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shocks. At present the grain and oilseed models incorporate rainfall timing and locality, but the inclusion of carbon fertilisation and temperature effects is an essential improvement that is required. The modelling of climate change effects on the livestock industry will also have to be improved. This would increase the effect of heat stress on growth, milk and wool production. Efforts should also be made to disaggregate results to the regional and sub-regional level.

Research on the climate vulnerability of the South African horticultural and wine industries is urgently needed. Within the South African context, horticultural and wine production are particularly important from a food security perspective due to their role in ensuring that primary foodstuffs, mainly wheat and rice, can be imported at the lowest possible price. The research should also include the development and/or improvement of biodynamic modelling techniques and, in turn, should be integrated with existing sector models to improve the accountability for climate change effects.

Research on how the distribution of agricultural commodities can be improved is essential, given the need to reduce pollution and the expected increase in the trade. This would ensure greater global competitiveness and the provision of food to the consumer at the lowest possible price. The impact of improvements to the existing rail and road network should be investigated in order to inform policy.

The National Planning Commission (NPC, 2011) produced a plan that identifies the creation of an integrated and inclusive rural economy as the primary role of the agricultural sector and highlights the importance of the sector in the creation of employment. One of the plan's suggestions is the creation of employment through supporting labour-intensive 'winners' in order to expand production. The crops identified consist mainly of horticultural crops, including pecan nuts, avocados, mangoes, table grapes, apples, pears and others. The plan assigns a low importance to the maize and wheat industries due to their low growth potential and labour intensity. This highlights the importance of future research on the impact of climate change on horticultural production, the development of improved biophysical models and of integrated sector modelling approaches, due to the higher climate sensitivity of horticulture and its importance as foreign exchange earner/food security its and role as provider and potential creator of employment.

The plan also highlights the importance of increased agricultural productivity on the basis of expanded irrigation through infrastructure investments in new dams, the reduction of distribution losses, increased usage efficiency and improved water scheme management. Research is therefore required on the impact of climate change on existing and proposed storage capacity in the water sector to produce optimal policy recommendations.

Lastly, the plan also highlights the importance of the creation of livelihoods through small-scale agriculture. Research on how the responsiveness to change of these producers could be increased is important because, at present, these producers are not at the frontier of the adoption of new technology and practices when compared to their commercial counterparts.

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CLIMATE CHANGE ADAPTATION
FOOD SECURITY

Adaptation Scenarios Factsheet Series, Factsheet 5 of 7

THE LONG-TERM ADAPTATION SCENARIOS FLAGSHIP RESEARCH PROGRAMME (LTAS) FOR SOUTH AFRICA

The LTAS (April 2012 – June 2014) aims to respond to the South African National Climate Change Response White Paper (2011) by undertaking climate change adaptation research and scenario planning for South Africa and the Southern African sub-region.

The **Adaptation Scenarios Factsheet Series** has been developed to communicate key messages emerging from LTAS Phase 2 (June 2013 – June 2014) to policy- and decision-makers, researchers, practitioners and civil society. The Factsheet Series complements the LTAS Phase 2 technical reports. For further details on this factsheet, see the LTAS Phase 2 full technical report entitled *Climate Change Adaptation: Perspectives on Food Security in South Africa – Towards an Integrated Economic Analysis*.

1. Introduction

Numerous studies have been conducted on the potential effects of climate change on agricultural production in South and Southern Africa, particularly in the maize and wheat industries. Although the results are highly variable, a number of general observations can be made from the findings: i) from a sub-Saharan African perspective, wheat yields are expected to decline, while maize yields are expected to be affected only minimally; ii) the inclusion of carbon dioxide fertilisation has a positive impact through smaller declines or even increases in productivity; iii) irrigated crop production shows an increase in productivity; and iv) the results on South African maize suitability vary from negative to positive, whereas wheat suitability is expected to increase moderately or significantly.

These outcomes reflect the results of models that simulate the impact of climate change on crop productivity (yield) and changes in crop suitability. However, insights into the economic and social impacts of these changes in production and suitability over time are not considered. An integrated approach considering these factors is essential for the evaluation of the food security impacts of climate change. This is because food security is not only limited to availability through own or local production, but also includes accessibility to the product in terms of price.

2. Predicted impacts of climate change

The modelled data revealed that there is only one scenario in which future precipitation levels differ significantly from the base scenario i.e. expected trends in the absence of climate change. Therefore, only this scenario was considered for the analysis. This scenario (MPI 4.5) is equivalent to the warmer/drier scenario under LTAS, and represents the lowest decline in mean annual precipitation of the modeled scenarios. The expected impacts on production/prices of maize and wheat; consumers; and employment are presented in Boxes 1 – 3.

BOX 1: CLIMATE CHANGE IMPACTS ON PRODUCTION AND PRICES IN SOUTH AFRICA

The model data shows a decline in rainfall during the summer months in the maize producing areas of the country that resulted in a projected decrease maize yield. White maize yields are anticipated to decline by 1.1 t/ha on average to 2050, resulting in a drop in total production of approximately 1.6 million t/annum and an increase in the white maize prices of 16%. Within this increased price environment farmers could opt to increase white maize production by expanding the area planted.

Conversely, the model forecasts an increase in annual precipitation during the winter months in the summer wheat producing areas (mostly in the Free State) that results in a projected yield increase of more than 1 t/ha. This increase in yield does not result in an increase in the area planted due to the greater relative profitability of maize production. Within the winter wheat producing areas (Western Cape) the results projected by the model show a small decline in precipitation during the winter moths that in turn results in a decline in yield of 0.6 t/ha. Collectively these changes result in a projected decline in total wheat production of just over 100,000 t/annum relative to the base. This does not result in a change in domestic prices, however, since wheat prices are governed by import price levels.

The project is part of the International Climate Initiative (ICI), which is supported by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

environmental affairs
Department:
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REPUBLIC OF SOUTH AFRICA

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On behalf of
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
of the Federal Republic of Germany

SANBI
Biodiversity for Life
South African National Biodiversity Institute

BOX 2: CLIMATE CHANGE IMPACTS ON COSUMERS

The price impact of the respective climate scenarios on (mostly poor) consumers was evaluated. At present, maize porridge and brown bread contribute 73.5% of the costs of a 'five-item low-income weighted food plate'. In terms of bread, all the climate scenarios showed no deviation from the base because each of the scenarios is based on world prices. In terms of white maize meal, the warmer/drier scenario showed a small deviation from the base. The significance of this deviation decreases over time due to a declining trend in white maize production per household in favour of bread. It has to be stated, however, that the anticipated increase in the price of white maize under the warmer/drier scenario is on top of other staple food prices that are anticipated to increase significantly towards 2030: the cost of a weighted food plate almost doubles in price towards 2025. From a food security perspective this brings the affordability of a balanced diet prominently to the fore.

BOX 3: CLIMATE CHANGE IMPACTS ON AGRICULTURAL EMPLOYMENT

The maize and wheat industries are not major employers and are also not regarded as having significant growth potential – it estimated that these industries collectively employed less than 7% of the agricultural labour force in 2013. For the period 2014 to 2025, employment in the maize industry is expected to decline by 2% relative to the base scenario. This is in part due to the smaller contraction in the area planted in response to the increase in the maize price relative to the base case. This reduction does not necessarily equate to a decline in absolute employment due to the transfer of area (and labour) to the production of other crops, such as soybean.

3. Food security and adaptation responses

The challenges faced as a result of climate change do not act on farmers (subsistence and small-scale) in isolation, but rather interact with the multiple stresses to which farmers are exposed. It is therefore useful to consider how climate change adaptation responses could be integrated with existing best practices that have evolved to cope with these multiple stresses. Such an approach could focus specifically on responses that benefit farmers at multiple scales of production, from smallholder through to large-scale commercial agriculture. Examples include improved transport infrastructure; improvements in irrigation efficiency and water management; continued field trials in partnership with producers, commercial entities and the public sector; public research spending; and public information collection and sharing.

It also has to be emphasised that farmers are already adapting to climate change. The reduction in the area under wheat production that has already taken place serves as a good example. Farmers have opted to decrease the area planted by more than half, partly in response to price decreases, but also to decrease exposure to climate risks. Farmers are also continually conducting formal and informal field trials to identify the varieties suited best to each locality. A supportive response from the public sector would not replace these initiatives, but rather expand and integrate the results of these respective trials. Greater co-operation between farmers, seed companies and state will assist in improving the focus of public research and improve the quality of extension services provided, particularly to small-scale farmers in close proximity to these trials. There is an opportunity for government to explore the role of the state in providing an overarching climate change adaptation framework and associated capacity and support for all agricultural producers.

The area under irrigation could be expanded through new investments in storage capacity. Significant gains are possible, however, within existing systems by reducing distribution losses, adopting more efficient irrigation systems, and making improvements in the management and maintenance of existing irrigation systems. Incentives for the upgrading of existing systems to more efficient alternatives, for example flood irrigation to drip, would be beneficial, especially if incentivised by the state. Alternatively, the amount of water available to consumers could be regulated to encourage investments in more efficient systems.

BOX 4: SUPPORT TO SMALL-SCALE/SUBSISTENCE FARMERS

From a crop-production perspective, small-scale/subsistence farmers should be supported through:

- the development of irrigation infrastructure;
- extension services tailored towards conservation agriculture and climate-smart production systems;
- improvements to the rural road infrastructure to facilitate the delivery of support service to rural areas at the lowest possible cost;
- expansion of existing grants and/or provision of additional grants to allow purchase of goods and materials to improving farming practices, and of food when required; and
- connections to markets to increase their income earned from agricultural production.

BOX 5: ADAPTATION STRATEGIES ALREADY ADOPTED BY FAMERS

Some farmers are already employing adaptation strategies to reduce their production risk. Some examples include:

- reducing planting areas of certain crops, such as wheat, to decrease the exposure to climate risks (as well as in response to fluctuating prices);
- planting crop varieties with a shorter growing period;
- conducting formal and informal field trials to identify varieties best suited to specific localities;
- delaying the start of planting according to rainfall;
- investing in additional machinery to shorten planting time;
- collecting rainwater by creating of furrows near planted areas;
- increasing the use of irrigation; and
- adopting improved farm management practices, including conservation tillage, because of the advantages of reduced soil moisture losses, weed control, reduced erosion and increased general soil health.

4. Research recommendations

Climate change impacts cannot be viewed simply in terms of changes in the suitability of production, yield and eventually total production, but are more usefully viewed in the context of existing trends and farmers' responses to changes in price. With this in mind, a number of research needs are recommended.

The total agricultural production system in South Africa should be modelled (not simply two crops). The model used for the LTAS Phase 2 report covers 52 commodities in the agricultural sector. Therefore, a similar exercise as was undertaken for maize and wheat should be repeated for the other 50 commodities. The maize and wheat model, and that of all the other 50 commodities, will also have to be improved in terms of biophysical modelling capabilities in order to improve the ability to reflect the impact of climate