Quantifying the costs, benefits and risks associated with climate change risk for water resources - planning and management alternatives in the Berg River Catchment Area of the Western Cape Province of South Africa

SANCID 2012 Symposium
'Irrigation in a Changing Environment'
20-23 November 2012
Venue: Alpine Heath Resort, Northern Drakensberg (KwaZulu-Natal)

Daan Louw, Department of Agricultural Economics, University of Stellenbosch

Peter Johnston, Climate Systems Analysis Group, University of Cape Town

Mac Callaway, Unep-Risø Center, Institute of Management Engineering, Technical University of Denmark

Trevor Lumsden, School of Bioresources Engineering & Environmental Hydrology, University of KwaZulu-Natal

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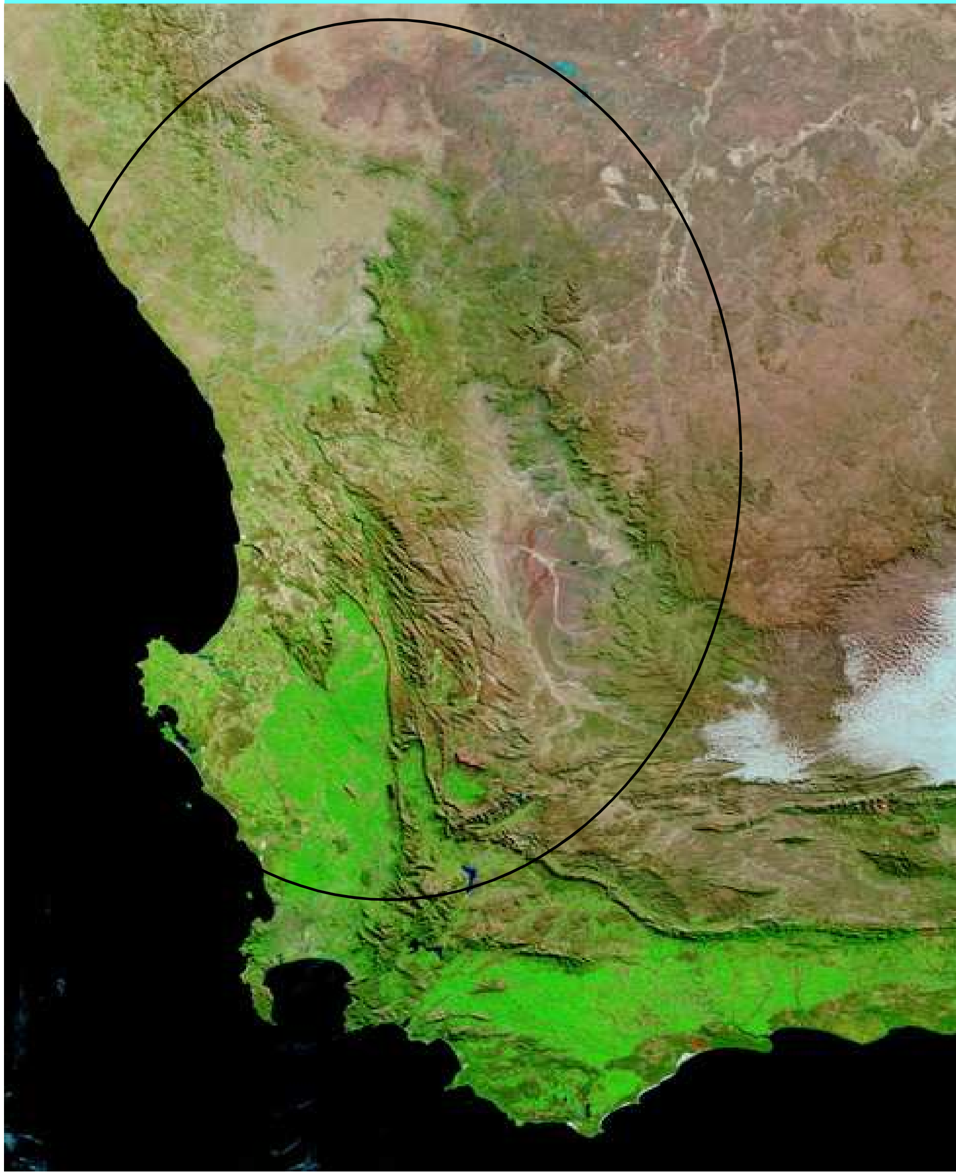
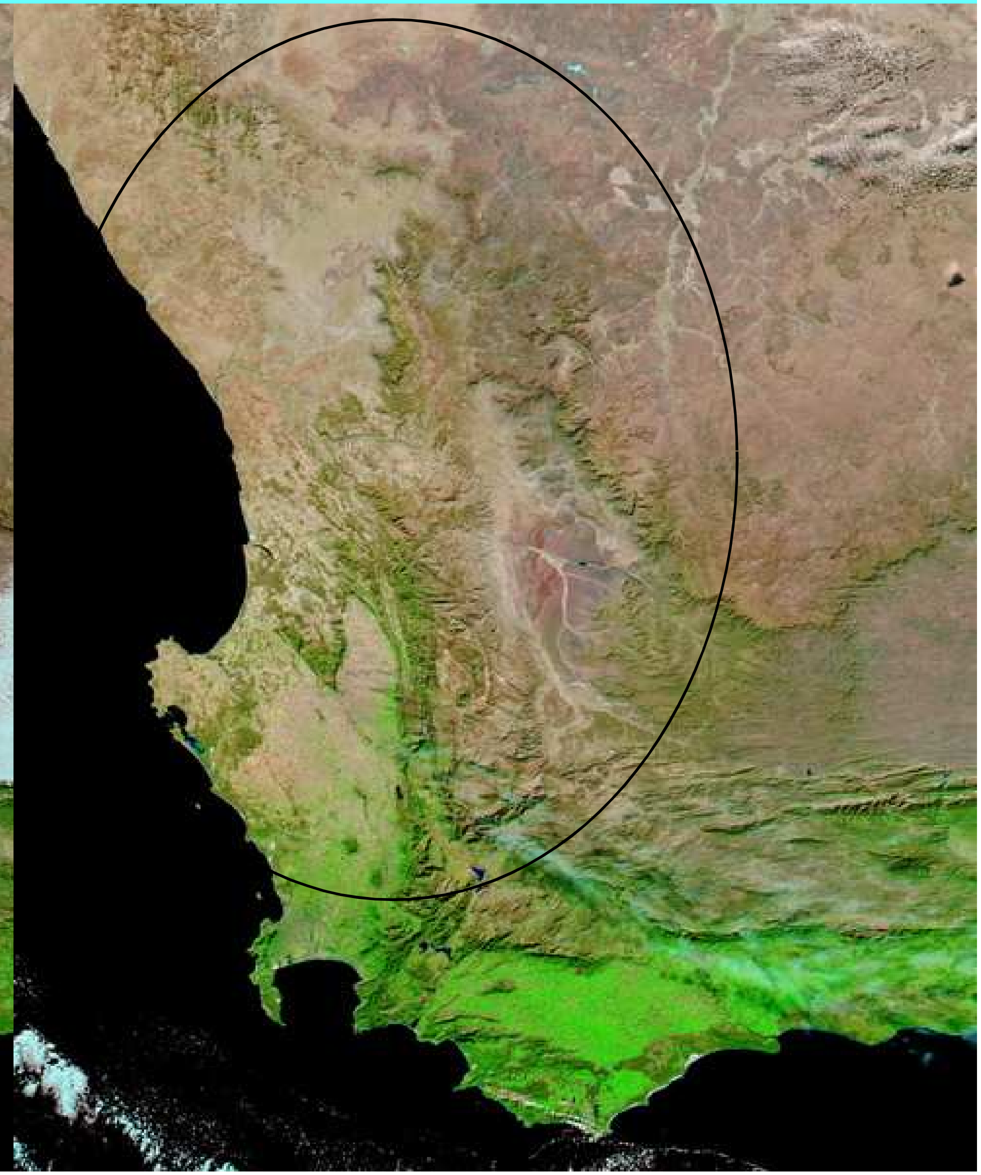
Water is already a scarce resource in the Western Cape

21 July 2002 - Normal



21 July 2003 - Drought



Introduction

- Substantial **increase in population** – Cape Town and rural towns accompanied by increased demand for more job opportunities

- After 1994 – post apartheid – international markets opened up – **growth in agriculture** and demand for irrigation water

- The Western Cape is an extremely important region to the economic development of South Africa – **one of the most valuable agricultural** production region

- All high value crops (job creating crops) that is farmed in this region is **under irrigation (vulnerable to climate change)**.

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Introduction….Cont.

- Increased **competition for water** between agric and urban sector
- Strong link between **agriculture and the tourism** industry
- **Strong forward and backward linkages** with secondary industries – 65% depend on agriculture
- Therefore **sustainable development** is of paramount importance to maintain existing job opportunities and to create new jobs

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- Water (and other climate) is the **most limiting factor** to grow agriculture, create jobs and reduce poverty

- **On top of this** rapid growth in water demand are the issues of **climate vulnerability and climate change**

- Need for a **integrated modelling framework** to investigate the costs and benefits of various adaptation strategies

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Modelling framework

- **CC scenario down scaling module** – statistical methods to approximate the regional scale response to the large scale forcing – Self Organising Map based downscaling - SOMD
- **Hydrology module** – Agricultural Catchments Research Unit – ACRU – estimate incremental runoff at specific locations
- **Economic impact model**

➢ **Regional dynamic linear programming** farm models

➢ **Intertemporal spatial equilibrium model** – simulate bulk infrastructure

➢ **Urban demand module**

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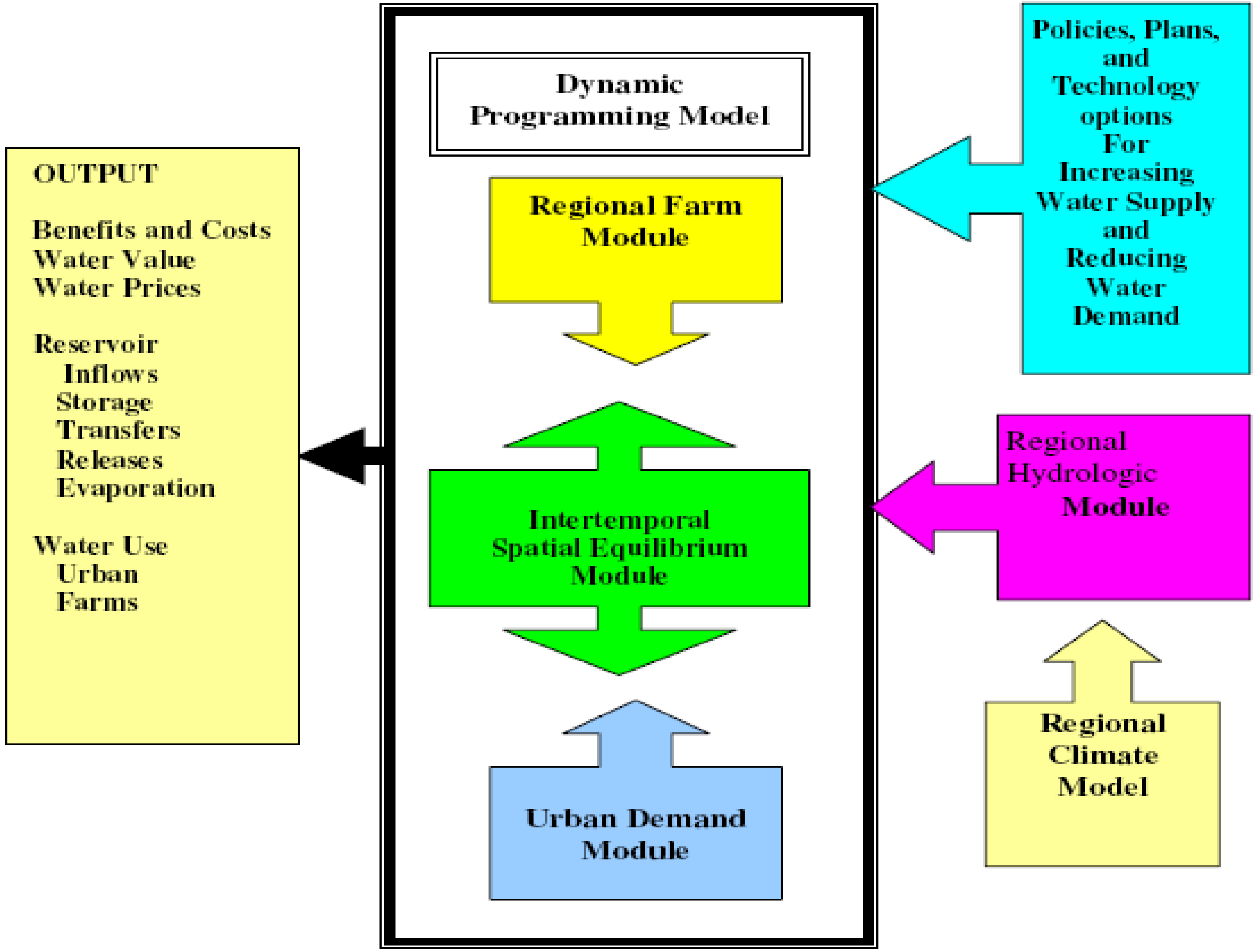

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Western Cape Dynamic Spatial Equilibrium Model

- **Dynamic**: Maintains water balances over time in main dams and farm dams and optimize farm resource use and profit over time
- **Spatial**: Distributes monthly ACRU runoff to cities, farms via main dams and natural and man-made conveyance systems
- **"Partial" Equilibrium**: The model maximizes the net economic returns to water by cities and farms in the region

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Downscaling results

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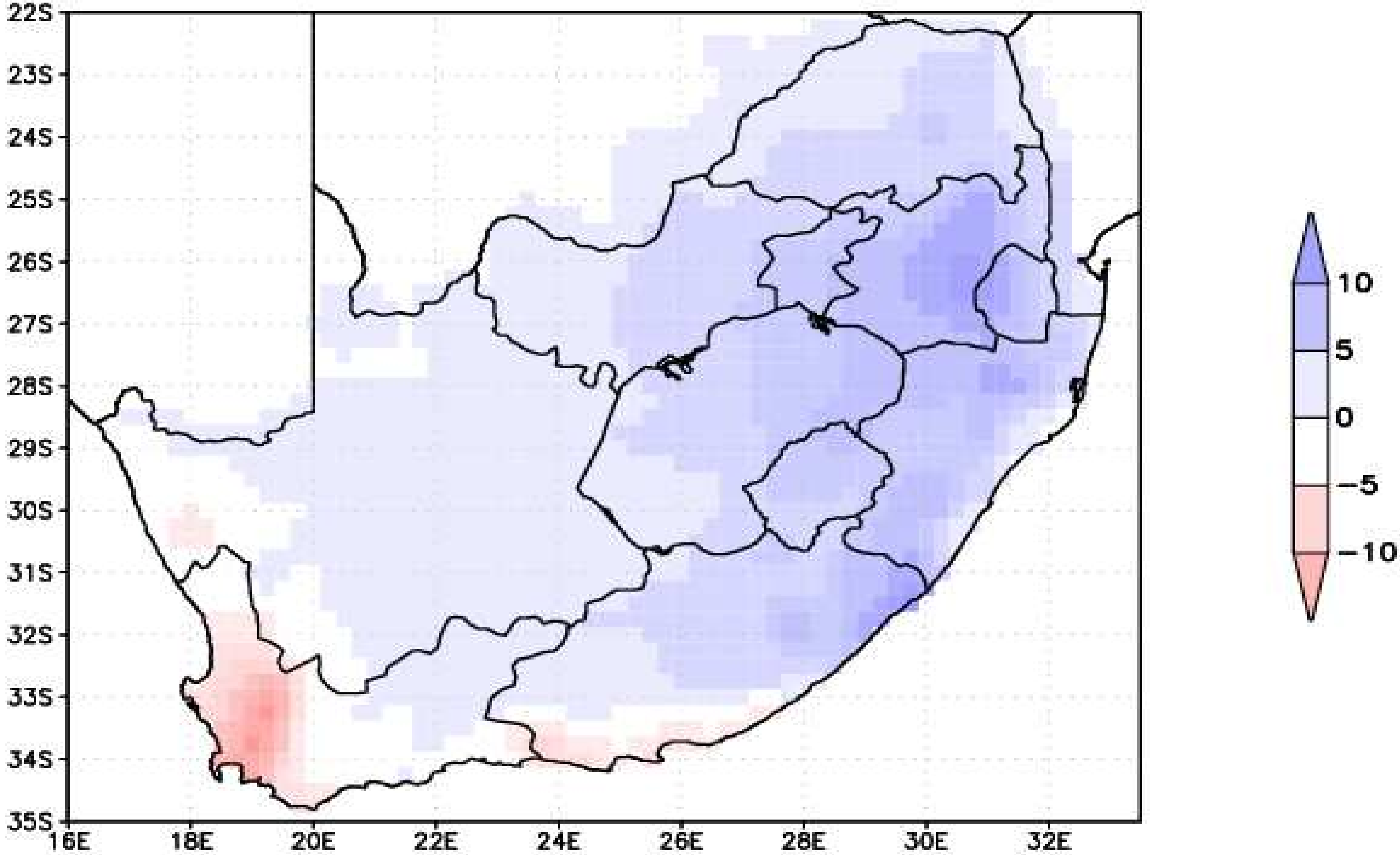
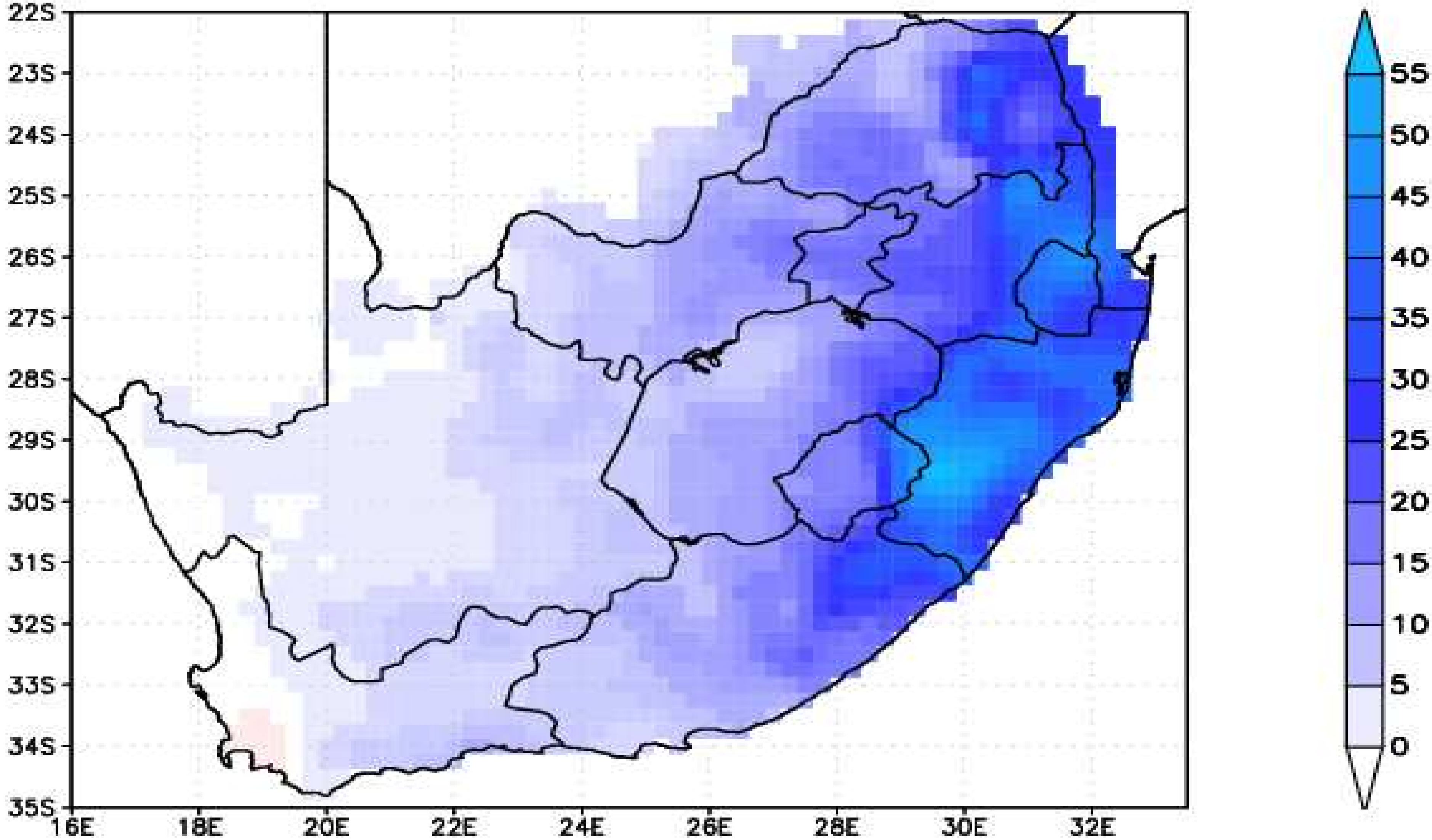
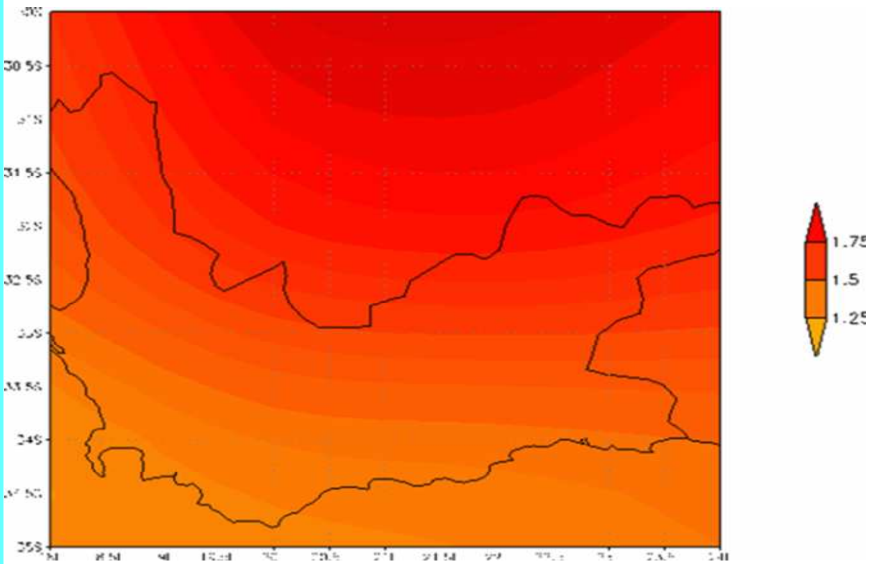
Winter (JJA) rainfall projections (2046-2065) for SA



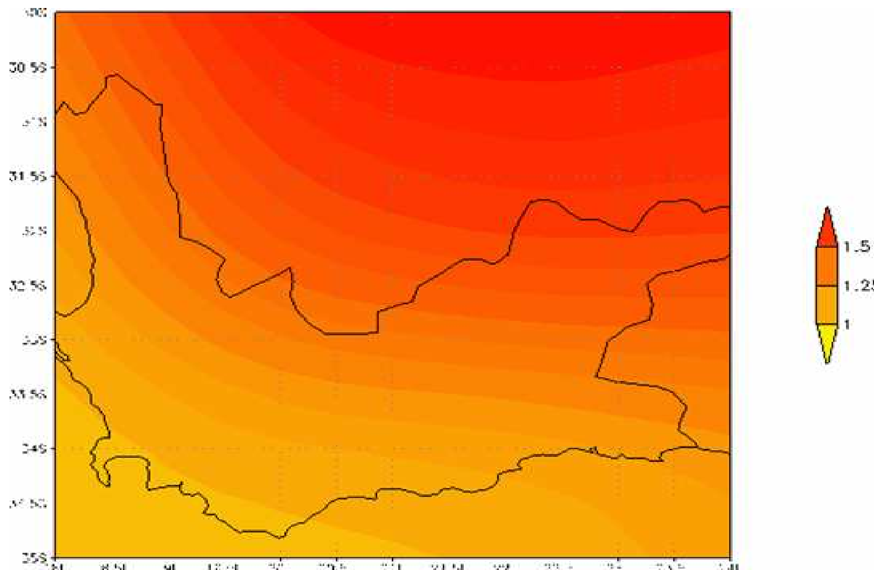
Summer (DJF) rainfall anomaly projections (2046-2065) for SA



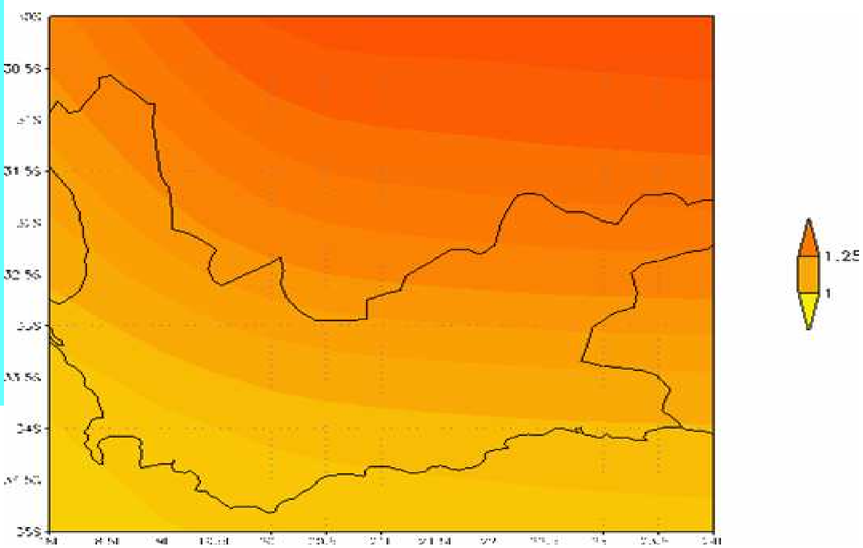
Projected temperature



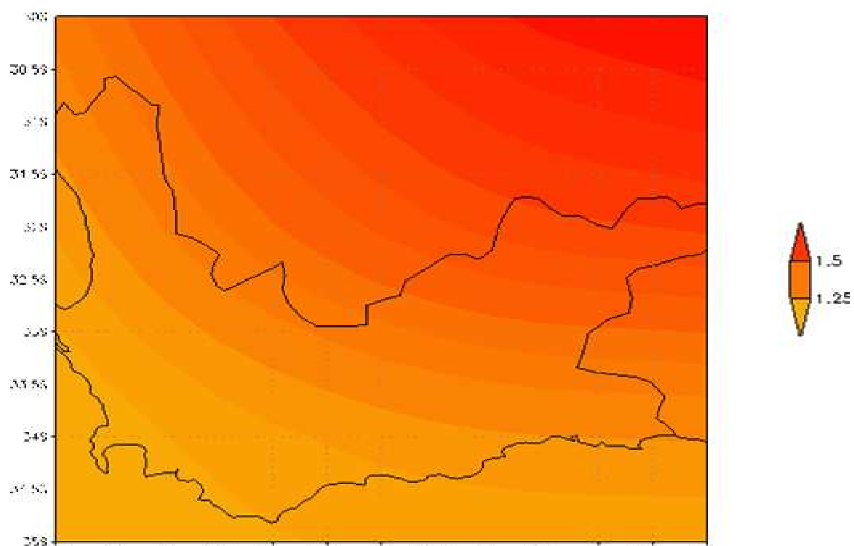
(a)DJF



(b)MAM

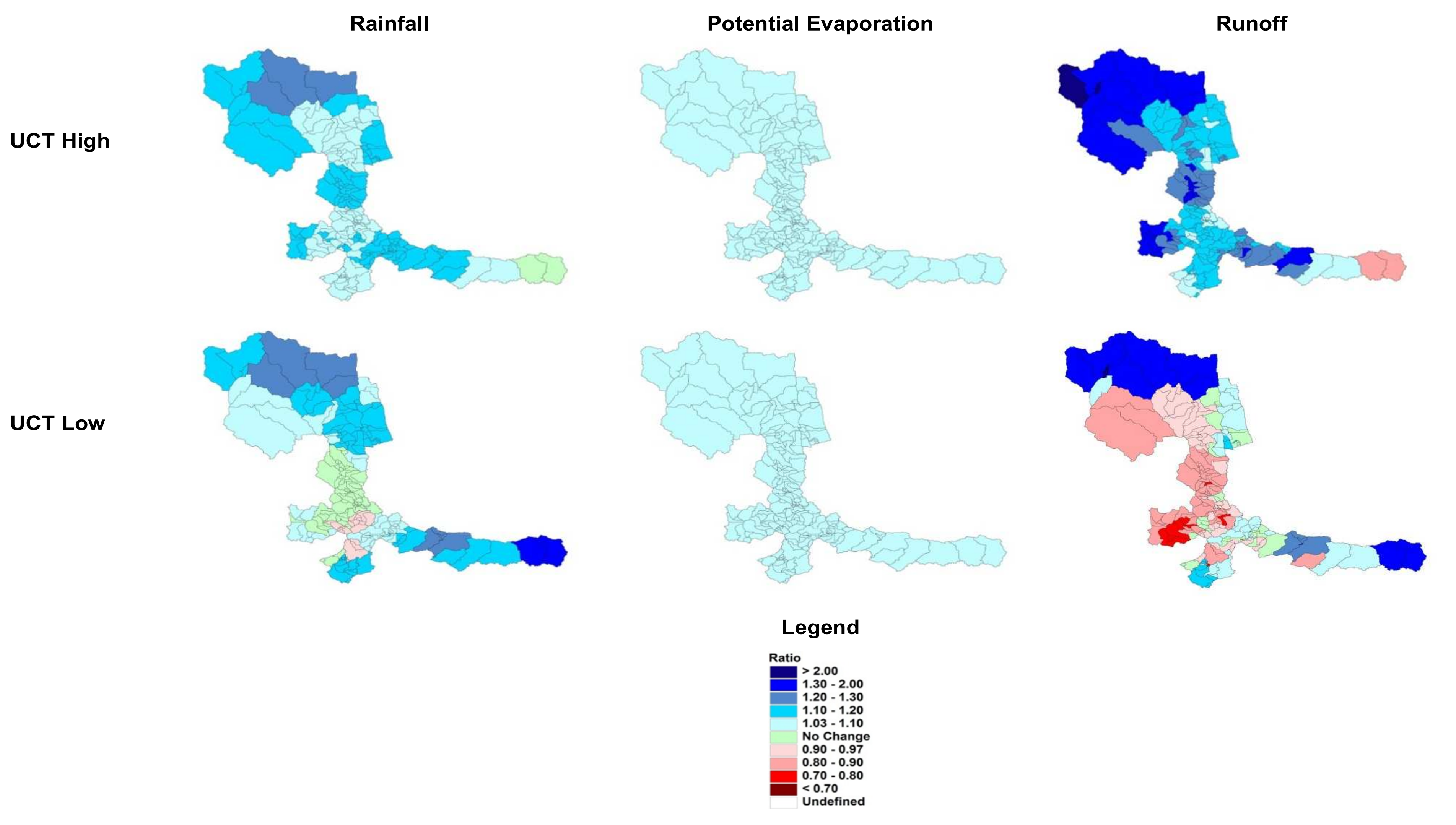


(c)JJA



(d)SON

Ratios of distant future to present mean annual precipitation, potential evaporation and runoff



Scenarios

- **Set 1:** comparing the base analysis (no adaptation)
  - **UCT Base Low** (simulation based on historical climate data from 1971-1990) – on average this simulation shows a **“dry” future**.
  - **UCT Base Low Future** (same as UCT Base Low except for future runoff and crop water use for the period 2046 to 2065)
  - **UCT Base High** (simulation based on historical climate data from 1971-1990) – on average this simulation shows a **“wet” future**.
  - **UCT Base High Future** (same as UCT Base Low except for runoff and crop water use
- **Set 2:** An **increase in farm dam capacity of 20%** as an adaptation strategy to climate change. The relative changes compared to the base analysis are presented and discussed.

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Set 1 results – no adaptation

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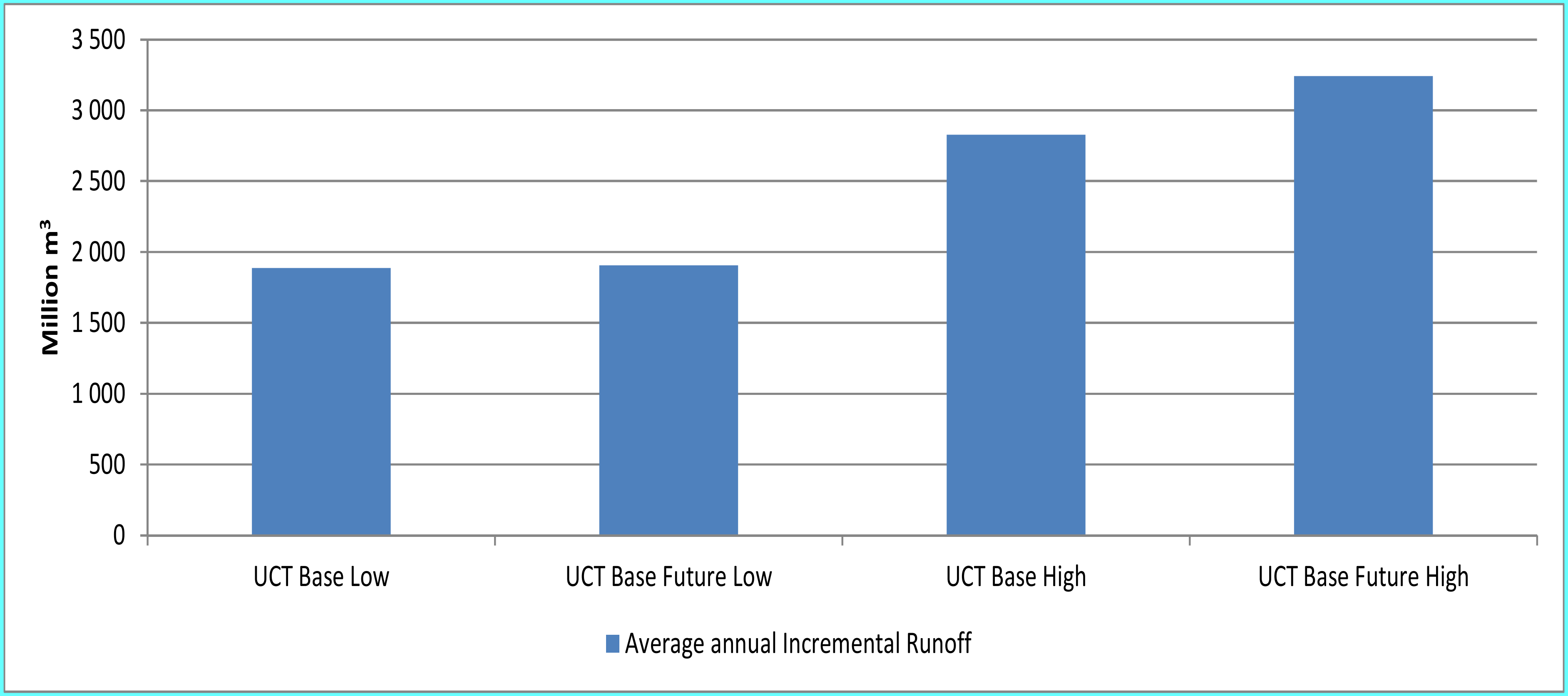
Incremental runoff



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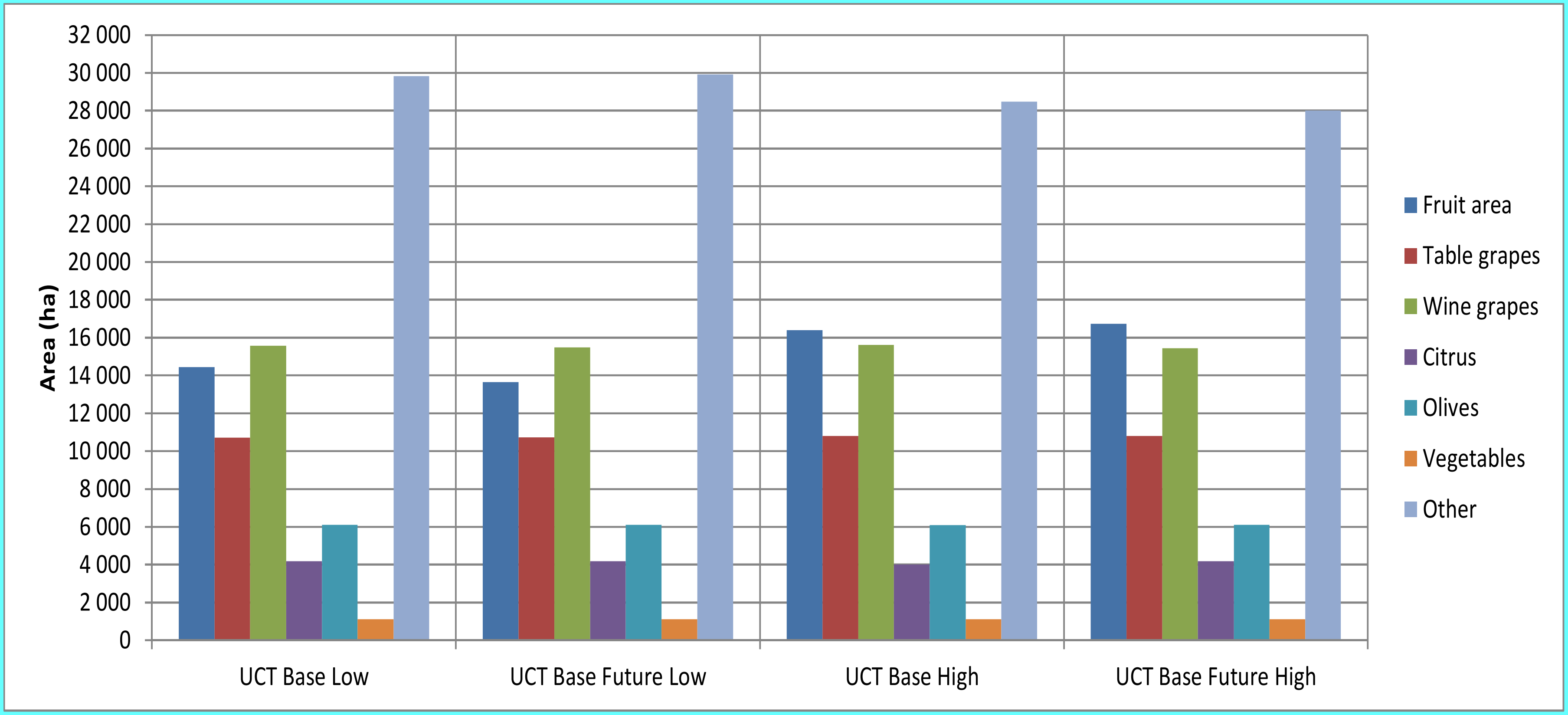
Change in crop combination



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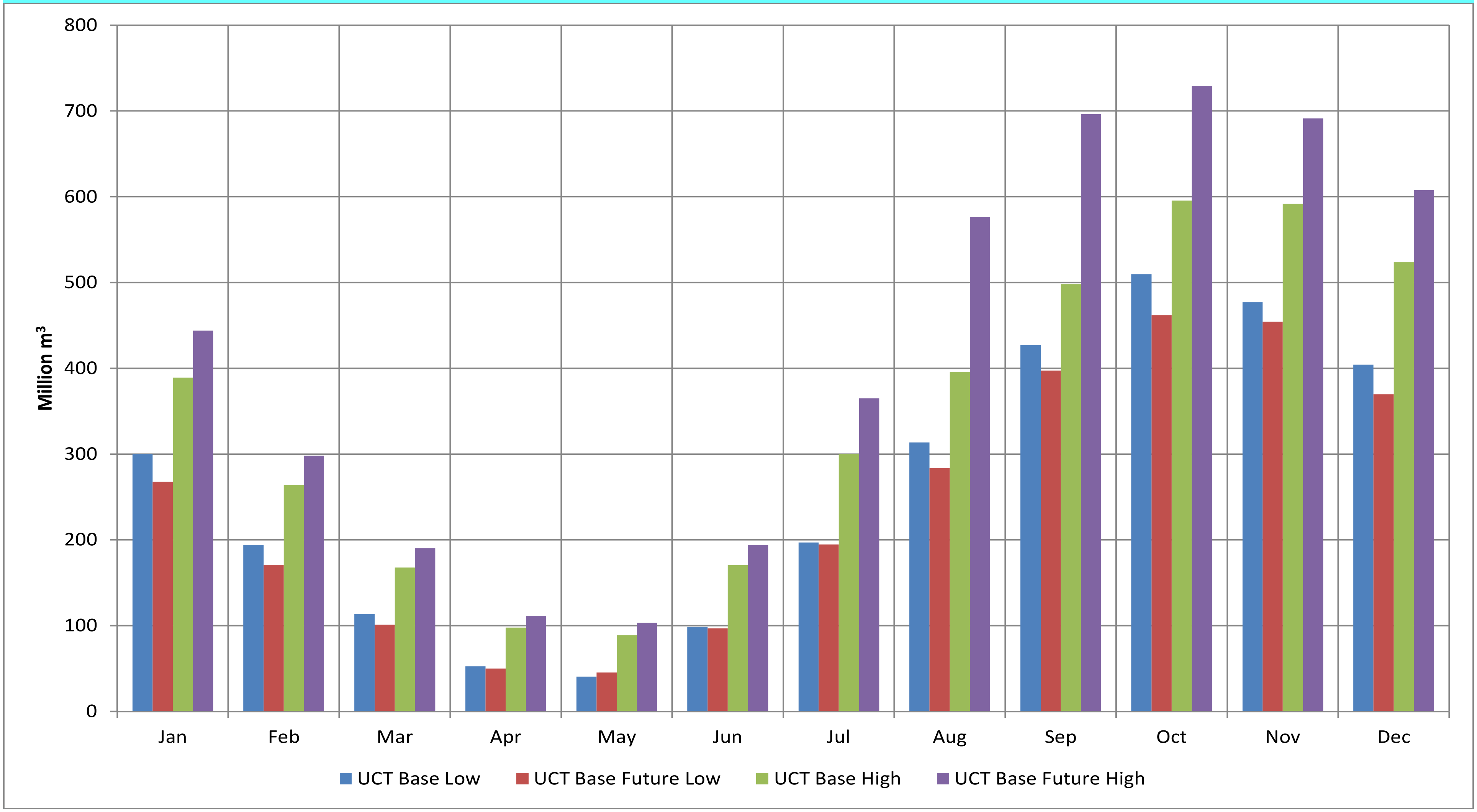
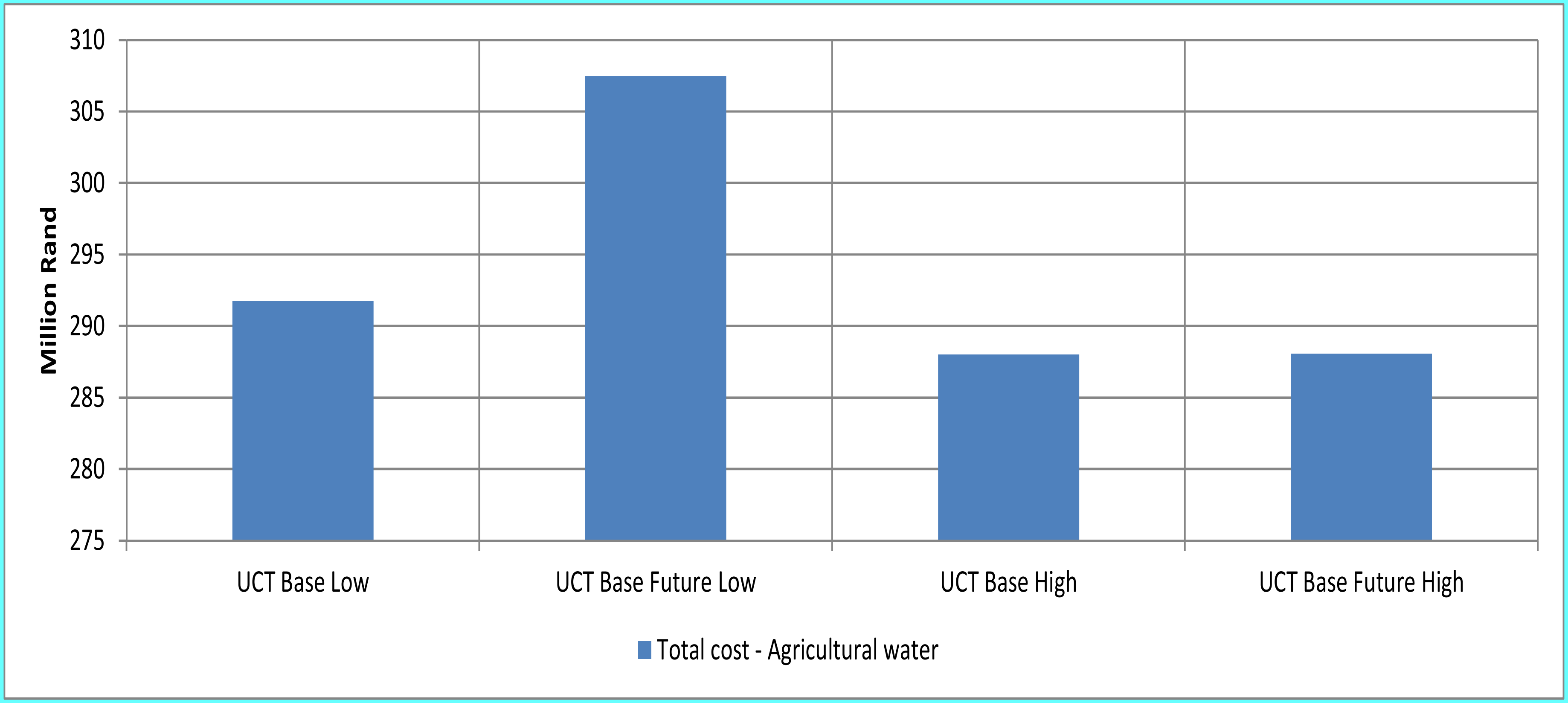
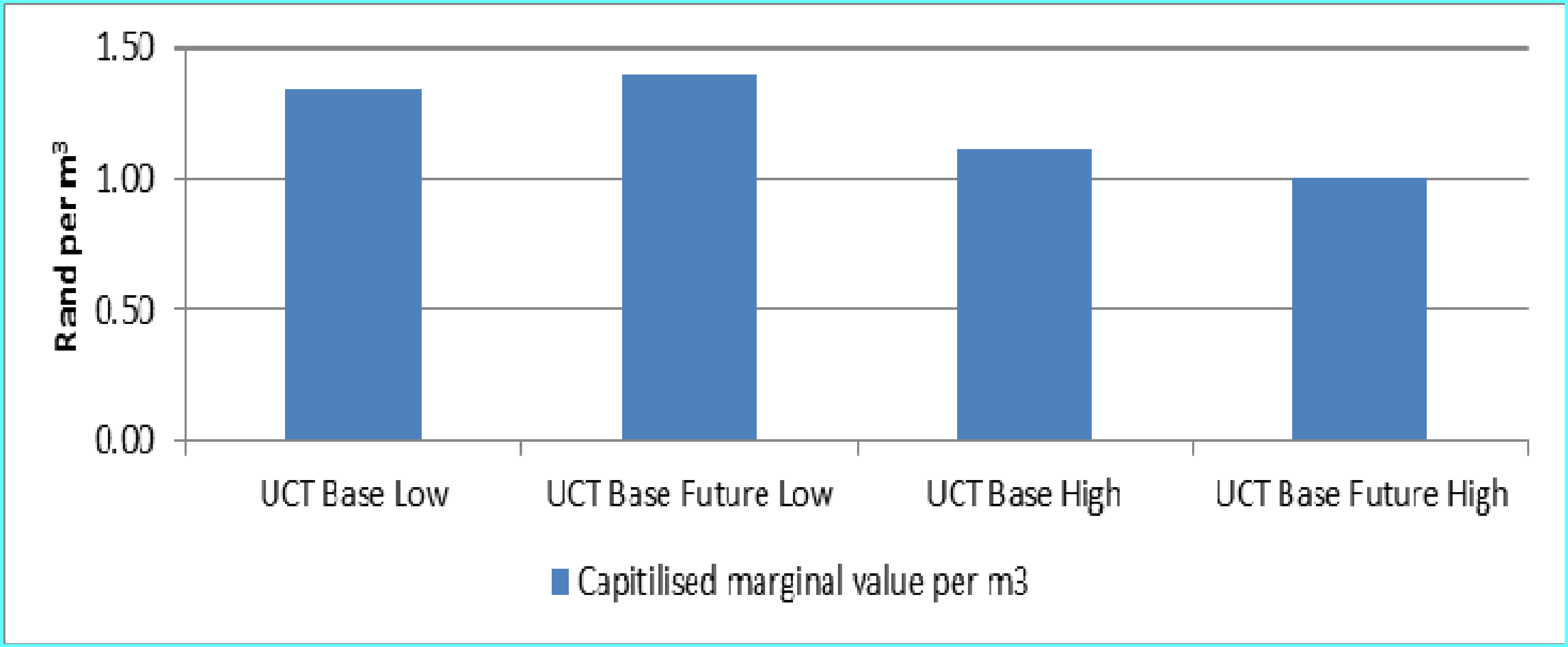
Main dam storage levels



Total cost of agricultural water



Marginal value of water



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Results: 20% increase in farm dam capacity

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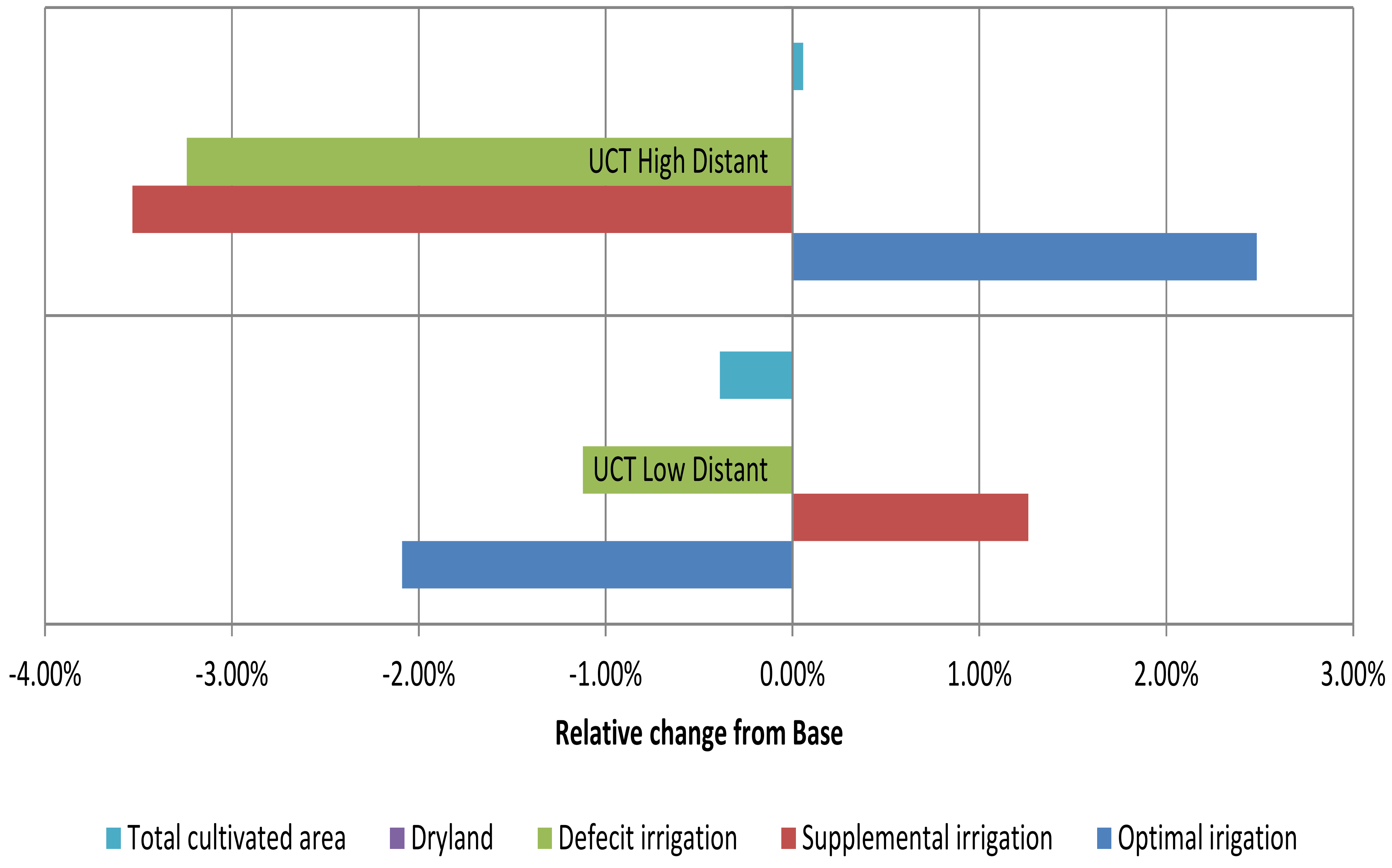
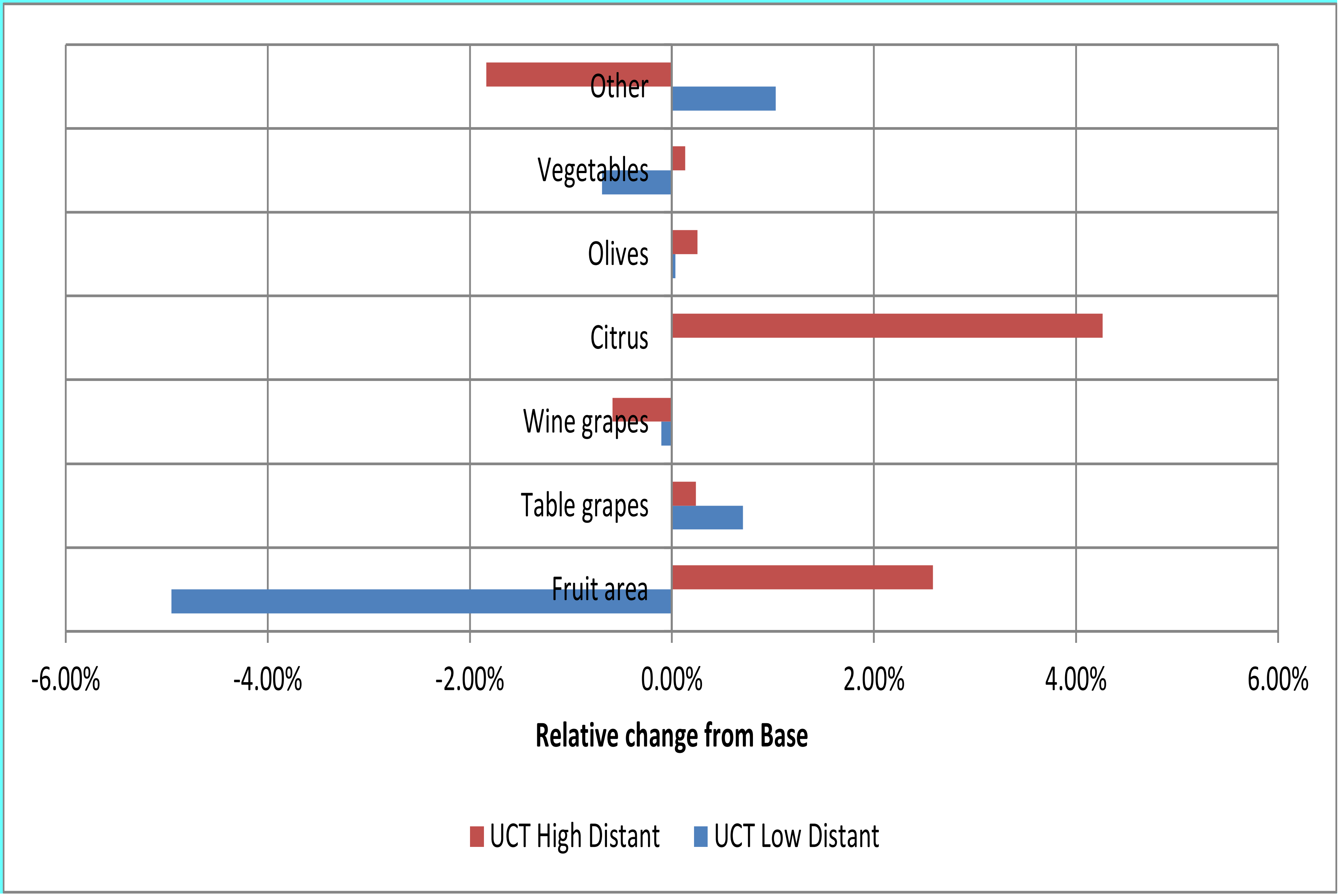
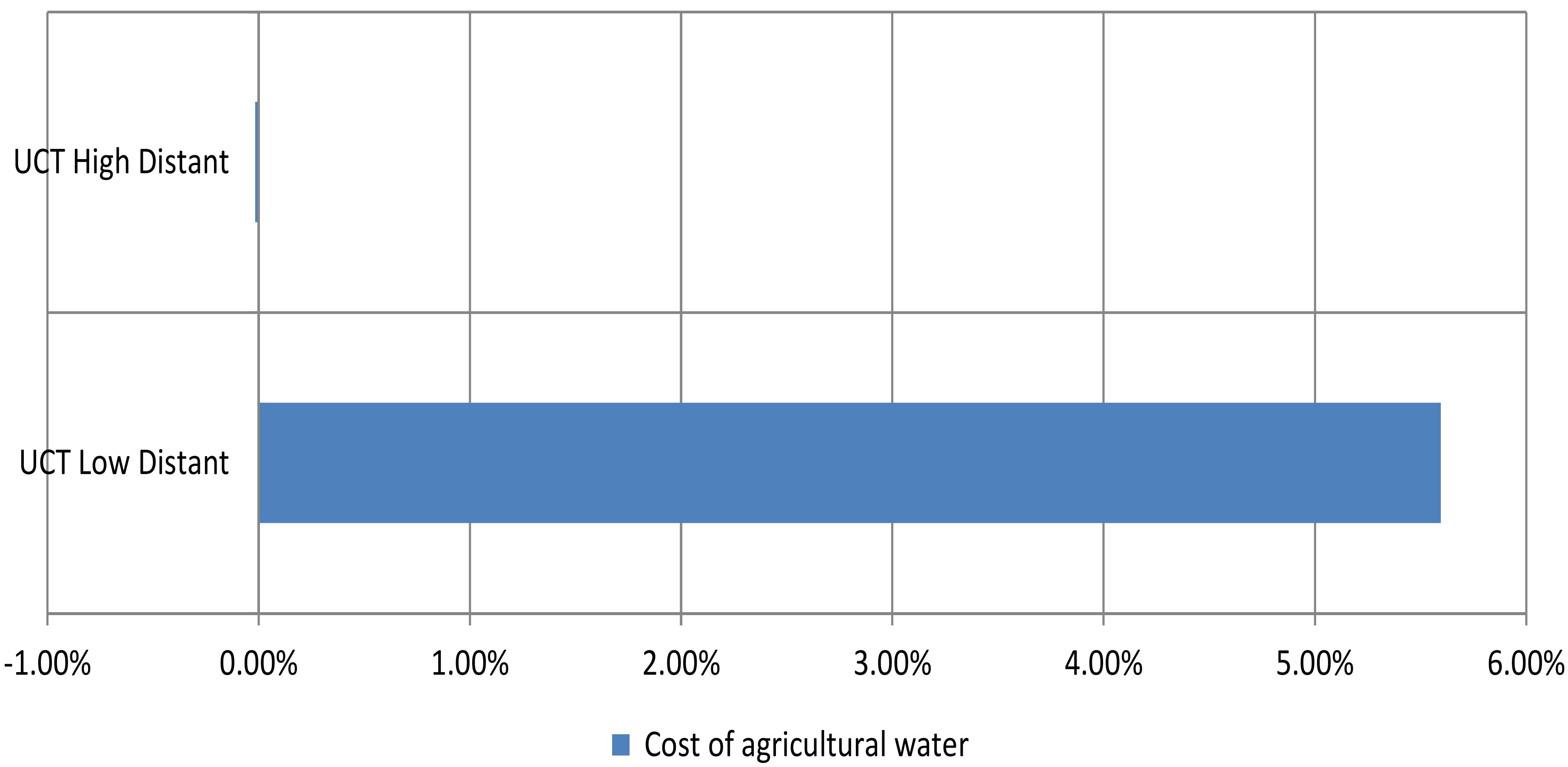
Irrigation technology



Change in crop combinations



Cost of agricultural water



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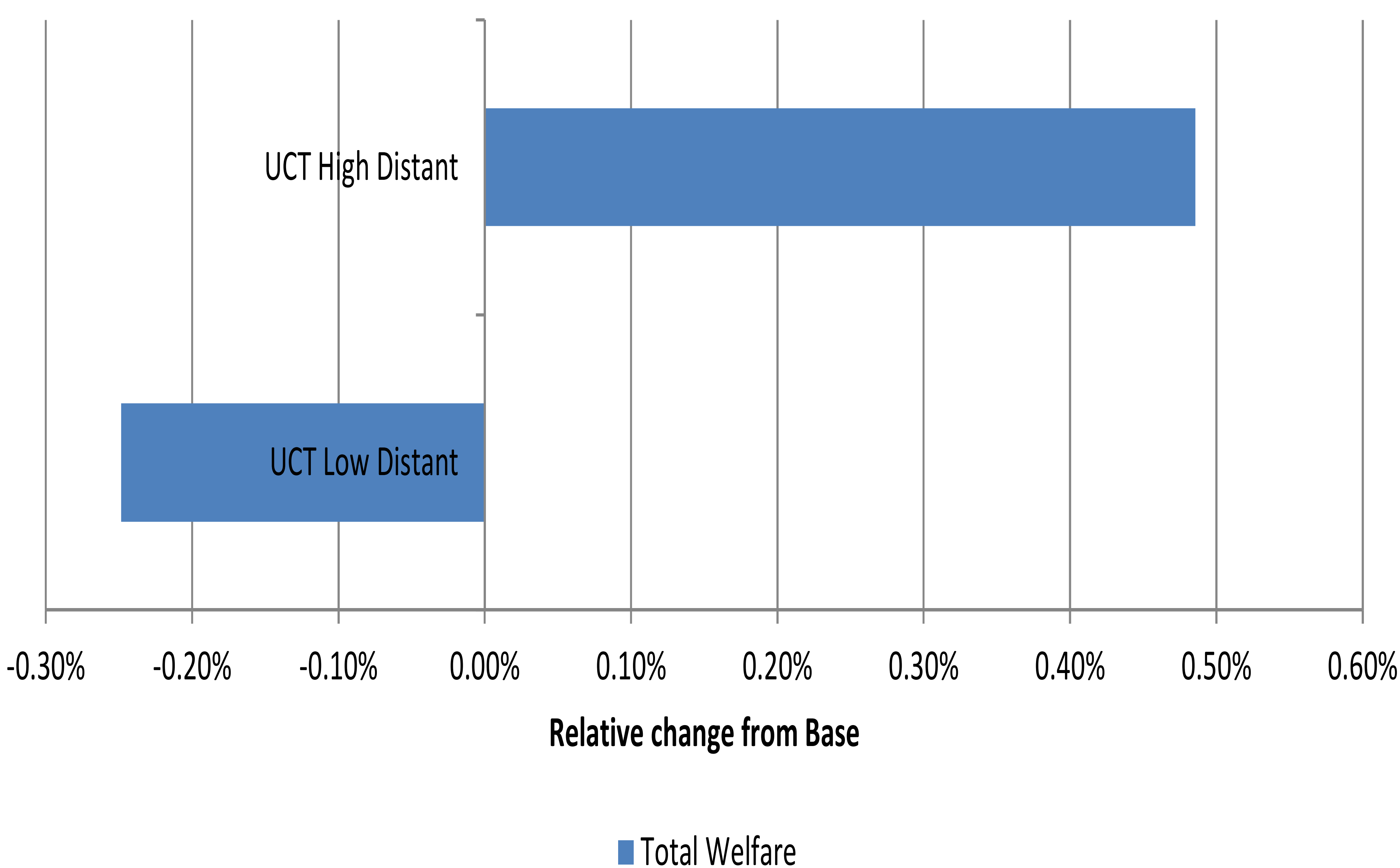
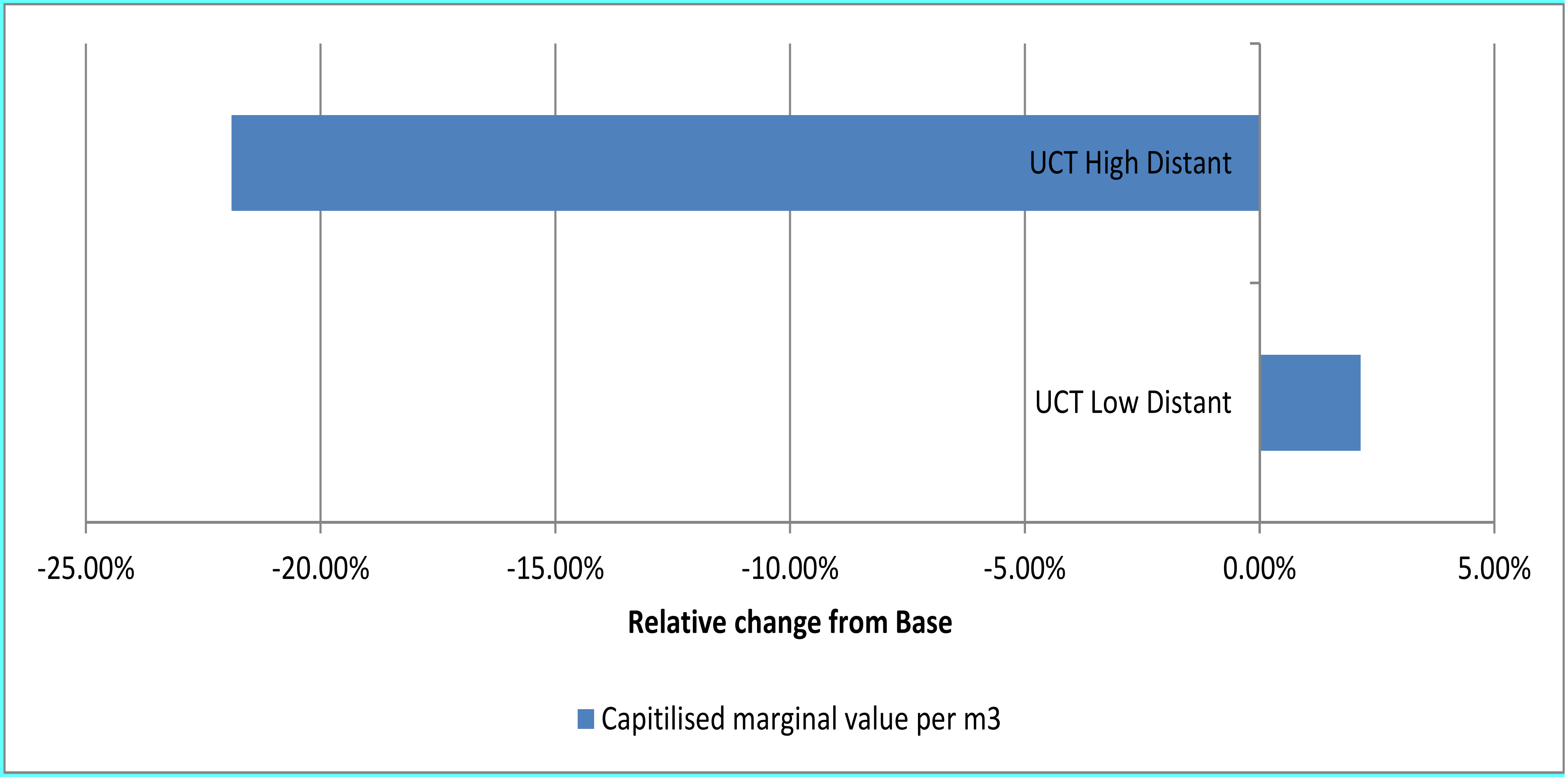
Total welfare



Marginal value of water



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Conclusions

- Models are never complete since they will change as our understanding of the systems improve

- The objective of the modelling exercise was to demonstrate that it is possible to develop an integrated modelling framework for evaluating and making adaptation decisions related to water resources in the Western Cape

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- **Set 1:** The integrated modelling framework can be used to simulate various climate change scenarios and that the results correspond with what can be expected from the impact on runoff, the farming systems, and urban water use.

- **The Set 2** analysis clearly illustrated that the development of 20% additional farm dam capacities is not a good adaptation strategy for the Low flow scenarios.

- A more effective adaptation strategy in the Low flow scenario would probably be to increase overall irrigation efficiency and to make structural changes

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Get the facts, or the facts will get you. And when you get them, get them right, or they will get you wrong.

Dr. Thomas Fuller (1654 – 1734) British physician

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Let us take things as we find them: let us not attempt to distort them into what they are not. We cannot make facts. All our wishing cannot change them.

We must use them.

John Henry Cardinal Newman English Catholic cardinal

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