable, production increases may increase incomes for small-scale farmers
3. Increased availability of meat and dairy products will enhance nutrition outcomes
4. Income generating opportunities in the meat and dairy sector and value chains increase
5. Increased livestock production would entail an increase in emissions and therefore measures would have to be taken across other sectors to offset the emissions and make the sector less carbon/emission intensive.

4f Irrigation

Low Climate / Low Tech

CS3: The mean percentage change to irrigation water with RCP2.6, scenario lt is 13% (range across climate models -20 to 33%; 1/18 climate models are outliers). This becomes mean 15%, range -17 to 33% after removing the lower limit outliers.

Increased irrigation means that water conflicts are expected to increase between agricultural users and downstream consumers including transboundary escalation (e.g. Lower Shire River Basin and Zambezi river into Mozambique), including conflicts between livestock and crop production needs / hydro-electric generation

The potential that sustainable irrigation has to offset yield losses due to climate change is not realised.

High Climate / Low Tech

CS3: The mean percentage change to irrigation water with RCP8.5, scenario lt is 5% (range across climate models -17 to 38%; 0/18 climate models are outliers).

Reduced irrigation areas would limit crop diversification, presumably restricted to areas already under irrigation e.g. Shire basin / Lake Malawi basin (so localised impacts, rather than national)

Slight increase in irrigation (presumably intensification of areas already irrigated, if overall area irrigated has declined by 10%) means that water conflicts are expected to increase between agricultural users and downstream consumers including transboundary escalation (e.g. Lower Shire River Basin and Zambezi river into Mozambique), including conflicts between livestock and crop production needs / hydro-electric generation

The potential that sustainable irrigation has to offset yield losses due to climate change is not realised.

Low Climate / High Tech

CS3: The mean percentage change to irrigation water with RCP2.6, scenario ht is 1136% (range across climate models 756 to 1506%; 0/18 climate models are outliers).

1. Land conflicts expected to increase with expansion of agricultural land e.g. between livestock and crop production / between conservation/tourism and agriculture between agricultural and energy (e.g. hydro)
2. Decline in environmental sustainability/health would be expected, with reductions in ecosystem services (regulating/provisioning/cultural/supporting)
3. There would be increased need for robust cross-sectoral planning and regulation for land and resources (e.g. water, energy, mining/minerals, biodiversity etc.)
4. There would be increased need for infrastructural development, particularly for agricultural services e.g. storage, processing and transportation
5. With expansion of agriculture/pasture, inequitable land access and insecure land tenure will result in increased rural vulnerabilities, exacerbate poverty and increase social inequalities
6. Water conflicts expected to increase between agricultural users and downstream consumers including transboundary escalation (e.g. Lower Shire River Basin and Zambezi river into Mozambique), including conflicts between livestock and crop production needs
7. There would be increased demand on extension services (e.g. agricultural/irrigation).
8. There is potential for inequality to rise, as upscaling of irrigation technologies does not reach all households and/or households cannot access or afford technologies
9. The risk of pests could also entail high usage of chemicals which may lead to pollution and diminishing water quality and fisheries resources downstream of irrigation schemes
10. There would be need for integrating technologies to achieve water use efficiency and limit the pressure posed on water resources by the increase in irrigation water use. Climate smart technology could help reduce irrigation water demand.
11. Conflicts may also arise from the choice of crops to be grown under irrigation. High value crops may be sought which may create deficits in other crops with them consequently becoming more expensive and less accessible by those that cannot afford to grow (under the irrigation technologies) or buy. New sugar producing factories in Salima have for instance prompted farmers to opt for sugarcane (for sale at the sugar company) over rice.
12.

High Climate / High Tech

CS3: The mean percentage change to irrigation water with RCP8.5, scenario ht is 1130% (range across climate models 817 to 1668%; 1/18 climate models are outliers). This becomes mean 1098%, range 817 to 1584% after removing the upper limit outliers.

1. Land conflicts expected to increase with expansion of agricultural land e.g. between livestock and crop production / between conservation/tourism and agriculture between agricultural and energy (e.g. hydro)
2. Decline in environmental sustainability/health would be expected, with reductions in ecosystem services (regulating/provisioning/cultural/supporting)
3. There would be increased need for robust cross-sectoral planning and regulation for land and resources (e.g. water, energy, mining/minerals, biodiversity etc.)
4. There would be increased need for infrastructural development, particularly for agricultural services e.g. storage, processing and transportation
5. With expansion of agriculture/pasture, inequitable land access and insecure land tenure will result in increased rural vulnerabilities, exacerbate poverty and increase social inequalities
6. Water conflicts expected to increase between agricultural users and downstream consumers including transboundary escalation (e.g. Lower Shire River Basin and Zambezi river into Mozambique), including conflicts between livestock and crop production needs
7. There would be increased demand on extension services (e.g. agricultural/irrigation).
8. There is potential for inequality to rise, as upscaling of irrigation technologies does not reach all households and/or households cannot access or afford technologies
9. The risk of pests could also entail high usage of chemicals which may lead to pollution and diminishing water quality and fisheries resources downstream of irrigation schemes

10. There would be need for integrating technologies to achieve water use efficiency and limit the pressure posed on water resources by the increase in irrigation water use. Climate smart technology could help reduce irrigation water demand.
11. Conflicts may also arise from the choice of crops to be grown under irrigation. High value crops may be sought which may create deficits in other crops with them consequently becoming more expensive and less accessible by those that cannot afford to grow (under the irrigation technologies) or buy. New sugar producing factories in Salima have for instance prompted farmers to opt for sugarcane (for sale at the sugar company) over rice.
12.

4g TNT

Low Climate / Low Tech

Insufficient calories and nutrition security is not achieved for most nutrient (vitamin C marginal). Nutrients adequate at baseline fall below requirement.

1. Hunger/food insecurity would lead to increased reliance on food aid and imports
2. Acute and chronic undernutrition would lead to detrimental health impacts, particularly for children and mothers and already-vulnerable populations
3. There would be declines in labour productivity, due to hunger/ill-health
4. Rise in food prices will likely lead to inequitable food access, with the poorest becoming increasingly vulnerable to food insecurity/ hunger/ undernutrition
5. Inequalities would be exacerbated owing to gender differentiated care roles
6.

Sufficient calories and nutrition security achieved.

1. 1.If food is affordable, accessible and nutritionally adequate, then there should be a healthy population.
2. If food is not affordable nor accessible, then only the wealthiest will benefit, and marginalised populations will not achieve food or nutrition security

High Climate / Low Tech

Insufficient calories and nutrition security is not achieved for most nutrient (vitamin C marginal). Nutrients adequate at baseline fall below requirements.

1. Hunger/food insecurity would lead to increased reliance on food aid and imports
2. Acute and chronic undernutrition would lead to detrimental health impacts, particularly for children and mothers and already-vulnerable populations
3. There would be declines in labour productivity, due to hunger/ill-health
4. Rise in food prices will likely lead to inequitable food access, with the poorest becoming increasingly vulnerable to food insecurity/ hunger/ undernutrition
5. Inequalities would be exacerbated owing to gender differentiated care roles
6.

Sufficient calories and nutrition security achieved.

1. 1.If food is affordable, accessible and nutritionally adequate, then there should be a healthy population.
2. If food is not affordable nor accessible, then only the wealthiest will benefit and marginalised populations will not achieve food or nutrition security

Low Climate / High Tech

1. 1.If food is affordable, accessible and nutritionally adequate, then there should be a healthy population.
2. If food is not affordable nor accessible, then only the wealthiest will benefit and marginalised populations will not achieve food or nutrition security

High Climate / High Tech

1. 1.If food is affordable, accessible and nutritionally adequate, then there should be a healthy population.
2. If food is not affordable nor accessible, then only the wealthiest will benefit and marginalised populations will not achieve food or nutrition security

4h Yield Shocks

Low Climate / Low Tech

A downward trend in yields, coupled with increasing yield variability in the case of soybean and potato, result in approximately double the number of years of yield shock. Soybean shows signs of being more resilient to extreme weather, with fewer shocks than the other three crops. Medium Confidence.

1. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
3. We may expect an increased need to diversify away either a) from agriculture, or b) to alternative crops
4. There would be increased demand on extension services (e.g. agricultural and climate).

High Climate / Low Tech

A downward trend in yields, coupled with increasing yield variability in the case of soybean and potato, contributes to an increase of approximately 2-3 times the number of years of yield shock for maize and groundnut and ~6 times more yield shocks for potato. Soybean yields do not show a downward trend and show an increase of only 0-1 times more yield shocks. Medium Confidence.

1. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
3. We may expect an increased need to diversify away either a) from agriculture, or b) to alternative crops.
4. There would be increased demand on extension services (e.g. agricultural and climate).

Low Climate / High Tech

Effectively implemented irrigation and crop varietal improvements across the country result in significantly reduced yield shocks. Medium Confidence.

1. There would be increased demand on extension services (e.g. agricultural and climate).
2. There is potential for inequality to rise, as upscaling of agricultural technologies (seeds varieties and irrigation) does not reach all households or households cannot afford to purchase technologies
3. Water conflicts expected to increase between agricultural users and downstream consumers including transboundary escalation (e.g. Lower Shire River Basin and Zambezi river into Mozambique), including conflicts between livestock and crop production needs
4. Conflicts may also arise from the choice of crops to be grown under irrigation. High value crops may be sought which may create deficits in other crops with them consequently becoming more expensive and less accessible by those that cannot afford to grow (under the irrigation technologies) or buy. New sugar producing factories in Salima have for instance prompted farmers to opt for sugarcane (for sale at the sugar company) over rice.
5.

High Climate / High Tech

Effectively implemented irrigation and crop varietal improvements across the country result in significantly reduced yield shocks. Medium Confidence.

1. There would be increased demand on extension services (e.g. agricultural and climate).
2. There is potential for inequality to rise, as upscaling of agricultural technologies (seeds varieties and irrigation) does not reach all households or households cannot afford to purchase technologies
3. Water conflicts expected to increase between agricultural users and downstream consumers including transboundary escalation (e.g. Lower Shire River Basin and Zambezi river into Mozambique), including conflicts between livestock and crop production needs
4. Conflicts may also arise from the choice of crops to be grown under irrigation. High value crops may be sought which may create deficits in other crops with them consequently becoming more expensive and less accessible by those that cannot afford to grow (under the irrigation technologies) or buy. New sugar producing factories in Salima have for instance prompted farmers to opt for sugarcane (for sale at the sugar company) over rice.
5.

South Africa

5a Climate and extremes

1. Increased demand on extension services - particularly for climate and weather forecasting information
2. See statements for 5b-5h

5b Climate impacts

Low Climate / Low Reform

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.

1. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
3. Reductions in maize yields will likely lead to diversification to alternative staple starch food sources e.g. cassava, potato, rice, wheat etc.

High Climate / Low Reform

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.

1. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
3. Reductions in maize yields will likely lead to diversification to alternative staple starch food sources e.g. cassava, potato, rice, wheat etc.
4. Recurrent droughts may lead to a shift towards pasture management in short-term and land abandonment in the long-term for emerging and small-scale farmers, as cultivating land under climate risks become risky.

Low Climate / High Reform

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.

1. If markets are inclusive and sustainable, yield increases may raise incomes
2. If markets are not inclusive or sustainable, yield increases have limited impacts on incomes for all households. Likely that marginalised populations will be excluded from financial gains.
3. Increase in agri-production may increase seasonal labour demand for the emerging (land reform) and small-scale farmers (e.g. For harvesting, processing and/or packaging), providing seasonal income generating opportunities for rural households.
4. Large-scale and heavily mechanised agriculture is prominent in South Africa. It is expected that agriculture will become more automated and mechanised with reduced reliance on labour - especially for large-scale farmers with better access to capital

High Climate / High Reform

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..

1. If markets are inclusive and sustainable, yield increases may raise incomes
2. If markets are not inclusive or sustainable, yield increases have limited impacts on incomes for all households. Likely that marginalised populations will be excluded from financial gains.
3. Increase in agri-production may increase seasonal labour demand for the emerging (land reform) and small-scale farmers (e.g. For harvesting, processing and/or packaging), providing seasonal income generating opportunities for rural households.
4. Large-scale and heavily mechanised agriculture is prominent in South Africa. It is expected that agriculture will become more automated and mechanised with reduced reliance on labour - especially for large-scale farmers with better access to capital
5. Reductions in yields for cash crops (Potato) are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
6. Recurrent droughts may lead to a shift towards pasture management in short-term and land abandonment in the long-term for emerging and small-scale farmers, as cultivating land under climate risks become risky.
7.

5c Crop pests

IS Applicable to all Scenario Quadrants:

1. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in yields (particularly on larger commercial farms) may reduce the availability and demand for seasonal labour, thus reducing income generating opportunities for rural households
3. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
4. There would be increased demand on extension services, particularly for (chemical) crop pest and disease management practices and/or biocontrol measures. However, access to services and government support is likely to differ among production models. Government support - provisioning of mechanisation and government extension, is often restricted to emerging (land reform) and small-scale farmers. Large-scale commercial farmers often do not access government loans, farmer cooperatives, extension, and access to subsidies. So there may be inequality in the quantities and quality of extension the different production models receive. Commercial farmers often depend on their market networks and input suppliers for gathering important information.

5. There would be increased demand for R&D on biocontrol measures
6. Increase in pests/diseases will lead to an increased reliance/need for pesticides, herbicides and fungicides and related increased expenditures
7. Increased need for chemical control has multiple implications:
    a. Technologies may not reach all farms
    b. Not all farmers can afford to purchase inputs
    c. Not all farmers are able/prepared to use them (e.g. Those using organic practises/involved in organic value chains)
    d. Gendered inequality exacerbated as women typically have less access to inputs than men
8. There is potential for inequality to rise, as upscaling of pest/disease control technologies does not reach all farms and/or farmers cannot access or afford technologies - small-scale and emergent farmers more likely to be excluded/missed.
9. If agriculture becomes unviable (e.g. too expensive, too labour intensive, or successive pest/disease outbreaks), we may expect an increased need to diversify away either a) from agriculture, or b) to alternative crops
10. Increased use of chemical inputs has negative impacts on human and environmental health

5d Emissions and soils

IS Applicable to all Scenario Quadrants:

1. With increased GHG emissions, it is possible that mitigation-focussed CSA may increase, e.g. increase in 'payment for ecosystem services'-type programmes, with potential income for households, e.g. to plant trees
2. There would be increased demand on extension services (e.g. forestry/agroforestry).
3. There is potential for inequality to rise, as upscaling of mitigation technologies does not reach all households and/or households cannot access or afford technologies

5e Food production

IS Applicable to all Scenario Quadrants:

1. Alongside an increase in yields, there would be increased need for infrastructural development, particularly for agricultural services e.g. storage, processing and transportation
2. There would be increased demand on extension services (e.g., agricultural, veterinary and climate).
3. There is potential for inequality to rise, as upscaling of agricultural technologies do not reach all farmers and/or farmers cannot access or afford technologies
4. If market opportunities are inclusive and sustainable, yield increases may increase incomes for small-scale farmers
5. If markets are not inclusive nor sustainable, yield increases have limited impacts on incomes for all households. Likely that marginalised populations will be excluded from financial gains
6. Increase in agri-production may increase seasonal labour demand (e.g. For harvesting, processing and/or packaging), providing seasonal income generating opportunities for rural households

Low Climate / Low Reform

IS Applicable to LC/LR Scenario Quadrant:

1. Land conflicts expected to increase with expansion of pastureland e.g. between livestock and crop production / between conservation/tourism and pasture
2. Decline in environmental sustainability/health would be expected with expansion of pastureland, with reductions in ecosystem services (regulating/provisioning/cultural/supporting)
3. With expansion of pasture there would be increased need for robust cross-sectoral planning and regulation for land and resources (e.g. water, energy, mining/minerals, biodiversity etc.)
4. With expansion of pastureland, inequitable land access and insecure land tenure will result in increased rural vulnerabilities, exacerbate poverty and increase social inequalities

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

1. Increase demand for agricultural labour
2. With higher food availability, there is potential for food prices to decline and affordability to increase
3. Increased crop diversity enhances opportunities for on-farm income generation
4. We may expect increased livelihood resilience, owing to diverse cropping opportunities (risk spreading)
5. With increased crop diversity, we may expect an increased availability of nutritionally-diverse food crops
6. Higher yields may increase market competition for producers (though see IS #3 above)

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

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

1. Increased availability of meat and dairy products will enhance nutrition outcomes
2. Income generating opportunities in the meat and dairy sector and value chains increase

High Climate / Low Reform

IS Applicable to HC/LR Scenario Quadrant:

1. Land conflicts expected to increase with expansion of agricultural land and reduction in pastureland e.g., between livestock and crop production / between conservation/tourism and agriculture between agricultural and energy (e.g. hydro/mining)
2. Decline in environmental sustainability/health would be expected, with reductions in ecosystem services (regulating/provisioning/cultural/supporting)
3. There would be increased need for robust cross-sectoral planning and regulation for land and resources (e.g., water, energy, mining/minerals, biodiversity etc.)
4. With expansion of agriculture, inequitable land access and insecure land tenure will result in increased rural vulnerabilities, exacerbate poverty and increase social inequalities
5. With increased irrigation, water conflicts are expected to increase between agricultural users and downstream consumers (e.g. particularly urban) including transboundary escalation (e.g., Limpopo Watershed into Mozambique), including conflicts between livestock and crop production needs
6. Under high climate risks, smallholder farmers, and farm labourers might be pushed towards uncertainty in terms of employment and income generation. This may lead to further conflicts between different farming communities – commercial vs small scale, and potential rise in violent crimes and farm thefts (as experienced with previous levels of job insecurity/uncertainty).
7. Farmers may out-migrate to areas with more favourable environments, leaving land idle.

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

1. Increase demand for agricultural labour
2. With higher food availability, there is potential for food prices to decline and affordability to increase
3. Increased crop diversity enhances opportunities for on-farm income generation
4. We may expect increased livelihood resilience, owing to diverse cropping opportunities (risk spreading)
5. With increased crop diversity, we may expect an increased availability of nutritionally-diverse food crops
6. Higher yields may increase market competition for producers

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

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

1. Increased availability of meat and dairy products will enhance nutrition outcomes
2. Income generating opportunities in the meat and dairy sector and value chains increase
3. Increased need for veterinary services (e.g., to deal with potential increase in disease / heat stress)

Low Climate / High Reform

IS Applicable to LC/HR Scenario Quadrant:

1. Land conflicts expected to increase with expansion of pastureland e.g., between livestock and crop production / between conservation/tourism and pastureland
2. Decline in environmental sustainability/health would be expected with expansion of pastureland, with reductions in ecosystem services (regulating/provisioning/cultural/supporting)
3. With expansion of pasture there would be increased need for robust cross-sectoral planning and regulation for land and resources (e.g. water, energy, mining/minerals, biodiversity etc.)
4. With expansion of pastureland, inequitable land access and insecure land tenure will result in increased rural vulnerabilities, exacerbate poverty and increase social inequalities
7. Land reform with government support will promote uptake of mechanisation and increase global market access to land-reform farmers. Influenced by globalised trade, crop diversity likely reduces, as farmers specialise in particular export markets. We may expect declines in livelihood resilience, owing to less-diverse cropping systems (limiting risk spreading)
5. Mechanisation displaces low-skilled workers. High-skilled workers who specialised in operating and maintaining machinery are in demand, but we may expect wages to remain low as industrial/commercial farmers try to keep input cost minimum and prices competitive.
6. Under land reform without government support, small to medium scale farmers who received land through redistribution programme may struggle to cultivate the land and access supply chains due to lack of advice and support from government.
7. **LIVELIHOOD IMPACTS OF SOCIALLY DIFFERENTIATED REFORM> MULTIPLE THOUGH UNCLEAR ON SPECIFICS**

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

1. If land reform happens without significant contribution and support from the government, land reform emerging farmers with poor access to capital may operate rain-fed low input agriculture with high dependence on agricultural labour, increasing the demand and cost of hiring low-skilled to semi-skilled labour in farms.
2. With higher food availability, there is potential for food prices to decline and affordability to increase
3. Increased crop diversity may enhance opportunities for on-farm income generation, as markets diversify
4. We may expect increased livelihood resilience, owing to diverse cropping opportunities (risk spreading)
5. With increased crop diversity, we may expect an increased availability of nutritionally-diverse food crops
6. Higher yields may increase market competition for producers

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

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

1. Increased availability of meat and dairy products will enhance nutrition outcomes
2. Income generating opportunities in the meat and dairy sector and value chains increase

High Climate / High Reform

IS Applicable to HC/HR Scenario Quadrant:

1. With decline in arable /pastureland, there is potential for environmental sustainability/health to improve (though dependent on the 'rewilding' of previously used land), with expected improvements in ecosystem services (regulating/provisioning/cultural/supporting)
2. With increased irrigation, water conflicts are expected to increase between agricultural users and downstream consumers (e.g. particularly urban) including transboundary escalation (e.g., Limpopo Watershed into Mozambique), including conflicts between livestock and crop production needs
3. **LIVELIHOOD IMPACTS OF SOCIALLY DIFFERENTIATED REFORM> MULTIPLE THOUGH UNCLEAR ON SPECIFICS**

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

1. Increase demand for agricultural labour
2. With higher food availability, there is potential for food prices to decline and affordability to increase
3. Increased crop diversity enhances opportunities for on-farm income generation
4. We may expect increased livelihood resilience, owing to diverse cropping opportunities (risk spreading)
5. With increased crop diversity, we may expect an increased availability of nutritionally-diverse food crops
6. Higher yields may increase market competition for producers

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

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

1. Increased availability of meat and dairy products will enhance nutrition outcomes
2. Income generating opportunities in the meat and dairy sector and value chains increase
3. Increased need for veterinary services (e.g., to deal with potential increase in disease / heat stress)

5f Irrigation

Where irrigation increases:

1. With increased irrigation, water conflicts are expected to increase between agricultural users and downstream consumers (e.g. particularly urban) including transboundary escalation (e.g., Limpopo Watershed into Mozambique), including conflicts between livestock and crop production needs
2. There is potential for inequality to rise, as upscaling of agricultural technologies (e.g. Irrigation) do not reach all farmers and/or farmers cannot access or afford technologies

5g TNT

1. 1.If food is affordable, accessible and nutritionally adequate, then there should be a healthy population.
2. If food is not affordable nor accessible, then only the wealthiest will benefit and marginalised populations will not achieve food or nutrition security

4h Yield Shocks

IS Applicable to all Scenario Quadrants:

1. There would be increased demand on extension services (e.g. agricultural and climate).

Without applied technology trends and/or no irrigation benefits:

1. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
3. We may expect an increased need to diversify away either a) from agriculture, or b) to alternative crops
4. Declines in agri-production may decrease seasonal labour demand (e.g. for harvesting, processing and/or packaging), reducing seasonal income generating opportunities for rural households

With applied technology trends:

1. There is potential for inequality to rise, as upscaling of agricultural technologies do not reach all farmers and/or farmers cannot access or afford technologies

Low Climate / Low Tech

None additional to the above

High Climate / Low Tech

1. With increased irrigation, water conflicts are expected to increase between agricultural users and downstream consumers (e.g. particularly urban) including transboundary escalation (e.g., Limpopo Watershed into Mozambique), including conflicts between livestock and crop production needs

Low Climate / High Tech

None additional to the above

High Climate / High Tech

1. With increased irrigation, water conflicts are expected to increase between agricultural users and downstream consumers (e.g. particularly urban) including transboundary escalation (e.g., Limpopo Watershed into Mozambique), including conflicts between livestock and crop production needs
2. With government support and development programs, irrigation infrastructure may improve, resulting in industrialisation of emerging and small-scale farmers and subsequent increase in trade-driven and commodity-based agriculture.
3. Food prices may rise, due to high dependence on input orient and mechanised farming under recurring droughts, floods.

Tanzania

6a Climate & Extremes

IS Applicable to all Scenario Quadrants:

1. Increased demand on extension services - particularly for climate and weather forecasting information
2. See statements for 6b and 6c

6b Climate Impacts

Low Climate / Low Tech

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.

1. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
3. Reductions in maize yields will likely lead to diversification to alternative staple starch food sources e.g. cassava, potato, rice, wheat etc.

High Climate / Low Tech

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.

1. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
3. Reductions in maize yields will likely lead to diversification to alternative staple starch food sources e.g. cassava, potato, rice, wheat etc.

Low Climate / High Tech

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.

4. If markets are inclusive and sustainable, yield increases may raise incomes
5. If markets are not inclusive or sustainable, yield increases have limited impacts on incomes
6. There is potential for inequality to rise, as upscaling of agricultural technologies does not reach all households and/or households cannot access or afford technologies

High Climate / High Tech

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.

1. If markets are inclusive and sustainable, yield increases may raise incomes
2. If markets are not inclusive or sustainable, yield increases have limited impacts on incomes
3. There is potential for inequality to rise, as upscaling of agricultural technologies does not reach all households and/or households cannot access or afford technologies

6c Crop Pests

IS Applicable to all Scenario Quadrants:

1. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
3. There would be increased demand on extension services, particularly for (chemical) crop pest and disease management practices and/or biocontrol measures
4. There would be increased demand for R&D on biocontrol measures
5. Increase in pests/diseases will lead to an increased reliance/need for pesticides, herbicides and fungicides
6. Increased need for chemical control has multiple implications:

    a. Technologies may not reach all households
    b. Not all households can afford to purchase inputs
    c. Not all farmers are able/prepared to use them
    d. Gendered inequality exacerbated as women typically have less access to inputs than men
7. There is potential for inequality to rise, as upscaling of pest/disease control technologies does not reach all households and/or households cannot access or afford technologies
8. If agriculture becomes unviable (e.g. too expensive, too labour intensive, or successive pest/disease outbreaks), we may expect an increased need to diversify away either a) from agriculture, or b) to alternative crops
9. Increased use of chemical inputs has negative impacts on human and environmental health
10. Agricultural livelihood outcomes (income, food security) dependent on ability to adapt e.g. availability of / affordability of inputs (pesticides/fungicides, seed varieties, labour requirements for adaptation/adoption), knowledge of new practices
11. Livelihood opportunities generated if per-resistant crops can be propagated / biocontrol measures can be produced and sold locally

Low Climate / Low Tech

CS1: In the mountain production systems, mixed farming with cash and food crops is practiced. Farmers grow maize, beans, cassava, sweet potatoes, bananas, and various spices, such as clove, cardamom, and black pepper. CPD-induced yield losses are lower in the highlands compared to the lowlands.

1. Would expect an increase price of / pressure on agricultural lands in highlands compared to lowlands
2. Population migration from lowland to highlands
3. Increased pressure on mountainous forests (deforestation - with subsequent declines in biodiversity and negative impacts on localised/micro-climate)
4. Decline in environmental sustainability/health, with reduction in ecosystem services (regulating/provisioning/cultural/supporting)

High Climate / Low Tech

as outlined above (IS applicable to all scenarios)

Low Climate / High Tech

as outlined above (IS applicable to all scenarios)

High Climate / High Tech

as outlined above (IS applicable to all scenarios)

6d Emissions and soils

IS Applicable to all Scenario Quadrants:

1. With increased GHG emissions, it is possible that mitigation-focussed CSA may increase, e.g. increase in 'payment for ecosystem services'-type programmes, with potential income for households, e.g. to plant trees
2. There would be increased demand on extension services (e.g. forestry/agroforestry).
3. There is potential for inequality to rise, as upscaling of mitigation technologies does not reach all households and/or households cannot access or afford technologies

6e Food Production

IS Applicable to all Scenario Quadrants:

1. Land conflicts expected to increase with expansion of agricultural land e.g. between livestock and crop production / between conservation/tourism and agriculture between agricultural and energy (e.g. hydro/mining)
2. Decline in environmental sustainability/health would be expected, with reductions in ecosystem services (regulating/provisioning/cultural/supporting)
3. There would be increased need for robust cross-sectoral planning and regulation for land and resources (e.g. water, energy, mining/minerals, biodiversity etc.)
4. There would be increased need for infrastructural development, particularly for agricultural services e.g. storage, processing and transportation
5. With expansion of agriculture, inequitable land access and insecure land tenure will result in increased rural vulnerabilities, exacerbate poverty and increase social inequalities
6. There would be increased demand on extension services (e.g. agricultural, veterinary and climate).
7. If market opportunities are inclusive and sustainable, yield increases may increase incomes for small-scale farmers

Low Climate / Low Tech

CS1: The mean percentage change to crop production with RCP2.6, scenario lt is 65% (range across climate models 42 to 106%; 3/18 climate models are outliers). This becomes mean 64%, range 50 to 79% after removing both upper and lower limit outliers.

1. Increase demand for agricultural labour
2. Increased crop diversity enhances opportunities for on-farm income generation
3. We may expect increased livelihood resilience, owing to diverse cropping opportunities (risk spreading)
4. With increased crop diversity, we may expect an increased availability of nutritionally-diverse food crops

CS2: The mean percentage change to livestock meat production with RCP2.6, scenario lt is 62% (range across climate models 52 to 73%; 0/18 climate models are outliers)

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

1. Increase demand for agricultural labour

High Climate / Low Tech

CS1: The mean percentage change to crop production with RCP8.5, scenario lt is 38% (range across climate models 25 to 56%; 1/18 climate models are outliers). This becomes mean 36%, range 25 to 55% after removing the upper limit outliers.

No additional to the 7 outlined above

CS2: The mean percentage change to livestock meat production with RCP8.5, scenario lt is 73% (range across climate models 65 to 80%; 1/18 climate models are outliers). This becomes mean 74%, range 65 to 80% after removing the lower limit outliers.

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

1. Increased consumption of water due to dehydration/heat stress in cattle
2. Increased need for veterinary services (to deal with potential increase in disease / heat stress)

Low Climate / High Tech

CS1: The mean percentage change to crop production with RCP2.6, scenario ht is 685% (range across climate models 613 to 832%; 2/18 climate models are outliers). This becomes mean 680%, range 631 to 733% after removing both upper and lower limit outliers.

1. With higher food availability, there is potential for food prices to decline and affordability to increase
2. Water conflicts expected to increase between agricultual users and downstream consumers including transboundary escalation (e.g. Lake Malawi Watershed), including conflicts between livestock and crop production needs
3. Increased crop diversity enhances opportunities for on-farm income generation
4. We may expect increased livelihood resilience, owing to diverse cropping opportunities (risk spreading)
5. With increased crop diversity, we may expect an increased availability of nutritionally-diverse food crops
6. There is potential for inequality to rise, as upscaling of agricultural technologies does not reach all households and/or households cannot access or afford technologies

CS2: The mean percentage change to livestock meat production with RCP2.6, scenario ht is 289% (range across climate models 276 to 316%; 1/18 climate models are outliers). This becomes mean 288%, range 276 to 303% after removing the upper limit outliers.

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

1. With higher food availability, there is potential for food prices to decline and affordability to increase
2. Water conflicts expected to increase between agricultural users and downstream consumers including transboundary escalation (e.g. Lake Malawi Watershed), including conflicts between livestock and crop production needs
3. Increased availability of meat and dairy products will enhance nutrition outcomes
4. Income generating opportunities in the meat and dairy sector and value chains increase

High Climate / High Tech

CS1: The mean percentage change to crop production with RCP8.5, scenario ht is 1676% (range across climate models 1592 to 1806%; 0/18 climate models are outliers).

1. It is likely that smallholders become outgrowers. However with this is a risk that they become controlled by large-scale enterprises and dependent on facilities and services they provide
2. Small-scale farmers would likely be more dependent on controlled markets / contracts with large-scale farmers
3. If contractual arrangements are equitable and fair, there is potential for small-scale farmers to generate more guaranteed/stable incomes
4. Assuming farmers receive fair prices, increases in yields have potential to increase on-farm incomes, with improvements in wellbeing outcomes possible
5. Increased use of inputs (e.g. 'icides and fertilisers) would likely result in high-cost farming
6. There is potential for inequality to rise, as upscaling of agricultural technologies does not reach all households and/or households cannot access or afford technologies
7. Decreased crop diversity reduces opportunities for on-farm income generation
8. We may expect reduced livelihood resilience, owing to less-diverse cropping opportunities (limiting risk spreading)
9. With reduced crop diversity, we may expect reductions in the availability of nutritionally-diverse food crops

Cs2: The mean percentage change to livestock meat production with RCP8.5, scenario ht is 530% (range across climate models 514 to 546%; 0/18 climate models are outliers).

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

1. With higher food availability, there is potential for food prices to decline and affordability to increase
2. Water conflicts expected to increase between agricultural users and downstream consumers including transboundary escalation (e.g. Lake Malawi Watershed), including conflicts between livestock and crop production needs
3. Increased availability of meat and dairy products will enhance nutrition outcomes
4. Income generating opportunities in the meat and dairy sector and value chains increase

6f Irrigation

Low Climate / Low Tech

Cs3: The mean percentage change to irrigation water with RCP2.6, scenario lt is 30% (range across climate models -1 to 73%; 1/18 climate models are outliers). This becomes mean 27%, range -1 to 68% after removing the upper limit outliers.

1. Land conflicts expected to increase with expansion of agricultural land e.g. between agricultural and hydro-electric generation
2. Decline in environmental sustainability/health would be expected, with reductions in ecosystem services (regulating/provisioning/cultural/supporting)
3. Water conflicts expected to increase between agricultural users and downstream consumers including transboundary escalation (e.g. Lake Malawi Watershed), including conflicts between livestock and crop production needs
4. There would be increased need for robust cross-sectoral planning and regulation for land and resources (e.g. water, energy, mining/minerals, biodiversity etc.)
5. There would be increased demand on extension services (e.g. agricultural, veterinary and climate).
6. There is potential for inequality to rise, as upscaling of irrigation technologies does not reach all households and/or households cannot access or afford them

High Climate / Low Tech

C3: The mean percentage change to irrigation water with RCP8.5, scenario lt is -100% (range across climate models -100 to -100%; 0/18 climate models are outliers)

1. Reductions in irrigation increases reliance on rainfed agriculture.

Low Climate / High Tech

C3: The mean percentage change to irrigation water with RCP2.6, scenario ht is 607% (range across climate models 309 to 860%; 0/18 climate models are outliers

1. Land conflicts expected to increase with expansion of agricultural land e.g. between agricultural and hydro-electric generation
2. Decline in environmental sustainability/health would be expected, with reductions in ecosystem services (regulating/provisioning/cultural/supporting)
3. Water conflicts expected to increase between agricultural users and downstream consumers including transboundary escalation (e.g. Lake Malawi Watershed), including conflicts between livestock and crop production needs
4. There would be increased need for robust cross-sectoral planning and regulation for land and resources (e.g. water, energy, mining/minerals, biodiversity etc.)

5. There would be increased demand on extension services (e.g. agricultural, veterinary and climate).
6. There is potential for inequality to rise, as upscaling of irrigation technologies does not reach all households and/or households cannot access or afford them

High Climate / High Tech

C3: The mean percentage change to irrigation water with RCP8.5, scenario ht is 608% (range across climate models 358 to 787%; 0/18 climate models are outliers).

1. Land conflicts expected to increase with expansion of agricultural land e.g. between agricultural and hydro-electric generation
2. Decline in environmental sustainability/health would be expected, with reductions in ecosystem services (regulating/provisioning/cultural/supporting)
3. Water conflicts expected to increase between agricultural users and downstream consumers including transboundary escalation (e.g. Lake Malawi Watershed), including conflicts between livestock and crop production needs
4. There would be increased need for robust cross-sectoral planning and regulation for land and resources (e.g. water, energy, mining/minerals, biodiversity etc.)
5. There would be increased demand on extension services (e.g. agricultural, veterinary and climate).
6. There is potential for inequality to rise, as upscaling of irrigation technologies does not reach all households and/or households cannot access or afford them

6g TNT

Low Climate / Low Tech

Insufficient calories and nutrition security is not achieved for most nutrient (vitamin C and thiamine marginal) and all lower than baseline. Nutrients adequate at baseline fall below requirements.

1. Hunger/food insecurity would lead to increased reliance on food aid and imports
2. Acute and chronic undernutrition would lead to detrimental health impacts, particularly for children and mothers and already-vulnerable populations
3. There would be declines in labour productivity, due to hunger/ill-health
4. Rise in food prices will likely lead to inequitable food access, with the poorest becoming increasingly vulnerable to food insecurity/ hunger/ undernutrition
5. Inequalities would be exacerbated owing to gender differentiated care roles

Sufficient calories and nutrition security achieved.

1. 1.If food is affordable, accessible and nutritionally adequate, then there should be a healthy population.
2. If food is not affordable nor accessible, then only the wealthiest will benefit and marginalised populations will not achieve food or nutrition security

High Climate / Low Tech

Insufficient calories and nutrition security is not achieved for most nutrient (vitamin C and thiamine marginal) and worse than baseline. Some nutrients adequate at baseline then fall below requirement.

1. Hunger/food insecurity would lead to increased reliance on food aid and imports
2. Acute and chronic undernutrition would lead to detrimental health impacts, particularly for children and mothers and already-vulnerable populations
3. There would be declines in labour productivity, due to hunger/ill-health
4. Rise in food prices will likely lead to inequitable food access, with the poorest becoming increasingly vulnerable to food insecurity/ hunger/ undernutrition
5. Inequalities would be exacerbated owing to gender differentiated care roles

Sufficient calories and nutrition security achieved.

1. 1.If food is affordable, accessible and nutritionally adequate, then there should be a healthy population.
2. If food is not affordable nor accessible, then only the wealthiest will benefit and marginalised populations will not achieve food or nutrition security

Low Climate / High Tech

Sufficient calories and nutrition security is achieved for most nutrients and improve from baseline levels (marginal improvement for iron and calcium but not adequate).

Sufficient calories and nutrition security achieved.

1. 1.If food is affordable, accessible and nutritionally adequate, then there should be a healthy population.
2. If food is not affordable nor accessible, then only the wealthiest will benefit and marginalised populations will not achieve food or nutrition security

High Climate / High Tech

Sufficient calories and nutrition security is achieved for most nutrients with improvement from baseline levels (improvement but still marginal for calcium).

Sufficient calories and nutrition security achieved.

1. 1.If food is affordable, accessible and nutritionally adequate, then there should be a healthy population.
2. If food is not affordable nor accessible, then only the wealthiest will benefit and marginalised populations will not achieve food or nutrition security

6h Yield Shocks

IS Applicable to all Scenario Quadrants:

1. There would be increased demand on extension services (e.g. agricultural and climate).

Low Climate / Low Tech

A downward trend in yields contributes to the ~50% increase in the number of years of yield shocks in maize and groundnut. Soybean shows signs of being more resilient to extreme weather, with only a small increase in yield shocks, and potato shows a much higher shock rate due to low baseline yield shocks and increasing variability. Medium Confidence.

1. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
3. We may expect an increased need to diversify away either a) from agriculture, or b) to alternative crops

High Climate / Low Tech

A downward trend in yields, coupled with increasing yield variability in the case of potato, contributes to, approximately, a doubling in the number of years of yield shocks for maize and groundnut and ~6 times more shocks for potato. Soybean yields show a smaller increase in shocks (30%, on average). Medium Confidence.

1. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
3. We may expect an increased need to diversify away either a) from agriculture, or b) to alternative crops

Low Climate / High Tech

Effectively implemented irrigation and crop varietal improvements across the country result in significantly reduced yield shock rates. Medium Confidence..

1. There is potential for inequality to rise, as upscaling of agricultural technologies (seeds varieties and irrigation) does not reach all households or households cannot afford to purchase technologies

High Climate / High Tech

Effectively implemented irrigation and crop varietal improvements across the country result in significantly reduced yield shock rates. Medium Confidence.

1. There is potential for inequality to rise, as upscaling of agricultural technologies (seeds varieties and irrigation) does not reach all households or households cannot afford to purchase technologies

Zambia

7a Climate and extremes

IS Applicable to all Scenario Quadrants:

1. Increased demand on extension services - particularly for climate and weather forecasting information
2. See statements 7b-7h

7b Climate impacts

Low Climate / Low market efficacy (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.

1. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
3. Reductions in maize yields will likely lead to diversification to alternative staple starch food sources e.g. cassava, potato, rice, wheat etc.
4. If markets are inclusive and sustainable, yield increases may raise incomes
5. If markets are not inclusive or sustainable, yield increases have limited impacts on incomes

High Climate / Low market efficacy (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.

1. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in yields for subsistence crops are likely to lead to increased food insecurity

3. Reductions in maize yields will likely lead to diversification to alternative staple starch food sources e.g. cassava, potato, rice, wheat etc.

Low Climate / High market efficacy (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.

1. If markets are inclusive and sustainable, yield increases may raise incomes
2. If markets are not inclusive or sustainable, yield increases have limited impacts on incomes

High Climate / High market efficacy (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.

1. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
3. Reductions in maize yields will likely lead to diversification to alternative staple starch food sources e.g. cassava, potato, rice, wheat etc.
4. If markets are inclusive and sustainable, yield increases may raise incomes
5. If markets are not inclusive or sustainable, yield increases have limited impacts on incomes
6. Gendered inequality exacerbated as women typically have less access to markets than men

7c Crop pests

IS Applicable to all Scenario Quadrants:

1. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
2. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
3. There would be increased demand on extension services, particularly for (chemical) crop pest and disease management practices and/or biocontrol measures
4. There would be increased demand for R&D on biocontrol measures
5. Increase in pests/diseases will lead to an increased reliance/need for pesticides, herbicides and fungicides
6. Increased need for chemical control has multiple implications:
    a. Technologies may not reach all households
    b. Not all households can afford to purchase inputs
    c. Not all farmers are able/prepared to use them
    d. Gendered inequality exacerbated as women typically have less access to inputs than men
7. Increase in pests lead to increased labour demand on farms to implement control measures
8. There is potential for inequality to rise, as upscaling of pest/disease control technologies does not reach all households and/or households cannot access or afford technologies
9. If agriculture becomes unviable (e.g. too expensive, too labour intensive, or successive pest/disease outbreaks), we may expect an increased need to diversify away either a) from agriculture, or b) to alternative crops
10. Increased use of chemical inputs has negative impacts on human and environmental health
11. Agricultural livelihood outcomes (income, food security) dependent on ability to adapt e.g. availability of / affordability of inputs (pesticides/fungicides, seed varieties, labour requirements for adaptation/adoption), knowledge of new practices
12. Livelihood opportunities generated if pest-resistant crops can be propagated / biocontrol measures can be produced and sold locally

Low Climate / High market efficacy (HT)

1. Reduced wild food safety net options in homogenised agricultural landscapes

High Climate / High Market efficacy (HT)

2. Reduced wild food safety net options in homogenised agricultural landscapes

7d Emissions and soils

IS Applicable to all Scenario Quadrants:

1.With increased GHG emissions (or to meet the reductions), it is possible that mitigation-focussed CSA may increase, e.g. increase in 'payment for ecosystem services'-type programmes, with potential income for agricultural households/farmers, e.g. to plant trees
2.There would be increased demand on extension services (e.g. forestry/agroforestry).
3.There is potential for inequality to rise, as upscaling of mitigation technologies does not reach all households and/or households cannot access or afford technologies
4. Labour demand/costs to farmer to improve soil organic carbon stocks

7e Food production

Low Climate / Low market efficacy (LT)

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

1. If markets are inclusive and sustainable, yield increases may raise incomes
2. If markets are not inclusive or sustainable, yield increases have limited impacts on incomes
3. If markets are not available for cash crops, yield increases have limited impacts on incomes
4. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
5. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
6. Farmers dependent on rain-fed crops vulnerable to rainfall variability / induced shocks/stress

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

1. If markets are inclusive and sustainable, production increases may raise incomes
2. If markets are not inclusive or sustainable, production increases have limited impacts on incomes
3. Farmers dependent on water supplies for livestock vulnerable to rainfall variability / climate-induced shocks/stress
4. Increased availability, affordability and accessibility of meat will enhance nutrition outcomes

5. Decreased availability, affordability and accessibility of meat products will negatively affect nutrition outcomes

6. If meat/dairy production increases income generating opportunities in the meat and dairy sector and value chains likely to increase
7. If meat/dairy production decreases income generating opportunities in the meat and dairy sector and value chains likely to decrease

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

1. If markets are inclusive and sustainable, production increases may raise incomes
2. If markets are not inclusive or sustainable, production increases have limited impacts on incomes
3. Farmers dependent on water supplies for livestock vulnerable to rainfall variability / climate-induced shocks/stress
4. Increased availability, affordability and accessibility of meat will enhance nutrition outcomes

5. Decreased availability, affordability and accessibility of meat products will negatively affect nutrition outcomes

6. If meat/dairy production increases income generating opportunities in the meat and dairy sector and value chains likely to increase
7. If meat/dairy production decreases income generating opportunities in the meat and dairy sector and value chains likely to decrease

High Climate / Low market efficacy (LT)

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

1. If markets are inclusive and sustainable, yield increases may moderately raise incomes
2. If markets are not inclusive or sustainable, yield increases have limited impacts on incomes
3. Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
4. Reductions in yields for subsistence crops are likely to lead to increased food insecurity
5. If markets are not available for cash crops, yield increases have limited impacts on incomes

6. If irrigation focussed on crop production, potential for increased conflict over water between crops and non-agricultural uses including energy generation, water and sanitation

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

1. If markets are inclusive and sustainable, production increases may raise incomes
2. If markets are not inclusive or sustainable, production increases have limited impacts on incomes
3. If irrigation focussed on crop production, potential for increased conflict over water between crops and livestock
4. Increased availability, affordability and accessibility of meat will enhance nutrition outcomes

5. Decreased availability, affordability and accessibility of meat products will negatively affect nutrition outcomes

6. If meat/dairy production increases income generating opportunities in the meat and dairy sector and value chains likely to increase
7. If meat/dairy production decreases income generating opportunities in the meat and dairy sector and value chains likely to decrease

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

1. If markets are inclusive and sustainable, production increases may raise incomes
2. If markets are not inclusive or sustainable, production increases have limited impacts on incomes
3. If irrigation focussed on crop production, potential for increased conflict over water between crops and livestock
4. Increased availability, affordability and accessibility of meat will enhance nutrition outcomes

5. Decreased availability, affordability and accessibility of meat products will negatively affect nutrition outcomes

6. If meat/dairy production increases income generating opportunities in the meat and dairy sector and value chains likely to increase
7. If meat/dairy production decreases income generating opportunities in the meat and dairy sector and value chains likely to decrease

Low Climate / High market efficacy (HT)

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

1. If markets are inclusive and sustainable, yield increases may raise incomes
2. If markets are not inclusive or sustainable, yield increases have limited impacts on incomes
3. With higher food availability, there is potential for food prices to decline and affordability to increase
4. Water and land use conflicts might increase between agricultural users and other consumers (due to expansion, increased productivity and irrigation) including conflicts between livestock and crop production needs if policies not coherant/complementary
5. Impacts on biodiversity/forests/wildlife due to increases in production areas - potential to lead to reduced wild food safety nets.

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

1. If markets are inclusive and sustainable, yield increases may raise incomes
2. If markets are not inclusive or sustainable, yield increases have limited impacts on incomes
3. With higher food availability, there is potential for food prices to decline and affordability to increase
4. Water and land use conflicts might increase between agricultural users and other consumers (due to expansion, increased productivity and irrigation) including conflicts between livestock and crop production needs if policies not coherant/complementary
5. Impacts on biodiversity/forests/wildlife due to increases in production areas - potential to lead to reduced wild food safety nets
6. Increased availability, accessibility and affordability of meat products will enhance nutrition outcomes

7. If meat/dairy production increases income generating opportunities in the meat and dairy sector and value chains likely to increase

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

1. If markets are inclusive and sustainable, yield increases may raise incomes
2. If markets are not inclusive or sustainable, yield increases have limited impacts on incomes
3. With higher food availability, there is potential for food prices to decline and affordability to increase
4. Water and land use conflicts might increase between agricultural users and other consumers (due to expansion, increased productivity and irrigation) including conflicts between livestock and crop production needs if policies not coherant/complementary
5. Impacts on biodiversity/forests/wildlife due to increases in production areas - potential to lead to reduced wild food safety nets
6. Increased availability, affordability and accessibility of meat will enhance nutrition outcomes

7. If meat/dairy production increases income generating opportunities in the meat and dairy sector and value chains likely to increase

High Climate / High market efficacy (HT)

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

1. If markets are inclusive and sustainable, yield increases may raise incomes
2. If markets are not inclusive or sustainable, yield increases have limited impacts on incomes
3. With higher food availability, there is potential for food prices to decline and affordability to increase
4. Water and land use conflicts might increase between agricultural users and other consumers (due to expansion, increased productivity and irrigation) including conflicts between livestock and crop production needs if policies not coherant/complementary
5. Impacts on biodiversity/forests/wildlife due to increases in production areas - potential to lead to reduced wild food safety nets

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

1. If markets are inclusive and sustainable, yield increases may raise incomes
2. If markets are not inclusive or sustainable, yield increases have limited impacts on incomes
3. With higher food availability, there is potential for food prices to decline and affordability to increase
4. Water and land use conflicts might increase between agricultural users and other consumers (due to expansion, increased productivity and irrigation) including conflicts between livestock and crop production needs if policies not coherant/complementary
5. Impacts on biodiversity/forests/wildlife due to increases in production areas - potential to lead to reduced wild food safety nets
6. Increased availability, affordability and accessibility of meat will enhance nutrition outcomes

7. If meat/dairy production increases income generating opportunities in the meat and dairy sector and value chains likely to increase

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

1. If markets are inclusive and sustainable, yield increases may raise incomes
2. If markets are not inclusive or sustainable, yield increases have limited impacts on incomes
3. With higher food availability, there is potential for food prices to decline and affordability to increase
4. Water and land use conflicts might increase between agricultural users and other consumers (due to expansion, increased productivity and irrigation) including conflicts between livestock and crop production needs if policies not coherant/complementary
5. Impacts on biodiversity/forests/wildlife due to increases in production areas - potential to lead to reduced wild food safety nets
6. Increased availability, affordability and accessibility of meat will enhance nutrition outcomes

7. If meat/dairy production increases income generating opportunities in the meat and dairy sector and value chains likely to increase

7f Irrigation

IS Applicable to all Scenario Quadrants: ***(severity of issue likely to increase with scale of increase)***

1. Water conflicts expected to increase between agricultural users, downstream consumers and other water users (e.g. hydro-electric generation), including conflicts between livestock and crop production needs
2. There would be increased need for robust cross-sectoral planning and regulation for land and resources (e.g. water, energy, mining/minerals, forests/biodiversity etc.)
3. There would be increased demand on extension services linked to irrigation / crop changes
4. There is potential for inequality to rise, as upscaling of irrigation technologies does not reach all households and/or households cannot access or afford them.

7g TNT

IS Applicable to all Scenario Quadrants (except for each Trade optimisation scenario):

1.Hunger/food insecurity would lead to increased reliance on food aid and imports
2.Acute and chronic undernutrition would lead to detrimental health impacts, particularly for children and mothers and already-vulnerable populations
3.There would be declines in labour productivity, due to hunger/ill-health
4.Rise in food prices will likely lead to inequitable food access, with the poorest becoming increasingly vulnerable to food insecurity/ hunger/ undernutrition
5. Inequalities would be exacerbated owing to gender differentiated care roles

IS Applicable across the Scenario Quadrants for Trade optimisation scenario:

1.1.If food is affordable, accessible and nutritionally adequate, then there should be a healthy population.
2.If food is not affordable nor accessible, then only the wealthiest will benefit and marginalised populations will not achieve food or nutrition security

4h Yield Shocks

Low Climate / Low market efficacy (LT)

1.There would be increased demand on extension services (e.g. agricultural and climate).
2,Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
3.Reductions in yields for subsistence crops are likely to lead to increased food insecurity
4.We may expect an increased need to diversify away either a) from agriculture, or b) to alternative (more resilient) crops

High Climate / Low market efficacy (LT)

1.There would be increased demand on extension services (e.g. agricultural and climate).
2.Reductions in yields for cash crops are likely to lead to acute income loss, undermining household resilience and increasing financial vulnerability
3.Reductions in yields for subsistence crops are likely to lead to increased food insecurity
4.We may expect an increased need to diversify away either a) from agriculture, or b) to alternative (more resilient) crops

Low Climate / High market efficacy (HT)

1.There would be increased demand on extension services (e.g. agricultural and climate).
2.There is potential for inequality to rise, as upscaling of agricultural technologies (seeds varieties and irrigation) does not reach all households or households cannot afford to purchase technologies

High Climate / High market efficacy (HT)

1.There would be increased demand on extension services (e.g. agricultural and climate)
2.There is potential for inequality to rise, as upscaling of agricultural technologies (seeds varieties and irrigation) does not reach all households or households cannot afford to purchase technologies