Project report

Adaptation of agricultural practices to climate change in Sub-Saharan Africa (CAADP)

Good agricultural adaptation practices: South Africa

Date: 1st December 2014

On behalf of
Gesellschaft für internationale Zusammenarbeit, GIZ

Project number: 11.9757.3-001.00
Contract number: 81147672
Reporting company: UNIQUE-KULIMA
Freiburg

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Acronyms

ANC	African National Congress
ARC	Agricultural Research Council
AU	African Union
BEE	Black Economic Empowerment *(Affirmative action)*
BT	*A type of genetically modified seed produced by Monsanto*
CAADP	Comprehensive Africa Agriculture Development Programme
CDC	Catholic Development Centre
DOA	Department of Agriculture
ECOWAS	Economic Community Of West African States
ECRDA	Eastern Cape Rural Development Agency
EM	Efficient microbes
GDP	Gross Domestic Product
GM	Genetically-modified
ha	Hectare
KZN	KwaZulu Natal
MEC	Member of the Executive Council
NAIP	National Agricultural Investment Plan
NEPAD	New Partnership for Africa's Development
NGOs	Non-governmental organisations
PTO	Permission to occupy
SMMEs	Small, micro and medium enterprises
TOT	Transfer of technology

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1 Introduction

Agriculture in South Africa contributes around 10% of formal employment, relatively low compared to other parts of Africa, as well as providing work for casual labourers and contributing around 2.6% of GDP for the nation. Due to the aridity, only 13.5% of the land's surface can be used for crop production, and only 3% is considered high potential. South Africa has a very diverse agricultural sector, not only in terms of the crops grown and the livestock kept but also in the types of farms which range from enormous, highly sophisticated and profitable commercial farms to tiny one hectare (ha), plots on which poor small scale farmers eke out a living using traditional methods.

The current research is part of a project, supported by GIZ, on identifying agricultural adaptation good practices for the Comprehensive Africa Agriculture Development Programme (CAADP). The aim was to highlight agricultural practices from six countries across the continent (Burkina Faso, Cameroon, Ethiopia, South Africa, Togo and Zambia) that will continue to be sustainable in the face of a changing climate. The report focuses on just four of the commodities farmed in South Africa: maize; wheat, vegetables and poultry (for an explantion of how this focus was determined, see UNIQUE and Kulima, 2013[1]). The research was spread geographically across a number of provinces (see figure 1) – poultry farming in KwaZulu Natal; maize farming in the Free State and Eastern Cape; vegetable farming also in the Eastern Cape and wheat farming in the Western Cape – and a range of farmers (commercial, development; small scale commercial and small scale) were included.

The report is laid out as follows. Section 2 provides an overview of the methods employed. Section 3 introduces the farming systems for the selected commodity types, and highlights potential climate change threats. Section 4 looks at gender and agriculture in South Africa. Section 5 outlines all the agricultural adaptations that were observed in the commodity types, and then section 6 analyses the reasons why they are considered good practices. Section 7 provides an overview of the status of development of South Africa's National Agriculture Investment Plan, and section 8 concludes.

Figure 1: Provinces of South Africa (source: Wikipedia, accessed 10 January 2015)

[1] All outputs from this project are available at www.kulima.com/agriculturaladaptation

2 Methods

The initial step in the research process was to undertake a scoping study of the literature around exisiting adaptation to climate change practices in the South African agricultural sector. The results of this research were then presented at a workshop held in Midrand, South Africa in August 2013. The purpose of the workshop was the identification of priority subsectors for further in-depth fieldwork in each of the six countries involved in the project and the development of a best practices framework to use to identify the existence of adaptation best practices. In order to choose subsectors for further investigation, a stepped process of selection and/or elimination was followed. The aim of this stepped process was to ensure that the ultimate shortlist was not only feasible for further investigation within each country, but would yield additional cross-country learnings of relevance to CAADP. Wheat, maize, poulty and vegetables were chosen as the four commodities on which to focus in South Africa (UNIQUE and Kulima, 2013).

As part of the secondary data collection, a long list of practices in adaptation, and the implicit reasons for which these examples were considered good practice, was included. At the Midrand workshop considerable discussion took place on the criteria that constitute good practices with regard to adaptation. Ultimately these were classified into a combination qualitative/quantitative "scorecard" – whereby scores are assigned by the experts, and qualified using appropriate qualitative data, according to a number of criteria relating to the practice itself, as well as the enabling environment. The scorecards were intended to be used as guide for qualitative data collection and not to be used as a questionnaire .

In South Africa, the the primary method of research was through interviews with farmers (sometimes through an interpreter) and others closely linked to the agricultural sector. The interviews were open-ended in order to allow the interviewees to raise the issues that they believed were most important. The scorecards were used to ensure that all the themes necessary for this research were covered. Access to farmers was largely organised by representatives of GrainSA, a grain producers organisation, highly active in the study areas chosen for this research and well respected by the farmers themselves.

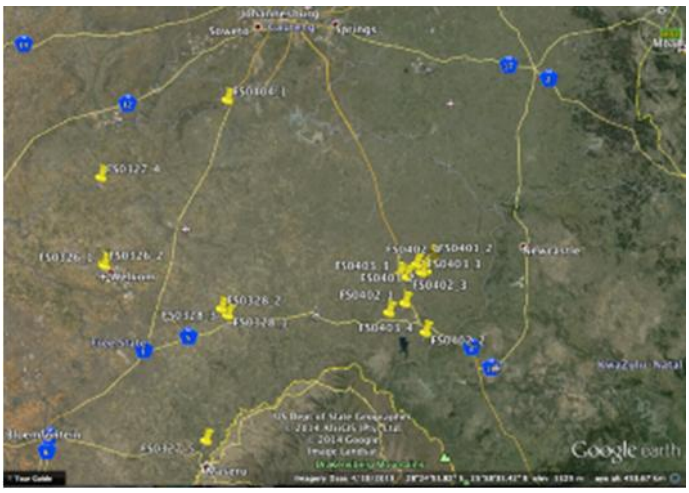

Figure 2: Location of interviews with maize farmers in the Free State

For the research into maize farming in South Africa, interviews were conducted with 18 stakeholders in the Eastern Cape province and 18 stakeholders in the Free State Province in March and early April 2014 (table 1, figure 2). Stakeholders were mostly farmers, with 15 small scale farmers, 14 commercial farmers and 3 development farmers participating in the study. The small scale farmers were located in the Eastern Cape and the commercial and development farmers were located in the Free State. Also interviewed were the heads of the GrainSA Farmer Development Programmes in the Eastern Cape and the Free State, and two representatives of the Eastern Cape Rural Development Agency.

Furthermore, the researcher was invited to attend a Farmers Day worshop organised by GrainSA in Welkom, Free State, at which she presented a brief overview of climate change and its anticpated impacts, which was very well received by the farmers attending (figure 3).

Figure 3: Farmers Day, Welkom, Free State

Table 1: Maize farmers of the Free State interviewed

Sex	**Role**	**Map location**
M	Farms maize, wheat, watermelons, spinach and soya	FS0326_01
M	Farms maize only	FS0326_02
M	Small scale maize farmer	FS0327_1
F	Small scale farmer	FS0327_2
M	Small scale farmer	FS0327_3
M	Commercial development maize farmer	FS0327_04
M	Manager of the GrainSA office in the Free State	FS0327_05
M	Retired farmer – mentors 5 of the best commercial development farmers (maize)	FS0328_01
M	The best commercial development farmer (maize) – mentored by Flip du Preex	FS0328_02

M	Maize farmer. Also mentors development farmers	FS0328_03
M	Maize farmers	FS0401_1
M	Maize farmer	FS0401_2
M	Maize farmer	FS0402_1
M	Maize farmer	FS0402_2
M	Maize farmer	FS0402_3
M	Maize farmer	FS0402_4
M	Maize farmer	FS0403_1
M	Maize farmer	FS0403_2
M	Maize farmer	FS0403_3
M	Commercial development farmer (maize)	FS0403_4
M	Maize farmer	FS0404_1

Figure 4: Location of interviews with poultry farmers in KwaZulu Natal

In KwaZulu Natal, interviews were conducted with 20 stakeholders in the poultry industry in May 2014 (table 2, figure 4). Sixteen of these were active farmers producing layers or broilers, as well as the manager of the Midlands Eggs packshed; the General Manager of the KwaZulu Natal Poultry Institute, a salesman from De Heus feed company and the manager of a company that distributes spent hens for informal sale.

Table 2: Poultry farmers of KwaZulu Natal interviewed

Sex	**Role**	**Map location**
M	Farms broilers	KZN0513_01
F	Pack house manager for Midlands Eggs	KZN0513_02
M	Farms layers	KZN0513_03
M	Farms layers and pullets	KZN0514_01
M	Farms layers	KZN0514_02
M & F	Farm layers and pullets	KZN0515_01
M	Farms broiler breeders	KZN0515_02

M	Farms layers	KZN0515_03
M	Farms broilers	KZN0515_04
M	Farms layers from day olds	KZN0516_01
M & F	Farm layers	KZN0516_02
M	Farms layers	KZN0519_01
M	Farms layers and beef	KZN0519_02
F	General manager of the KZN Poultry Institute	KZN0520_01
M	Farms layers from point of lay	KZN0520_02
M	De Heus salesman	KZN0521_01
M	Farms layers	KZN0522_01
M	Farms layers	KZN0522_01
M	Poultry distribution	KZN0522_02
M	Layers from point of lay	KZN0522_03

Figure 5: Location of interviews with small scale (vegetables and maize) farmers in the Eastern Cape

Amongst small scale maize and vegetable farmers, interviews were conducted with 21 stakeholders in the Eastern Cape province in June and July 2014 (table 3, figure 5). Most stakeholders were located in rural the areas surrounding Mthatha and East London. Eighteen of the participants were subsistence farmers, although some exhibited elements of commercial farming. Also interviewed were the head of the GrainSA Farmer Development Programme in the Eastern Cape and two representatives of the Eastern Cape Rural Development Agency. In addition, the researcher was invited to attend a farmers meeting which while not very useful in itself as it was conducted largely in Xhosa it did serve to introduce the researcher to the community.

Table 3: Small scale maize and vegetable and maize farmers of the Eastern Cape interviewed

Sex	Role	Map location
M	Head of GrainSA development office in Mthatha and my contact for interview arrangments	EC0626_01
M	Maize and vegetable farmer	EC0626_02
M	Secretary for the OR Tambo Farmers Association Farms fruit, organic vegetables and maize	EC0626_03
M	Maize and vegetable farmer	EC0626_04
M	Maize, vegetables and livestock farmer	EC0627_01
F	Sheep, cattle and maize farmer	EC0627_02
M	Spinach farmer (with some livestock)	EC0630_01
F	Vegetable farmer	EC0630_02
M	Vegetable and livestock farmer	EC0630_03
F	Vegetable farmer	EC0630_04
M	Vegetable and maize farmer	EC0630_05
M	Vegetable and miaze farmer	EC0701_01
F	Vegetable and maize farmer	EC0701_02
M	Maize and livestock farmer	EC0701_03
F	Maize and potatoes	EC0702_01
M	Vegetables and livestock	EC0702_02
F	Vegetable, maize and livestock	EC0703_01
M	Maize farmer	EC0703_02
M	Maize and livestock farmer	EC0703_03
M	Works at the Eastern Cape Rural Development Agency (ECRDA)	EC0704_01
	Works ECRDA	EC0704_01

Figure 6: Location of interviews with wheat farmers in the Western Cape

Interviews were also conducted with 20 stakeholders in the wheat farming sector in the Southern Cape and Swartland regions of the Western Cape, South Africa, in late May and early

June 2014 (table 4, figure 6). Most of these were active farmers, as well as development farmer mentors, an employee of Overberg Agri, the local co-operative, and a researcher at the Department of Agriculture at Elsenberg.

Table 4: Wheat farmers of the Western Cape interviewed

Sex	Role	Map location
M	Wheat, other grains and livestock farmer	WC0527_01
M	Cropping and livestock farmer	WC0528_01
M	Wheat, maize and livestock farmer	WC0528_02
M	Wheat, other grains, lucerne farmer	WC0528_03
M	Wheat and other grains farmer	WC0528_04
M	Wheat, other grains and ostrich farmer	WC0529_01
M	Wheat, other grains, lucerne and livestock farmer	WC0529_02
M	Mainly wheat and maize with some other crops	WC0530_01
M	Works for Overberg Agri (a grain co-op)	WC0530_02
M	A researcher at the Department of Agriculture	WC0602_01
M	Grows wheat and oats silage for his dairy cows and grazing fields for livestock	WC0602_02
M	Mainly wheat, canola and lupin farmer	WC0602_03
M	Mainly wheat and maize farmer	WC0603_01
M	Wheat and sheep farmer	WC0603_02
M	Wheat farmer	WC0603_03
M	Mainly wheat but also other grains and some livestock farmer	WC0604_01
M	Wheat and other grains farmer	WC0604_02
M	Wheat and other grains farmers	WC0604_03
M	Wheat farmer	WC0605_01
M & F	Wheat, maize and lucerne farmers	WC0605_02

Interview transcripts were typed up as soon after the interviews as possible in order to capture as much detail as possible. From the transcripts, adaptation practices were identified and a scorecard for each practice was completed (see Annex 1). A table of the scores for all of the adaptation practices across all four commodity types was then constructed in order to ease the process of identifying the adaptation practices that scored the most highly across the most number of commodity types (see Table5 in Annex 2). There were extremely few individual adaptation practices that were common to even two of the four commodities under investigation. It was therefore necessary to group the individual adaptation practices into six main adaptation practices categories: Diversification; Altered timing; Conservation farming; Mechanisation/ new technologies; Changing densification and Additions/ supplements (see table 6 in Annex3. Each commodity type is represented in each of the six main categories of

adaptation practices thereby making it possible to compare (main category) practices across the different commodities[2].

For each of the six main category adaptation practices, a scorecard was constructed (see Annex 4) showing not only the individual score allocated to each individual practice but also an elaboration/ justification for why the particular score was awarded. In addition, a median number for each section of the adaptation scorecards was calculated in order to aid comparison. The median is the middle score for a set of data that has been arranged in order of magnitude and is useful because it is less affected by outliers and skewed data than an average.

3 Farming systems for selected commodities

3.1 Maize

Maize is an important crop in South Africa (figure 7) and it is grown over a large area. There have been significant advances in maize production in recent years and in the last few decades many wheat farmers stopped farming wheat in favour of maize. One of the most important advances made has been the development of genetically modified (GM) seeds, made by Monsanto and other seed companies.

Before the mid-1990s the Maize Board set the maize price, but in the mid-1990s the Maize Board was closed down and replaced by the Maize Trust. As a result of this change the maize price became subject to the open market and currently the selling price is based on futures trading. Maize is traded internationally and the price worldwide is extremely volatile. According to farmers, this price variability is not influenced by the climate or the resultant yield in South Africa, but by many other factors such as the relative strength of the South African Rand and the recent political turmoil in the Ukraine. The variability of the maize price is a significant factor that affects farmers.

[2] All material is available at www.kulima.com/agriculturaladaptation

Figure 7: Maize farming, Free State

The stakeholders interviewed in the course of the research represented two extremely different groups of South African farmers. Commercial farmers in the Free State usually farm on family farms that have been in the family for generations and that they inherited from their fathers. These farms are usually extremely large, often as much as 1000 hectares, and farmers utilise large implements and sophisticated technology to farm them. These farms are characterised by high total yields. They are run by the farm owner or by a manager who is highly knowledgeable about farming and often have agricultural degrees. They also have a high level of access to technology and the internet.

On the other end of the spectrum are the small scale farmers in the Eastern Cape. They usually farm in the area in which they grew up, and frequently on the land farmed by their parents. In contrast to commercial farmers they generally do not own the land on which they farm, rather it is communal land that they have permission to occupy. Farms of this nature are generally very small, with the average farm size being between about one and five hectares. The total yields, and therefore the sales, of these farms are very low, and there is often a high rate of crop wastage occurring as a result of inadequate storage and harvesting facilities. Most of the Eastern Cape small scale farmers have no formal training in agriculture and they use the methods taught to them by their parents or by farmer organisations such as GrainSA that undertake farmer development in the region. A large percentage of the people currently farming in this setting previously had jobs in towns and cities - of the farmers participating in this research some had previously been miners and others teachers. These stakeholders had become farmers after their retirement from formal employment.

There is also a category of farmers in the Free State that are designated as ‘development’ farmers. They are black farmers who have usually acquired farms through land redistribution programmes. These farmers face many challenges when trying to make their farms successful. They usually have no formal training and very little experience in managing farms or businesses. Additionally, they are usually given (very short) leases by the government and therefore cannot

use their farms as surety for bank loans so are unable to access capital for farm inputs and equipment. In many instances they do not have access to good farmland with high potential yields because as soon as these farms go on to the market, they are bought by commercial farmers. The government, which buys the land for development farmers, is slower to act so they miss all the good options to purchase.

Adaptation practices, especially those that require expensive inputs, but also those that need knowledge and capacity, tend to be concentrated amongst the commercial farmers. To illustrate this point, according to one small scale maize farmer: *"[We] had a big problem with the weather last year – it was very hot. There were big storms and then there was no rain. [We] didn't know how to handle it – [we] had no answers. [We] always plant the same and then just hope for rain. If [we] know that it wouldn't rain then [we] would plant less, but [we] don't know that for sure so [we] plant the same."*

3.1.1 Climate change threats to maize production

Maize is a summer crop and is grown in the summer rainfall regions of South Africa. There are several potential climate stressors to maize production in the country. Firstly, the temperature plays a role in maize production as maize requires warm temperatures during the summer - it needs to have a certain number of hot days in order to have high yields. However, maize cannot withstand temperatures that are too high, particularly during sensitive stages of their lifecycle. Maize yields are decreased if the maize is exposed to frost before it has finished growing. In most of the maize producing regions included in the research farmers reported that the climate was within the moderate range for maize production, and that the crops could sustain cooler or warmer temperatures if required.

The amount and frequency of rain is also very important for maize production. One farmer stated that his main concern in terms of the climate is that the rainfall patterns are not the same every year and are not predictable. For mechanical reasons farmers need there to have been some rain before they plant maize, although larger planters are able to plant in drier ground. If the rainy season starts too late in the summer, planting is delayed, negatively affecting the crop yield. It is critical that rain is well distributed during the summer - if there is a prolonged dry period within the season the maize will stop growing and will not continue to grow even if there is a lot of rain later in the season. If this happens 15 – 20% of the potential yield can be lost. High temperatures exacerbate dry periods within the rainy season, so, although maize can withstand high temperatures, the impact of these temperatures is reduced moisture availability which is detrimental to maize. The dependence of farmers on regular and reliable rain is the way in which climate change is most likely to affect them. One small scale farmer in the Eastern Cape lamented: "*drought brings more poverty".* Maize crops are also at risk from large storms. Hail is one of the most common causes of damage to crops and extremely high rainfall causes erosion and soil runoff. In both cases, widespread damage to crops can occur. In the context of a changing climate the unpredictability of rain, and expected high intensity but infrequent rainfall events, is likely to make maize farming more difficult.

Maize farmers were concerned about climate change but, whilst many of them had adopted new practices that would help them adapt to climate change, many of these were adopted in order to increase yields and not because of climate change.

3.2 Wheat

Historically there was a much larger area under wheat production in South Africa and wheat farming under irrigation in the Free State contributed a large portion of the country's yield (figure 8). Wheat production was relatively low risk because the state run Wheat Board set the price of wheat at a rate derived from the cost of producing wheat. In the mid-1990s the Wheat Board was shut down and the wheat industry moved into the free market. This, coupled with the advances that were being made in maize cultivars, led many farmers in the Free State to start producing maize instead. Farmers in the Western Cape, the other important wheat producing area in South Africa, continued to grow wheat because they benefited from the winter rainfall in the region. Many farmers started innovating their methods at this time in an effort to remain competitive in the free market system.

Wheat farmers generally rely on several farming sectors for their income: they mostly grow oats, canola or barley in addition to wheat, and they usually also have livestock. Oats have always traditionally been grown in areas under wheat production. In the 1980s farmers started growing barley for South African Breweries (SAB) because South Africa was under sanctions and they could not buy barley for beer production from other countries. There are two factors that have now led to barley being planted begrudgingly by farmers. Firstly SAB is the only buyer and they set a price that farmers believe to be unfair. Secondly the cultivars that are available are relatively low yielding and breeding in South Africa has been financed by SAB and therefore focuses on increasing the beer brewing quality of the barley, and not the yield. In the early 1990s when the sanctions against South Africa were lifted, canola seeds became available to farmers. Canola became a very popular crop because there is a large demand for vegetable oil and vegetable oil cake. Canola gives farmers new options for chemical weed control because it is very different from wheat; and the combination of canola with wheat farming is good for the soil. The majority of farmers in the study group have sheep in addition to their crop farming, although some have cattle. Sheep are generally considered to work better within the wheat production system.

Figure 8: Wheat farming, Western Cape

Farmers emphasized the importance of economies of scale in wheat farming. Farms are becoming increasingly large and several farmers mentioned the fear that if they do not continually expand and keep acquiring new farms their ativities would no longer be economically viable. Farm expansion is particularly important because of the cost of the farming implements needed in the modern wheat production system. An unfortunate consequence of the need to have large farms is that it is very difficult for someone to start farming because of the high cost of start-up capital. A second consequence of the constant expansion of farms is that there are more farmhouses than there are farmers. Several people reported that they have opened Bed and Breakfasts and guesthouses in these unused farms, mostly to give their wives something to do, or as one farmer stated: *"… to keep the wife busy".* The income derived from these guesthouses was insignificant compared to the turnover of the farm and farmers denied that these pursuits were undertaken to contribute to their livelihoods.

3.2.1 Climate change threats to wheat production

The timing of rain is very important for wheat farming and there are three factors that determine the success of the season's yield. Planting takes place between April and May and can only begin once there has been some rain because the planters cannot plant in dry soil and the seeds need moisture to germinate. Delayed autumn rains shorten the growing season and result in lower yields. Mid-season droughts can be very damaging to the wheat crop. The third period in which rainfall affects wheat is just before or during harvesting. The wheat needs to dry to 13% moisture while in the fields before it can be harvested. If it rains when the wheat is already dry, but before it is harvested, it germinates while still in the field and begins to badly degrade. This results in wheat having the same volume but being much lighter and in this case they will not only have fewer tonnes to sell, but the wheat will also be sold at a lower grade and therefore at a lower price. The lack of rain during harvest time is so important that farmers commonly mentioned the expression *"the judge is sitting in September".*

Heavy rain, hail and wind also threaten grain production in the Western Cape. Heavy rain and hail damage the plants and result in lower yields and wind can be extremely detrimental to the amount of the crop that is actually harvested, rather than being scattered over the field. Wheat needs a certain number of cold units to grow well; if it is cold the wheat spreads out horizontally before growing vertically and results in a very high yield. If it is too warm the wheat grows very upright and the yield will not be good. Although temperature is a potential climate stressor for wheat farming, farmers were not particularly worried about its effect because they felt that it is more than cold enough in the Western Cape in winter, and even if winter temperatures are slightly higher, wheat farming will still be viable on their farms.

3.3 Small scale maize and vegetables

Figure 9: Small scale vegetable farmers, Eastern Cape

Farming in the regions around Mthatha and East London in the Eastern Cape employs mostly traditional methods and crop types (figures 9 and 10). The scale of production is mostly subsistence, however some farmers produce enough excess that they are able to sell produce to people in their communities or even to local supermarkets. A wide variety of vegetables are grown, including spinach, cabbage, broccoli, potatoes, onions, butternut, peas, beetroot, brinjals, chillies and lettuce. Farmers also cultivate fruit trees, especially peaches and oranges. Mostly these vegetables are grown in gardens adjacent to their houses but when they are grown as cash crops they sometimes occur on larger tracts of land away from the farmer's house. Due to the usage demands of small scale farming, farmers generally produce a small amount of a variety of different vegetables. However, there are some cases where they have focussed their efforts on a cash crop, which is grown on the majority of their land. This was the case particularly with spinach and potatoes. Farming is done in family units, so typically husbands, wives and children are all involved, and extra labour is hired only very infrequently when there is a big job to be done such as erecting a fence, or if there has been a particularly good harvest.

The land tenure system in the Eastern Cape plays a large role in the farming system. Most farming is done on communal land where farmers have been granted permission to occupy by the local traditional authority. Even when farmland is passed from one generation to the next it is done on the understanding that the new generation has permission to occupy but that they do not own the land. There are a few exceptions to this and in some cases farmers have managed to purchase land, but also on a small scale. In other areas of the Eastern Cape the predominant farming type is large scale, privately owned, commercial farms. Unlike small scale farming in the province, white farmers mostly own the large commercial farms, although there are some black farmers that have bought farms through help from the government.

The communal tenure system creates some advantages for farmers but also some significant challenges. An advantage is that it is possible to acquire large areas of land without any financial investment and any available capital can therefore be used for inputs. This effectively lowers the risk to farmers. A negative consequence of communal land tenure is that the farmer's right to the land is not guaranteed. One farmer explained that he has been given a large tract of land next to a river and he had plans to start a commercial coffee farm. After he had cleared all the land and was prepared to plant, the traditional leaders told him that, because he was planning to *"enrich himself"* with this land, they were taking it away from him. This left him in a very difficult position because although he later won a court case that determined that he would be allowed to keep the land, he was afraid of doing so and facing revenge from the leaders. Farming on communal land also makes it more difficult to access loans because banks need surety on the loans they give.

Figure 10: Small scale maize farmer with his crop, Eastern Cape

3.3.1 Climate change threats to small scale maize and vegetable production

The climate plays a large role in small scale maize and vegetable production in the Eastern Cape. This is particularly the case compared to commercial farming because small scale farmers have lower capacity to cope with adverse climate conditions. High temperatures affect farming to some degree - farmers stated that different vegetables could not cope with high temperatures. However, the far greater climate threat is water scarcity. Hot temperatures compound water scarcity. Vegetables are grown all year round and are usually planted approximately every three

months in response to the length of the plant lifecycle. During summer the plants are rain fed, but during winter most vegetables produced in the area require some irrigation. This is especially the case when they are seedlings. Many farmers stated that they could not cultivate a larger area because they did not have access to enough water for irrigation. Water for irrigation was often sourced from municipal supplies via reservoirs which dried up during the winter dry season. They did not pay for the water used. Even though several farmers in the study group farm in very close proximity to a dam, they lack the necessary permits to access the water and they do not have the capital to develop infrastructure that would allow them to use dam water for irrigation. In addition to water scarcity, storms threaten the success of vegetable farming. Hail can have a large negative effect on yields and erosion from rainstorms can wash plants like spinach away and necessitate replanting by farmers.

In addition to the financial and infrastructural incapacity of farmers to irrigate their farms, there is also a fundamental climate change threat resulting from the attitudes of farmers. Most farmers referred to the annual dry season as a 'drought' and although this may have been a consequence of a language barrier it was indicative of a general unpreparedness among those interviewed. Mostly they reported that they have drought every year, that there is nothing they can do to prepare for drought and that they farm using exactly the same methods as their parents. Both the unwillingness of farmers to adapt and the practical difficulties in doing so has left them vulnerable to negative consequences from climate change.

3.4 Poultry

The poultry industry is divided into activities leading to the production of chickens for consumption and of eggs for consumption (figure 11). These two industries face sometimes similar but often very different challenges. Chickens that are bred for human consumption are called broiler chickens and they are bred to have large breasts and to grow very fast, maturing at about 5 weeks old. Chickens that produce eggs for human consumption are called layer chickens and they have been bred for the speed and quality of their laying. They mature and start laying eggs at about 18 weeks and continue to lay until about 70 weeks, at which time their production declines and they are culled. One of the biggest challenges that poultry farmers face is disease and many poultry farms have very strict biosecurity measures in place. For reasons of biosecurity, broilers and layers are not produced on the same farms. The biggest threats for transfer of diseases are people, wild birds and dust. Broilers are far less hardy than layers, and all birds are also particularly vulnerable when they are young.

Figure 11: Poultry farming, KwaZulu Natal

3.4.1 Climate change threats to poultry production

Most poultry farmers interviewed in KwaZulu Natal stated that they did not face any challenges from potential climate change, or that there is very little they could do about climate change so they do not worry about it. According to a representative of the KZN Poultry Institute: *"They [poultry farmers] haven't felt the impact of climate change on poultry production yet because everything is so artificially controlled, but it will have an impact in the future. There may come a point in the future when it is too expensive to cool the hen houses down".*

It was also pointed out that farmers do not intentionally adapt to climate change, but that they do it without realising. Upon questioning, several threats emerged. Chickens are very vulnerable to heat stress. When it is hot feed consumption decreases and consequently the rate of growth for broilers and of egg production for layers is reduced. Birds are also likely to die if the heat stress is too severe. Heat stress is generally worst in the afternoon when the sheds have been warming all day, and it has a strong geographic pattern. Farmers in cooler areas within the study site had sustained very few losses due to heat stress whereas farmers in warm areas (which they explained to be nearer to the coast) faced real heat stress challenges every year. Heat stress is also more severe when coupled with high levels of humidity. Broilers are more susceptible to heat stress because they mature so fast and therefore climate change may affect the broiler industry more.

Water scarcity is another potential threat from climate change. Chickens have to have a very constant supply of clean drinking water; they need to drink twice the volume that they eat and their water demand also goes up when it is hot. Without water, the chickens would die. Water is also vital for other aspects of poultry production. It is very important for biosecurity in terms of cleaning people and cars entering the farms, and for cleaning sheds and equipment periodically. Broiler production requires a large amount of water because of the extra cleaning associated with slaughtering birds. Many of the measures taken to reduce the risk of heat stress

also require water, so the heat challenge from climate change could be exacerbated by insufficient water or water of inferior quality. Most poultry farmers in the study area get their water from private boreholes. This requires a pump to extract the water and they have to pay a levy on the water used, but it still works out to be a very cheap water source. Other water sources used are rivers and municipal water. Rivers are generally not used for feeding the chickens because of variable water quality, but are used for supporting services like cleaning. Municipal water is very expensive and many farms are too remote to be connected to piped water, however the water is of high quality and when necessary those farmers with access use municipal water for chicken drinking water only.

Climate change is likely to affect farmers in many ways, one farmer declared: *"we haven't done anything about climate change, it's all about the maize farmers for us"*. Chicken feed in South Africa is composed of about 60% yellow maize, 10% sunflower oilcake and 10% soya oilcake. Broilers and layers are given different feed depending on the stage in their lifecycle and the time of year. The price of feed accounts for 60 – 70% of the total input costs of poultry production. Poultry farming is therefore highly dependent on the price of maize. Many farmers cited this as the biggest way in which climate change could affect them due to the effect of climate on maize yields. Most of the maize used in chicken feed in South Africa is grown locally, but if the local maize yield is not good or the price is too high, it is also frequently imported from regions such as Eastern Europe, South America and China. Although yields, and potentially poor yields from climate change, undoubtedly play a role in influencing the maize price, the biggest determinant according to farmers was the occurrence of futures trading in grain making the price of maize highly variable.

Amongst poultry farmers interviewed there seemed to be the general belief that technology would be enough to overcome the negative impacts of climate change but there is acknowledgement that this is expensive. Already there is a move to larger farms – to quote one of the poultry farmers interviewed: *"… the South African poultry industry is moving towards very large farms. In South Africa 80% of production is from 20% of producers. At the moment a farm of 100 000 layers is big enough to be profitable, but it might not always be like that."* This move to bigger and bigger farms may increase production, but at the same time could have negative social consequences as it is likely to exacerbate the existing social inequalities in South Africa.

4 Gender and agriculture in South Africa

Since 1994 the South African government's national and provincial Departments of Agriculture (DOA) have made concerted efforts to develop policies and programmes aimed at making South Africa's agricultural sector stronger and more robust. Crucial to this strategy was to increase the equity among farmers in terms of racial and gender representation and access to land, modern technologies and other inputs. However, an analysis undertaken by Hart and Aliber (2012) argues that the succession of many post-1994 policies and programmes, including the 1995 White Paper on Agriculture, the 1998 Agricultural Policy in South Africa discussion document, the 2001 Strategic Plan for South African Agriculture and the 2004 Comprehensive Agricultural Support Programme, has supported the widespread criticism that there is a shift away from supporting the poor and more vulnerable farmers, especially female farmers, towards an overwhelming focus on the better-resourced and more commercially-oriented black farmers.

The current support provided by the government to smallholder farmers promotes the adoption of new technologies, but does not pay attention to the diversity of farmers in a range of circumstances. In order for new technologies to work, farmers need access not only to land, but also to education, technologies that suit their farming needs and appropriate agricultural extension support. Gender and gender dynamics inherent in agricultural production need to be taken into account to address the fact that women farmers continue to be marginalised members of the rural community. More so than men, women are confronted with a range of challenging cultural and socioeconomic factors (for example, low levels of education) which limit their ability to take advantage of new opportunities. Therefore, simply including women as recipients of projects will not provide them with the support that they need to build and sustain viable farming enterprises. This situation is made worse by the limited access to agricultural support to farmers in general (Hart and Aliber, 2012).

Hart and Aliber (2012) contend, and it is supported by the current research, that South Africa's public agricultural services have pursued a delivery approach based on top-down transfer of technology (TOT) models. This approach is not participatory and it does not consider the relevance of local circumstances such as local knowledge, available resources and aspirations. The primary focus has been to support the black farming sector in South Africa, but with an implementation bias towards emerging more commercially-oriented black farmers who are better able to use technologies that were originally developed for the large-scale and well-resourced commercial farming sector. Such an approach does not acknowledge the diversity of the farmers and of their circumstances. This is vital as technology needs to be developed and adjusted to the differences in the skills, resources, motivations and objectives of rural households that engage in some form of agriculture. The prevalence and poverty of smallholder farmers means that attention should be paid to technologies to improve their efficiency and protect the natural resources over which they have stewardship, and this must be done within the parameters of the group's socioeconomic situation. This presents a particular challenge for women farmers who differ from their male counterparts in terms of household and cultural status and this, in turn, influences motivations for farming, land access and education levels (Hart and Aliber, 2012).

A specific effort was made to include women in the current research study. However, as can be seen from the list of people interviewed (see Methods section), this aim was only partly achieved. That said, the percentage of interviews conducted with women farmers is a fair indication of the overall number of women farmers in the four commodities targeted. However, findings showed very clearly that gender roles and relations, and the socially-constructed expectations of women compared to that of men plays a large role in the gendered nature of farming activities. Additionally the intersection of cultural differences with gender was also observed – such that in some contexts there are very distinct differences between men's and women's roles in farming, but not in others.

There are very few women involved in maize production in the Free State, within both black and white communities. This is very closely tied with gender roles and the social expectations of men compared to those of women. All of the Free State farmers in the study were men, although several of their wives help with the farm operations in some way, most commonly in

administration. The only time women were hired on some farms was during the harvest when seasonal jobs are available. The reasons for this were predominantly cultural. For example, maize farming is very mechanical and requires a lot of machinery. Farmers have observed that, as a result of upbringing and exposure, men are generally more mechanically minded and therefore more suited to maize than women. Safety and security was suggested as a potential reason that women do not farm maize – bearing in mind the physical nature of the work. One farmer explained that his three adult daughters are an accountant, a secretary, and an Eskom office worker, but that his thirteen-year-old son has an interest in farming and will take over the farm one day. It was reported that women are becoming more involved in the technical services side of farming, and that there are a lot of women involved in farming higher value crops, but that there are no women in maize farming.

The social structure of farming in the Eastern Cape is very different to that in the Free State. Many of the farmers that were interviewed were female farmers (figure 12). Both male and female farmers reported that there is no difference farming as a man or as a woman. One female farmer laughed and expressed disbelief at the suggestion that, in some farming communities in South Africa, farms are only passed on to sons and not daughters. She stated that this is not the case there, and the only determinant of whether or not land is bestowed on someone is the extent of his or her passion to farm. Even single female farmers are able to farm as successfully as male farmers because harvesting and other heavy work is usually done by the whole extended family. Some female farmers reported that men are less inclined to work than women because they are “lazy” as a result of their experiences as migrant workers in mines or cities.

Figure 12: Woman vegetable farmer, Eastern Cape

Most of the farmers in the poultry study group were men and this is typically the case in poultry farming, largely because farms are passed from father to son. In many instances the wives of farmers are heavily involved in poultry production. One farmer worked closely with his daughter who was a food nutritionist. Women are frequently involved in a supporting capacity, for example the manager of the Midlands Eggs packshed was a women, as was the general manager of the KwaZulu Natal Poultry Institute. A high percentage of workers on poultry farms are women, particularly on layer farms. Farmers reported that women are better workers in egg production because they are gentle with eggs and empathetic with chickens, and also that they are generally more hardworking and diligent. In general there were slightly more men working on broiler farms because the work is more physically demanding, including catching chickens, and requires less delicate work such as handling eggs. When women are employed to do work directly related to the chickens, men are often employed for other tasks such as driving tractors, slaughtering chickens and for any heavy lifting. There are not very many female workers involved in management, although there are a few exceptions and this was attributed to cultural factors. It was suggested that Zulu men refuse to take orders from women, and that even Zulu women do not accept leadership from other Zulu women. The involvement of women and men in the various tasks in the poultry industry is a combination of traditional gender roles and physical characteristics.

There is no differentiation between women and men farming in the small scale communities of the Eastern Cape. Most farming is done in family units consisting of a man, a woman and their children; and often the man and woman will each have different aspects of the farm for which they take responsibility. All of the farmers interviewed stated that it is equally easy or difficult to attain land as a man or a woman, and that all farmers are afforded equal respect regardless of gender. Discussions with farmers did not suggest that it is an gender equal society; just that farming is the domain of both men and women. The only stakeholders who alluded to a difference in farming as a man or a woman were the representatives from the Eastern Cape Rural Development Agency. They asserted that although there was no gender bias in their organisation and the support it provides, women still faced discrimination from some organisations and from society in general.

There are very few women involved in wheat production in the Western Cape. All of the farmers in the study were men, although several of their wives help with the farm in some way, most commonly in administration and especially before they have children or after their children are grown up. One farmer's wife ran the farm entirely for a year while he continued with his studies. He believes that there is no reason that women are not able to run farms, it is just tradition and culture that causes them not to. Wheat production is not very labour intensive, and the labourers that are employed are men because the work is physically demanding with long hours and farmers perceive that women do not want that kind of work. There are more women involved in other sectors in the province, particularly in dairies and in fruit production because, for physical and cultural reasons, they are deemed to be more suitable jobs. It was also mentioned that more women are hired deliberately in these sectors for the purpose of improving BEE scorecards.

5 Results

The results section is structured according to the six main categories of adaptation practices identified from the research undertaken in the four commodities (see Methods section). This section outlines and describes the adaptation practices identified as being most common and/ or "good" while the following section analyses why each of these adaptation practices is considered important. See Annex 4 for more detail on the scores awarded to each of the practices.

5.1 Diversification

Diversification is an especially important adaptation practice that is common to farming of all four commodities. This category includes diversifying farming activities and sources of income as well as using different seeds or cultivars.

5.1.1 Diversifying farming activities

Many of the maize farmers interviewed, particularly those in the eastern Free State, produce a variety of agricultural products. It was frequently the case that they farmed high value crops, like apples and raspberries, but staple food crops like potatoes were also produced. In the Eastern Cape and western Free State raising livestock was a popular option for farmers to diversify their income, and it was mentioned that you could always sell cattle if the weather is bad, unlike a crop which will not make any money back if the crop fails. One farmer suggested that he would start farming poultry if his maize stopped being profitable. In the western Free State several farmers stated that they would switch to farming sunflowers if maize stops being feasible. Sunflowers do well in shallow soil and require less water than maize (figure 13). Sorghum is another potential alternative crop because it has a very low water requirement, even lower than sunflowers.

Figure 13: Many maize farmers have started growing sunflowers, Free State

Amongst the poultry farmers in Kwa Zulu Natal, many engaged in farming activities alongside poultry farming. The distinct advantages of this were that they had a second source of farm income on which to rely if they had a bad poultry season, and that they were able to use the poultry waste as an input for the other farm activities. Chicken manure was used on vegetables, on pastures for beef production and in one case even processed into organic sterile fertiliser for sale.

5.1.2 Switching to more drought resistant crops

Several small scale vegetable farmers in the Eastern Cape reported that they are now planting more potatoes than previously, largely because potatoes "*do well during droughts*". In addition to potatoes, butternuts "*do very well in dry soil*" and are sometimes planted in preference to previously popular crops for this reason. Switching to more drought resistant crops will be an important adaptation in the future because it will allow food security to be maintained in a changing climate. Potatoes are a popular food among Eastern Cape farmers and they are willing to switch to these, however an adaptation of this type is only possible if the replacement crop is socially and culturally acceptable.

5.1.3 Diversifying to alternative cash crops

Wheat farmers in the Western Cape alternate between different cash crops. The four cash crops grown in rotation in the southern Cape and the Swartland are wheat, oats, barley and canola. Rotation of all of these crops has advantages for income security: in a year when one of the crops does badly or the selling price is low, it is likely that the other crops will not fare similarly badly and can provide an alternative income for the farmer. If the climate becomes less predictable having a variety of different cash crops could help farmers to have more stable income. Cash crop rotation also has other benefits, particularly in the case of canola. Canola is nitrogen fixing and planting canola one year leads to noticeable improvements in the wheat yield the following year as a result of soil improvements. Canola is also susceptible to entirely different diseases than wheat, so alternating the two crops can break disease cycles. In addition, different herbicides are available for use with the two different crops, so weeds are more easily controlled. The Department of Agriculture is also doing research into triticale, a wheat/rye hybrid, as a potential alternative crop because it can be grown in marginal areas that are not suitable for wheat.

5.1.4 Diversifying to include livestock farming

All of the wheat farmers in the Western Cape study group keep either cattle or sheep, or both. This is done partly because they are a component of a system and they work well with wheat, but also partly as a way for farmers to diversify their income. Farmers stated that crop farming is more risky because input costs are high and it is possible that bad weather will destroy most of the yield, but that the potential gains with crop farming are very high. When the weather is good, as in the last three years, farmers can produce high yield and make a large profit. Livestock on the other hand offer a more steady income, the potential profits are not as high but if the

weather is bad or any other factor is negatively influencing the livestock it is possible to sell them and recoup the input costs. Farmers rely on the income from their livestock during bad cropping years. The balance between land under cropping and land under improved silage for livestock differs between farmers in relation to their farm size, preferences, and how much risk to which they are prepared to expose themselves.

5.1.5 Alternate seeds

Most of the maize farmers interviewed said that they have experimented with different seeds in an effort to achieve higher yields. There are a wide variety of different seed options. Small scale farmers who grow maize have, in recent years, stopped saving seeds and replanting them each year as was traditional. Due partly to the training from GrainSA they have adopted commercially available high yielding seeds, which they replace annually. Although they have to pay for these seeds they experience a substantial increase in yields. There are also a large number of farmers in the Eastern Cape, particularly those in co-operatives, who receive seeds directly from the government each year. A direct benefit of buying seeds is that different cultivars have different growing lengths. Commercial and small scale farmers tend to choose the length cultivar based on how early or late in the season they plant. These different cultivars vary in growing time by a few weeks and they can help farmers to efficiently utilise the entire growing season. Shorter length cultivars have potential as an adaptation to climate change because they can be planted late but still be harvested at the optimal harvest time. The downside of shorter growers is that they are generally lower yielding than longer growers.

Some small scale farmers have also started buying genetically-modified (GM) seeds, mainly on the advice of GrainSA. Most of those who have tried GM seeds have only done so for one or two seasons and it remains to be seen whether they will continue to purchase them annually at prices higher than that of other seeds. The commercial farmers in the Free State mostly buy GM seeds, either those modified to be resistant to herbicide (Roundup ready maize), those designed to resist insects (BT maize), or a combination of both. GM maize is very controversial among consumers and is illegal in some countries but it is the preferred choice for most South African maize farmers. GM seeds increase yields, and give more opportunities for weed and pest control. There are a small number of South African farmers that produce non-GM maize because it is sold at a higher price. Non-GM grain is sold to the international market or used for specialised small-scale food production within South Africa. In the last few years Monsanto, a leading GM seed producer, has developed a drought resistant maize seed, which could be an extremely important factor in the ability of farmers to adapt to climate change. Some South African maize farmers say that the only way to farm maize in the future will be with GM seeds. However, the highly political and controversial status of GM seeds may reduce their usefulness as an adaptation. Opposition to GM food crops is related to concerns over human and environmental health, food sovereignty, and because of the commercial nature of GM seed development and sales. GM seeds are illegal in several African countries and some African leaders have gone as far as to reject GM food aid. In this context, the potential for GM seeds as a climate change adaptation is uncertain.

In the growing of whea, there are different cultivars available for different season lengths. These are not a new adaptation and farmers have been using them for a long time. The long growing

cultivars are used if the rain comes early and they have the highest yields. The shortest growing cultivars are used if the rain is late, but they produce lower yields. Farmers generally use a mix of long, medium and short growing cultivars, mostly depending on the speed that they are able to plant. The short growing cultivars may be of use if climate change results in a shorter rainy season, but farmers are not happy about them because of the lower yields they give. Many farmers stated that there has not been enough seed development in South African wheat farming because it is too small an industry; and they compared the huge advances in maize seeds to the small ones for wheat. There is not currently a GM wheat variety available, although it was mentioned that Monsanto and others have recently developed a drought resistant wheat variety in Australia and that at some point they may make a GM version.

5.2 Altered timing of farming stages

Changing the timing of various stages in the farming process is common to both the crop and livestock farmers represented in this study. Vegetable and maize farmers delay the planting of their crops until the first rains have fallen whilst poultry farmers alter the timing (and quantity) of what they feed their chickens, depending on the climate conditions.

5.2.1 Changing planting and harvesting dates

Altering the planting date for different crops is an adaptation that is unconsciously undertaken by small scale vegetable farmers. This is mostly determined by the arrival of the first rain of the season, and by subsequent rainfall during the rainy season. Vegetable crops are generally planted approximately every three months, but planting can be varied depending on climate conditions. The farmers in the study group were not able to suggest a changing pattern in rainfall over time, and had no ability to plan for or predict rainfall. This is not likely to be a very successful adaptation because although it has the potential to change the timing of yields, it will probably not increase overall seasonal yields.

Amongst maize farmers, one of the easiest and most common adaptations that occurs is altering planting and harvesting dates. Planting of maize usually only occurs after the summer rains have started for the season. If the rain comes late then farmers have to plant later than they would like to, and if the rains are early they can plant earlier than usual. The flexibility of planting dates allows farmers to adapt to a shifting climate. To a large degree the planting date determines the harvesting date and farmers have to adjust accordingly. This can have negative consequences caused by the shortening of the season. In this case the maize sometimes has to be harvested too early or is threatened by the onset of winter. Altering the planting and harvesting date has the potential to help farmers adapt somewhat, but it will be best used in combination with other adaptation measures, for example those that allow farmers to plant maize before the first rains.

5.2.2 Change in feeding quantities and times

In poultry farming, prolonged warm weather lowers the productivity of laying hens because they do not like to eat when they are too hot, and they therefore produce fewer eggs. To cope with this challenge some farmers feed their chickens at night when it is cool and they would normally not have access to food. This ensures that the hens consume the same amount of feed that they

would normally. Some farmers also choose to withhold food during the heat of the day because if chickens are not eating their metabolism slows down and they do not generate as much body heat. Diets are also more or less dense depending on the season, and the stage in the lifecycle of the chicken.

5.3 Conservation farming

There are a variety of different agricultural practices which together are classified as "conservation farming". Farmers in all the commodity groups under investigation in this study employed at least one, but in most cases several, conservation farming practices.

5.3.1 Leaving fields fallow

Amongst maize producers, a few farmers, both commercial and small scale, reported that they leave fields fallow in order to let the soil recover or to allow moisture to accumulate within the soil profile. This practice is not widespread and modern agriculture has tended towards rather using crop rotation, especially with nitrogen fixing crops, to improve soils. Leaving fields fallow for a year means that every year only half of the fields are planted, and only farmers with very large farms and an excess of land are able to do this.

5.3.2 Water harvesting in a planting circle

The small scale farmers who had attended training by the Catholic Development Centre (CDC) created planting circles in order to capture and store all available water for their plants. Planting circles entail digging a circular, knee-deep, hole in the path of naturally occurring drainage. This hole is then filled with empty cans and old animal bones, before covering them with maize stalks, manure and, finally, soil (figure 14).

Figure 14: Animal bones collected to make a planting circle, Eastern Cape

A raised edge is built with soil around the down-slope side of the hole and vegetables are planted on the raised edge. Water drains into the hole and is then stored by the bones, cans and maize stalks, where plants on the edge can access it. Water harvesting of this nature ensures that plants can survive longer without rain. Farmers reported noticeably higher yields in the crops planted on the planting circle. This adaptation could contribute to local food security during droughts but installing planting circles is relatively labour intensive and it does not lead to very efficient production in terms of plant density. Water harvesting with a planting circle is therefore only a feasible adaptation for small-scale vegetables farmers, particularly those with large families and therefore enough available labour.

5.3.3 Mulching

One of the key principles of conservation farming is to leave a layer of stubble or mulch on the field after harvesting. Previously maize farmers used to burn the stubble so that the land was neat and because it made planting easier. Conservation farming recommends leaving all stubble on the field to break down and decompose naturally, thus increasing carbon levels in the soil, increasing the ability of the soil to retain water (through limiting evaporation) and it attracts healthy organisms like earthworms to the soil. Mulching has been embraced by several maize farmers in the Free State, and by a few in the Eastern Cape.

Amongst vegetable farmers in the Eastern Cape the CDC actively promotes mulching as a way to conserve moisture in the soil and increase resilience to dry periods (figure 15). The farmers who have attended CDC training employ mulching wherever possible, but other farmers who have not been trained by the CDC generally do not use mulching. The most popular materials for mulching are dry grass and maize stalks. When there are not enough of these for farmers to mulch all their crops they resort to a variety of other options, with varying levels of success. Alternative materials include cardboard, paper, sticks, foam and even corrugated roofing metal. In addition to keeping the soil moist, farmers reported that mulching helped to control weeds. Mulching will be a successful adaptation in the future because it requires otherwise unused resources and it can greatly enhance the potential for farming in dry conditions.

Figure 15: Mulching over spinach with dry grass, Eastern Cape

The wheat farmers in the southern Cape were more enthusiastic about leaving mulch on top, but those in the Swartland sometimes reported that they could not leave it all in place because the total lack of summer rainfall in the region means that the stubble does not decompose at all and planting the following season is almost impossible with all of the material still there. Some farmers in the Swartland reported that they partially break down the material by mechanical means such as dragging tyres behind tractors. Leaving the stubble in place also means that it is not available as grazing for livestock. However most commercial farmers do not rely on the stubble for this use.

5.3.4 Crop rotation

Crop rotation is practised among both the commercial maize farmers in the Free State and the small scale maize farmers in the Eastern Cape. In the western Free State maize is frequently rotated with sunflowers. Sunflowers are chosen as a suitable crop to rotate with maize because of their commercial value. Sunflowers are planted at around the same time as maize and farmers often rotate year on year in different fields. In the eastern Free State the most common rotations that occur are soya and legumes. These crops are selected because they are nitrogen fixing and/or they are deep rooting and therefore aerate the soil. In the Eastern Cape the most common crop that is rotated with maize are potatoes. Potatoes are chosen as a suitable crop because of their low water requirement and because they can be planted directly after maize. Crop rotation is a promising adaptation because it improves the quality of the soil in terms of nitrogen content and root structure, it helps to break disease cycles, and it diversifies the farmer's income because they can utilise to different markets to sell their produce. For small scale farmers crop rotation helps to maintain food security, so that if one crop does badly the other one can be depended upon.

Several small scale vegetable farmers in the Eastern Cape undertook crop rotation within their vegetable production systems. This was done largely so that they were able to produce a wide

variety of different vegetables for their own consumption. In addition to rotating crops for production of a variety of vegetables, some farmers rotated crops because they hoped it would increase productivity. For farmers who produced both vegetables and a maize crop, rotation was often done with maize and potatoes. Potatoes were planted immediately after maize was harvested so that fields did not lie fallow. Crop rotation is an easy adaptation for farmers to use and it has the potential to increase both yields and food security. Rotating with drought resistant crops could have positive implications for climate change adaptation. Both the CDC and GrainSA promoted crop rotation to farmers.

There are two different types of improved pasture rotation which wheat farmers in the Western Cape use. Improved pasture refers to a crop that is planted for use as feed for livestock and not as a cash crop for sale. The first of these is a short rotation with a type of clover species commonly called medics. Medics is a term that refers to any annual, self-regenerating, pasture legumes, and in South Africa this usually refers to one of several clover species, or a mix of these species. Medics are planted and then allowed to establish before being used for one season for grazing or silage for sheep. After one season the medics are cut down and wheat is planted among the medics stubble. After the wheat is harvested the medics naturally regenerate and grow in the place left by wheat. Medics only need to be planted once and will continue to grow indefinitely if they are well managed. Growing medics is a very good adaptation in terms of wheat production as they are nitrogen fixing and have a well developed root system, which leads to soil with a high nitrogen content and good structure. Good soil structure is particularly important for water infiltration and retention.

The medics rotation is only a single year of medics followed by a single year of wheat. The second type of improved pasture rotation that wheat farmers practice is a long rotation with lucerne. Lucerne is planted and then continues to grow for between four and seven years. While growing it is used for grazing and silage for sheep and cows. After the lucerne period is finished wheat is planted continually, usually for the same number of years as the lucerne. Lucerne rotation is a good adaptation because the root system that establishes over time gives the soil good structure, and because lucerne has distinct advantages for weed control. There are several herbicides available for use with lucerne, which cannot be used with wheat, and their continued use during the lucerne period can break the weed cycle. Weeds are a particular threat when faced with water scarcity because they have a large water requirement and less water is therefore available for the wheat. Lucerne is also nitrogen fixing.

5.3.5 Intercropping

Many of the small scale vegetable farmers interviewed practised intercropping. This was particularly the case with farmers who had been trained by the CDC and those that produced a wide variety of vegetables predominantly for their own use. At the scale of Eastern Cape small scale farmers, intercropping entails planting only one row of each crop type so that there is never a case of two rows of the same or similar plants adjacent to each other. Practically, if a farmer grows six or seven crop types then each crop is repeated every six or seven rows. According to farmers the main effect of intercropping is a reduction in pests and a reduced dependence on other pest control methods. Intercropping has additional benefits in that plants

with complementary water and nutrient requirements may be planted together thus ensuring better use of resources and therefore higher yields.

5.3.6 Minimum/ no-tillage

One of the key principles of conservation farming is that the soil is not disturbed. Traditionally, maize farmers prepared the soil for planting by ploughing, a process that mixes up and turns over the soil. Ploughing was done to aerate the soil and to kill weeds but it resulted in the soil drying out and it disturbed the beneficial organisms that live in the soil, like earthworms. It also destroyed the structure in the soil that naturally forms from plant roots and it removed organic matter. Conservation farming replaces traditional ploughing with minimum-tillage or, ideally, no-tillage, methods. The emergence of effective herbicides to control weeds is one of the factors that made minimum-tillage possible as farmers no longer have to mechanically control weeds with ploughing. Weed control is very important in the context of climate change because weeds have a higher water requirement and can outcompete crops for moisture.

Most of the commercial maize farmers in the Free State have started moving towards minimum-tillage approaches. This entails using a tine, disc or other minimum-tillage equipment to lightly prepare the soil, often by scraping lines in it that loosen compacted soil but do not turn it over or damage root structure. Minimum-tillage methods allow more carbon to stay in the soil, which aids water retention, and they leave root structure in the soil that acts as a conduit for surface water to penetrate deeply. There have been marked improvements in the ability of the soil to capture and retain water since farmers started practicing minimum-tillage, which has important implications for adaptation to climate change, particularly in light of the predicted intensity of storms. Farmers reported that they have much wetter soils as a result of minimum-tillage. One farmer stated that his conservation farming approach had increased the soil moisture so much that he has started planting eucalyptus trees around his crops in an attempt to dry the soil. However, farmers stated that you need very big and expensive equipment to do minimum-tillage, and it may be prohibitive for smaller farmers.

No-tillage is optimal in terms of conservation farming but many maize farmers do not feel that it is feasible because of the soil on which they farm or because they have livestock. It is not possible to have sheep or cattle grazing on a field if the farmer following no-tillage methods because livestock compact the soil and necessitate some tillage to break up the compaction and farmers are unwilling to give up their livestock. Some farmers in the Free State are starting to do no-tillage maize production but it is still very new and not widespread.

Although the commercial farmers in the Free State have embraced minimum-tillage and are moving towards practices of conservation farming, this is not the case in the Eastern Cape. The small scale farmers interviewed mostly had not heard of minimum-tillage and the few that had were not using minimum-tillage methods for various reasons. One of these is that it requires larger equipment to prepare a field using minimum-tillage implements, and farmers simply did not have the physical capacity to do so. Several of the farmers that had heard of this approach stated that they were unwilling to try out minimum-tillage until they knew more about it and they had seen its success on their neighbour‘s farms. Although most farmers had not heard of minimum-tillage, when it came up in the course of interviews they expressed interest in it and

requested that the GrainSA development officer teach them about it. However, it is unlikely that small scale farmers will adopt no-tillage because livestock are an important part of their livelihoods for economic and cultural reasons. They rely on the post-harvest stubble to feed their livestock, thus causing compaction and removing mulch.

Conservation farming is a system of farming that has been practised in the Western Cape for at least ten years. All of the farmers interviewed in the Western Cape have stopped ploughing in favour of minimum-tillage approaches. Farmers reported that they are able to plant much earlier in the season since they have been doing minimum-tillage because soil moisture is conserved. In addition, they are better able to withstand mid-winter droughts. A small percentage of the farmers interviewed have started doing no-tillage farming which uses a disc planter or a knifepoint planter to put the seeds directly into the soil without disturbing it at all. No-tillage is optimal in terms of conservation farming principles. However, many farmers do not feel that it is feasible because of the soil in which they farm or because they have livestock. No-tillage planters have trouble getting through soil that has a lot of stones in it or a lot of material left on the field. It is not possible to have sheep or cattle grazing on a field if following no-tillage methods because livestock compact the soil and necessitate some tillage to break up the compaction. Farmers in the Western Cape are unwilling to give up their livestock because the stream of income they derive from them is steady and reliable even in a year of bad weather. The biggest problem with minimum-tillage is that it requires heavy planters with large tractors and the start-up costs to buy implements are very high. Poor farmers therefore believe this makes it unfeasible to switch. However, the Department of Agriculture has conducted research and done trials suggesting that it is economically feasible to switch, and minimum-tillage is cheaper and more sustainable in the long run because it requires less diesel.

5.3.7 Planting trees for shade

Planting trees around sheds to provide them with shade is an adaptive practice used by some poultry farmers. It was reported that planting trees close to sheds could reduce direct sunshine on the sheds, lower the temperature of the site and act as a disease barrier. However it was mentioned that the conventional wisdom used to be against planting trees because, although they provide shade, they also prevent airflow and may house wild birds that are disease reservoirs. It is now accepted that the shade provided by trees is very beneficial for cooling sheds. When planting trees now, farmers can trim any low branches to encourage the trees to grow tall and thereby reducing the amount of airflow that is restricted. Planting trees is a very cheap adaptation, with small input costs and virtually no maintenance costs. It also has the added benefit of being sustainable and acting towards climate change mitigation.

5.4 Mechanisation/ new technologies

5.4.1 Mechanisation

Mechanisation is an adaptive strategy used by both commercial and small scale maize farmers. Commercial farmers are already highly mechanised, but this is not the case with small scale farmers, many of whom do not have modern farming implements or even tractors. Some farmers reported that they only started using tractors instead of animals to plough fields in the last two years. Although commercial farmers generally experience a high level of mechanisation

there are still possible improvements to be made. For example, investing in minimum-tillage implements can allow them to better adapt to climate change. Mechanisation has the potential to increase yields, and depending on the form mechanisation takes, it can increase the adaptive capacity of farmers.

Figure 16: Disk ploughs used in minimum-tillage, Free State

Although modern farming is highly mechanised, small scale vegetable farming in the Eastern Cape is still heavily reliant on manual labour. For example, up until a few years ago it was the norm for farmers to plough their fields with cattle. Those farmers that have managed to acquire tractors have experienced much higher yields than previously and the increased productivity per farmer has allowed them to cultivate larger areas. Many of those interviewed stated that they were seeking funding in order to mechanise further. The equipment most prized by farmers is a tractor but, depending on their scale, they also want rippers, discs, boom sprayers and planters (see figure 16 for an example of a disk plough). Mechanisation is a very important adaptation for small scale farmers. The international farming community accepts that mechanisation is vital for increasing productivity and, if small scale farmers are to successfully adapt to climate change, mechanisation must be part of the process. A lack of funding is the factor that prevents farmers from acquiring implements, but there are grants and loans available from various sources including the government and the Eastern Cape Rural Development Agency (ECRDA). GrainSA assists farmers in putting together the business plans that allow them to receive funding for equipment.

To manage the threat of rainfall during harvesting, wheat farmers have increased their harvesting capacity by buying bigger combines so that they can harvest faster. One farmer's wife stated that it used to take six weeks to harvest, but now they do it in two weeks. This reduces the risk of rain while the harvesting is happening and can save farmers a lot of money. This adaptation requires significant capital to buy new larger implements and it is not an option for less wealthy farmers. Commercial wheat farmers have also invested in modern planters. In addition to modern planters being required for minimum and no-tillage systems they have other distinct advantages. Modern planters plant the seeds deeper allowing them to access more water. They also leave little furrows on either side of the seed, so that rainwater in funnelled

towards the seed. This is known as rainwater harvesting and it allows seeds to benefit from very small amounts of rain. Modern planters cover a larger area than older technology, which means that planting can be done faster and with fewer people. They also provide different opportunities for herbicide application before planting. Modern planters are often also better at planting in dry soil and farmers can therefore plant earlier, ensuring a longer growing season and a higher yield.

5.4.2 Sheds

5.4.2.1 Controlled environment sheds

Figure 17: Controlled environment shed, poultry farm, Kwazulu Natal

Modern poultry farming is often done in 'light tight' sheds, which are completely sealed. In controlled environment sheds temperature and airflow are artificially regulated and the risk of heat stress is eliminated (figure 17). Many farmers expressed the opinion that controlled environment sheds are the future of poultry farming, particularly for broilers (chickens bred for meat), which are more vulnerable to heat stress. Controlled environment sheds help to eliminate exposure to disease, however when there is a disease outbreak it tends to be more severe because the chickens have lower immunity. The major factor preventing farmers from switching to controlled environment sheds is the cost it requires to build them - one farmer stated: "*you can cool birds down, but it will cost you money*". Investing such a large amount of money into the farm increases the level of risk to which the farmer is exposed. Controlled environment sheds have a high energy requirement and they may not be economically viable as energy costs rise or if there is an unreliable supply of electricity. They also have adverse environmental consequences.

5.4.2.2 Climate-sensitive shed design

Climate-sensitive shed design is one of the most important ways of reducing heat stress. Several adaptations have led to the shed designs used by poultry farmers today. Sheds are oriented from

east to west so that the sun tracks along the length of the roof. This minimises the amount of sunshine that enters the sheds during the day. Insulated roofs also reduce the temperature inside the shed. Varying the height of the roofs can also influence the maximum temperature inside the shed; the higher roofs keep the sheds cooler. Sheds usually have open sides to allow airflow; farmers regulate the amount of airflow and sunlight inside the shed using shade-cloth and moveable curtains. The individual adaptations that go into shed design can be used in isolation but the most effective sheds use a combination of these common design elements.

5.4.3 Cooling technology

5.4.3.1 Circulation fans and tunnel ventilation

Circulation fans are a simple adaptation that farmers started using in the 1990s and early 2000s. Circulation fans are normally basic ceiling fans and although they do not lower the total temperature of the air inside the sheds, they do cause movement in the air immediately surrounding the chickens and this is enough to prevent heat mortalities on hot days. Circulation fans are cheap to install and they use a relatively small amount of electricity to run. They can also be turned on only during the hottest time on hot days and energy is therefore not wasted when it is not needed. Tunnel ventilation also uses fans but the system draws cool air in from outside the shed and moves hot air out. On one end of the shed a fan blowing outwards creates a vacuum that draws cool air into the shed on the opposite side. The air that comes into the shed is therefore the same temperature as the air outside the shed. Tunnel ventilation lowers the temperature of the entire shed and works well in combination with circulation fans, which ensure that the air inside the sheds is well mixed.

5.4.3.2 Evaporative-cooling wall pads

Evaporative-cooling wall pads work as part of a tunnel ventilation system, but instead of having a simple air intake on the wall opposite the fan, there is a wet wall system in place. The wet wall is made up of a type of interwoven cardboard that is tightly packed together. Water is poured through the wet wall and as air is sucked through the wall into the shed it is cooled by evaporative cooling (figure 18).

Figure 18: Evaporative all cooling pads

Evaporative-cooling wall pads are very effective and can lower the temperature of the shed so much that air temperatures inside the shed are lower than those outside. However, in addition to the energy requirement to power fans, wet walls require large amounts of water to keep them continually wet. The amount of water needed depends on the size of the shed and on the local conditions, but one farmer estimated that the wall uses about 50 litres per hour. This adaptation will likely have a high environmental cost and potentially also a high financial cost.

5.4.3.3 Irrigating roofs

In addition to wetting chickens many farmers wet the roofs of their hen houses. This is done either with hosepipes on exceptionally hot days, or with specifically installed sprinkler systems, and the amount of water used varied from a fine mist to a large flow. This system effectively cools down the interior of the sheds, and it does not result in any detrimental effects for the chickens but it uses a large amount of water.

5.4.4 Solar reflective roof paint

In recent years poultry farmers have started using solar reflective roof paint. Solar reflective roof paint has tiny glass beads in it, which reflect sunlight away from the sheds. The paint is said to reduce temperatures inside the shed by up to between 7°C and 10°C, although some farmers have only realised benefits of about 3°C. Although solar paint is expensive, it requires no continuous inputs and may be a sustainable way to reduce temperatures inside the sheds, and therefore lower the heat mortality rate of the chickens.

5.5 Changing densification

5.5.1 Changing plant population and distribution

The plant population refers to the density of plants in a given area. The density of maize plants and the way that they are distributed within the field is one way that farmers are able to adapt their maize crop to the local conditions. Practically this is done in several ways. Some farmers reported that they have started planting maize in narrower rows than in the past, which results in denser crops. This was done so that the closely packed maize plants would create dense shade on the exposed soil and evaporation would be reduced. In one case the conservation farming employed by a farmer had resulted in fields that were too wet for optimal maize production and by increasing his plant population he was able to utilise all available water. The converse of this is also apparent in Free State maize farming. Some farmers in the western Free State reported that they were experiencing drier conditions than they used to and, as a result, they were making the rows wider so that fewer plants had to compete for the available water. One farmer stated that he decides on the row width seasonally based on the expected rainfall - if it is expected to be dry he plants in wider rows.

5.5.2 Reducing stock density

The body temperature of chickens is 42°C and part of the reason that they are vulnerable to heat stress is that they are densely packed in multi-level cages with no airflow around individual birds. Chicken cages are a standard size and the allowable stocking density in South Africa is five birds per cage. Reducing stocking density to four birds per cage can help to reduce incidences of heat stress because airflow around the birds is encouraged and there are fewer birds generating heat inside the shed. The trade-off with lowering the stocking density is that farmers are not able to raise as many birds and profits may then be lower. An additional benefit of lowering the stocking density is that it is more humane. Controlled environment sheds will usually be kept at a higher stocking density than simple open sided sheds, and smallholder farmers have an even lower stocking density than simple commercial sheds.

5.6 Additions/ supplements

5.6.1 Supplements in feed

Several poultry farmers stated that they give the chickens supplements in their feed, mostly in an effort to boost the birds' immune systems. The supplements listed by farmers include ascorbic acid, electrolytes and bicarbonate of soda. Supplements can be a cost effective way to reduce the risk of heat mortalities.

5.6.2 Fertiliser use

Fertilisers are used on maize crops at both a commercial and small scale level. Fertiliser increases yields and can make farming more efficient. Soil is tested for levels of soil nutrients, and suitable fertiliser recipes are then used where required. The commercial farmers send their soil to laboratories throughout South Africa for testing and some send soil to international laboratories because they doubt the objectivity of the South African testers. Small scale farmers in the Mthatha region of the Eastern Cape are assisted in their soil testing by GrainSA who notify them when it is required and then send the samples to appropriate South African laboratories. Some commercial farmers employ precision systems whereby the nutrient composition of each field is mapped and specific cocktails of fertiliser are applied to the exact areas required. This precise application of fertiliser can reduce the total amount used, cut down on costs to the farmer, and cause less environmental degradation than conventional fertiliser application. Fertiliser use will not directly enable farmers to adapt to climate change, but the increase in yields could help them to better cope with threats from climate change.

5.6.3 Vermicast and compost use

A small group of farmers in the eastern Free State have started farming worms for the production of vermicast. Vermicast is used as an organic fertiliser for crop production. Typically vermicast is used for high value, intensively farmed crops but a few farmers in the eastern Free State reported that they use vermicast for their maize. Vermicast has the potential to greatly increase yields. Similarly, some farmers use compost or manure instead of fertiliser. Compost is said to be better for the soil ecosystem and to result in high maize yields. It can also help to produce higher value crops if it is organic. The use of compost is not widespread because, although it is relatively affordable to buy, the costs associated with transporting it in large volumes make it prohibitively expensive. For comparison, a parcel of land that would require 400kg of chemical fertiliser would require 7 tonnes of compost or manure for the same nutritive benefit. Both vermicast and compost fit into a growing movement of farmers that enhance their crops 'biologically' instead of doing it 'chemically'. They aim to reach equilibrium in their soil so that the farming activities function as part of a natural system.

One wheat farmer in the study group is engaged in composting. He collects maize stalks into piles and leaves them for three months at a time. In addition to maize stalks he adds in some weeds, grass and kraal manure. Composting can increase yields and water retention, but it is not feasible on a large scale because of the transport expense.

6 Analysis of results

The research amongst farmers of four different commodity types highlighted that there are a number of agricultural adaptation practices that are undertaken by farmers. According to one maize farmer from the Free State: "*Farming problems as a result of climate change are largely self-imposed because there are methods to adapt to a changing climate. The difficulty in adapting good climate change practices is that it is a slow process to change, you can't just switch overnight, and it is a mind-set change, farmers have to abandon the methods of their fathers*."

It is important to note that few, in fact most, of the practices that count as adaptation have not been adopted in response to climate change but for a multitude of different reasons (mainly economic). Many of the farmers interviewed did not view climate change as a reality or a major problem - they recognised that there is change but farmers have always dealt with variability in the weather. A minority even viewed the change in climate as something positive: *"Climate change has made a huge difference, mostly positive. [We] now have hotter temperatures, which is good for maize because [we] already had a lot of rain"* and *"The effects of climate change so far have been positive because we can now plant soy beans as it is now warm enough."*

The six main agricultural adaptation practices identified in the research have already been described in the preceding section. The aim of this section is to analyse why these six practices have been identified as the "best" across all four commodity types, and to highlight the enabling circumstances that are required for them to be adopted as adaptations. This section is written as an input into the cross-country comparison to identify the continent-wide good practices, and thus there is some repetition of section 5 in explaining the nature of the practices.

6.1 Diversification

Diversification is a very common practice amongst all farmers. Scoring very high amongst maize and poultry farmers was the practice of diversifying farming activities and sources of income. Many wheat farmers have diversified into other cash crops or are either starting to farm livestock or increasing the amount of livestock they keep. Switching to more drought resistant crops, such as potatoes and butternut, is a practice adopted by small scale farmers in the Eastern Cape while commercial maize and wheat farmers are in a position to be able to try about alternative seeds and different cultivars which produce higher yields, can be harvested earlier or are more tolerant of dry conditions. All commercial maize farmers grow GM maize but this is not the case for wheat farmers as there are no GM wheat varieties. Two other adaptations practised by some farmers interviewed, that fall under the heading of diversification, are stopping farming completely and off-farm income but neither of them scored highly enough to be considered part of the best agricultural adaptations.

Diversification as an adaptation practice is likely to be robust under changed climate conditions and therefore become even more widely accepted. Increased temperatures, changing water availability and more extreme weather events will make some farming areas less suitable for the crops that are grown there now, thereby necessitating the change to growing different types of crops. Shorter length cultivars have potential as an adaptation to climate change because, if the

rains are delayed (as farmers are already beginning to see), they can be planted late but still be harvested at the optimal harvesting time. The downside of shorter-growers is that they are generally lower-yielding and therefore not very popular with farmers. A further downside is that some shorter maturing seeds are heavily reliant on irrigation *("if you lose your irrigation for as little as two days, you lose your crop"* according to one maize farmer) which could be problematic under conditions of reduced water availability. Planting a wider variety of crops is another adaptation to climate change as it will ensure that farmers' income and livelihoods remain stable. Keeping more livestock is regarded as a definite option in the face of a changing climate. While farming livestock is not as profitable as crop farming, if the weather is bad or there is any other factor negatively influencing the livestock, it is possible to resell them and recoup some of the input costs. This is not possible with seeds that have been sown.

Adaptation practices categorised as diversification have both positive and negative impacts on the wider environment. In some cases it depends on into what the farmer diversifies - one of the poultry farmers interviewed had started making concrete which is definitely not good for the environment (and contributes to climate change through emitting greenhouse gases). However, growing more than one crop means that different nutrients are used and replaced which results in a lower use of fertilisers than if just one crop was grown. On the other hand, the introduction of GM seeds, as is almost universal amongst maize farmers in South Africa, may have negative consequences. In the case of diversifying to livestock farming, in regions of South Africa that do not receive a lot of rainfall, livestock are a good agricultural option and this adaptation could increase farmer's resilience to climate change. However, an indirect adverse consequence for the environment of livestock farming is that it means that farmers are not able to practice no-till farming – a practice proven to be beneficial for the soil. For small scale farmers in the Eastern Cape, livestock are easier to farm because fences are not required and communal land can be used with no extra effort, cost or risk to the farmer. There is abundant grassland in the region and cattle and sheep can utilise this area. However, there is a problem with erosion from overgrazing and increasing numbers of livestock will exacerbate that problem. In regions of South Africa that do not receive a lot of rainfall livestock are a good agricultural option, so this adaptation could increase farmer's resilience to climate change.

With regards to social consequences, apart from the questions raised by using GM seeds, diversification is largely positive. Diversifying allows farmers to continue farming and producing food which means that not only are the livelihoods of farmers and their workers (as well as those in the agricultural support industry) safeguarded (and sometimes improved), but food security for wider society is maintained. On the other hand, the highly political and controversial status of GM seeds may reduce their usefulness as an adaptation. Opposition to GM food crops is related to concerns over human and environmental health, food sovereignty, and because of the commercial nature of GM seed development and sales. GM seeds are illegal in several African countries and some African leaders have gone as far as to reject GM food aid. In this context, the potential for GM seeds as a climate change adaptation is uncertain.

Diversification also has the advantage of being socially acceptable by farmers as can be seen from the large number of farmers, across all four commodities, who engage in this practice. Poultry farmers view diversification very favourably as they are often able to use waste from their birds as an input for vegetable production or on pastures for cattle. One poultry farmer

sells his waste to neighbouring farms. However, there are barriers to diversifying, especially amongst poorer farmers as it entails expensive inputs such as access to more land and buying seeds. According to a small scale farmer in the Eastern Cape who only grows one type of vegetable, he knows it is not ideal and he would like to diversify but at the moment he does not have the land or resources. Amongst small scale farmers who grow crops for their own consumption, diversification will only be a successful adaptation strategy if the replacement crop is socially and culturally acceptable. For instance, in other parts of southern Africa, cassava and sorghum have replaced maize because they grow better under dry conditions than maize does. This is very unlikely to be adopted in South Africa where maize is the centre of many people's diet.

South Africa has a well-developed seed industry so getting the right inputs for diversifying to different crops is not difficult. The situation is different with regards to GM seeds – for maize there are a wider variety of seed options but many wheat farmers complained that there was not enough seed development in the wheat sector because it is too small an industry. There is not currently a GM wheat variety available. Even in sectors where GM seeds are available, a stumbling block to their accessibility is that they are very expensive (almost twice the price of non-GM seeds) and therefore out of reach of poorer farmers. Another input which is lacking for many farmers (especially small scale farmers) is knowledge and familiarity with alternative seeds or different cultivars. In the Eastern Cape study area, only about 1% of farmers were using GM seeds because they are new and the farmers want to see what they can do before they start using them.

The different adaptation practices classified as diversification receive support from institutions to varying degrees. Amongst maize (commercial and small scale) and wheat farmers, GrainSA (a voluntary grain producers' organisation) is very active in supporting farmers through training and advice on using alternative seeds and/ or different cultivars. Most research is done by private companies which is problematic because they use it to only promote their own products. As has been seen above, wheat farmers do bemoan the fact that research is focussed on maize and that more research needs to be done into wheat cultivars. However, the Department of Agriculture is investigating triticale (a wheat/ rye hybrid) as a potential alternative crop because it can be grown in marginal areas that are not suitable for wheat. Government support is largely limited to small scale farmers – in the area studied, it is extended in the form of the ECRDA and by providing farmers with seeds.

Diversification to include livestock may be beneficial from a gender perspective as more women are involved in livestock farming than in commercial wheat and maize farming. Otherwise it is very difficult to say how this particular adaptation practice will have an impact on the livelihoods of women as so few women are involved in commercial farming. Amongst small scale farmers, diversification is not a new practice and women farmers have long grown a wide variety of crops. While training is open to women, cultural constraints may prevent them from taking advantage of this.

6.2 Altered timing of farming stages

The altered timing of farming stages includes changing planting and harvesting dates (practised by wheat, maize and vegetable farmers) and changing feeding times and quantities (poultry farmers). Waiting for the rains to come before planting has always been part of the way small scale farmers farm. Amongst maize farmers this is also one of the easiest and common adaptations – maize farmers have to wait until the ground is moist before planting and are now able to wait longer for the rains to begin as they have access to early maturing seeds. Unfortunately, this practice has the possibility of reducing the overall yield of the crop because typically faster maturing seeds do not produce as high a yield. For poultry farmers, changing when they feed their birds and the quantity of feed can ensure that their outputs remain high during hot periods and that heat mortalities are reduced.

In answer to the question of how robust this adaptation practice will be under changed climate conditions (higher temperatures, decreased water availability and an increase in extreme events), changing feeding times and quantities is likely to be more robust than altering planting and harvesting dates. As long as the former practice is combined with other adaptation practices such as controlled environment sheds (see below for more detail), increased temperatures will not affect it while the availability, or not, of water is not an issue and neither are extreme events. On the other hand, planting can only be delayed for a relatively short period as, even with fast maturing seeds, it has an impact on the length of the growing season, when the crop is harvested and therefore the yield of the crop. If the rains are delayed for too long or do not come at all, this adaptation practice will not work well and therefore cannot be considered robust.

Apart from introducing GM plants into the environment, altering planting and harvesting dates does not have a significant adverse impact on the environment. Changing the feeding times of, and quantities fed to, poultry is similarly relatively benign with regards to the wider environment. On the other hand, there are a number of adverse social consequences. As stated above, delaying the planting date can negatively impact the length of the growing season and increase the chance of running into bad weather later in the season. These factors mean that the final yield is likely to be reduced which will, in turn, adversely impact income and food security. Farmers have to be ready to plant as soon as the rains finally do arrive and for the very big farms this means that they have to invest in expensive machinery to get the planting done timeously. In the case of poultry farming, changing the time of feeding means that chickens are fed at night when it is cooler which means that farm workers have to work at night.

As was the case with the diversification adaptation practices analysed above, the most important inputs for altering the timing of farming stages are, in the case of crop farmers, faster maturing seeds and equipment to enable the farmers to plant quickly. Both of these are expensive and therefore, while available, are not accessible to all farmers. Also very important for this adaptation practice is knowledge – knowledge of the upcoming season's weather (especially rainfall patterns) so that planning can take place and the correct seeds purchased. Farmers also need to know which early maturing seeds to plant. Once again, not all farmers have access to this important input and receive very little support from private institutions or the government in this regard. For poultry farmers, feed suppliers give them the information they need and supply them with suitable feed.

As most poultry farm workers are women, the impact of the adaptation practice under discussion will largely be felt by them and it is negative. If farm workers have to work at night in order to feed chickens this will mean that women's central role in the family will be disrupted. Furthermore, travelling to and from work at night could prove to be dangerous in terms of personal security.

6.3 Conservation farming

Various conservation farming methods are used by maize, wheat and vegetable farmers: mulching; crop rotation and minimum or no-tillage is most common amongst the bigger commercial farmers. The small scale vegetable farmers also engage in mulching and crop rotation as well as water harvesting with a planting circle and intercropping. Leaving fields fallow was not as widespread as only the larger, better-off, farms can afford to let part of the land 'do nothing' for a period of time. Amongst poultry farmers, the only conservation farming method mentioned by farmers was the planting of trees. There has been a change in thinking around having trees closer to the chicken sheds - conventional wisdom used to be against planting trees because, although they provide shade, they also prevent airflow and may house wild birds that are disease reservoirs, but this thinking is changing. Not only do trees provide shade which lowers the heat stress on birds but it can be good for biosecurity with one farmer using them as a screen from the nearby highway.

The vast majority of farmers interviewed started using conservation farming techniques not as an adaptation to climate change but because it made economic sense – inputs were reduced (at least in the long run after the initial, start-up, costs had been incurred) while outputs increased. And yet conservation farming methods are well recognised as providing some of the best options for farmers to continue farming productively under changed climate conditions, especially with regards to reduced water availability and increased extreme events. Leaving fields fallow allows groundwater reserves to be replenished and mulching ensures that available soil moisture does not evaporate away. Crop rotation and intercropping reduces the number of weeds as farmers can use a wider variety of herbicides (and pesticides) and this is very important as weeds consume much more water than crops. Minimum/ no-tillage also reduces the number of weeds and farmers reported that they are able to plant much earlier in the season since they have been doing minimum-tillage because soil moisture is conserved. In addition, they are better able to withstand the mid-winter drought. According to one wheat farmer, the minimum-till system that they adopted has, over the last ten years, resulted in higher yields than the long-term average. He showed a graph with yield plotted against rainfall. Before about 1990 (when they were ploughing) yield tracked closely with rainfall (and the yield line was below the rainfall line on the graph). Then they started doing minimum-till with a light tine and the yield line went above the rainfall line on the graph. In about 2000 they switched to full no-till which utilised knifepoint planting and caused very little disturbance. After this the yields were even higher, and further above the rainfall line on the graph. It is not all positive as, under very dry conditions, mulching is no longer as effective. Already wheat farmers in the Swartland reported that sometimes they could not leave all the organic material in place because the total lack of summer rainfall in the region means that the stubble does not decompose at all, and planting the following season is almost impossible with all of the material still there.

Conservation farming is also an effective adaptation against projected extreme events. For instance, the techniques keep moisture in the soil so that it is available for crops during drought periods. Also, there have been marked improvements in the ability of the soil to capture and retain water since farmers started practicing minimum-tillage, which has important implications for adaptation to climate change, particularly in light of the predicted intensity of storms.

Conservation farming techniques are almost overwhelmingly positive with regards to their impact on the wider environment. The only possible negative impact identified in the research is that, as weed control is so important and weeds are no longer removed by ploughing, herbicides are typically used which can have an adverse impact on the environment. Generally speaking though, the consequences are positive: leaving fields fallow allows ground water supplies to be replenished; crops selected to be rotated are nitrogen fixing and/or they are deep rooting and therefore aerate the soil; minimum/ no- tillage requires less fertilizer, results in less erosion, requires reduced fuel use and encourages more herbicide use. As for social consequences, the impacts are both positive and negative: conservation farming results in greater yields and therefore enhanced livelihoods and income. On the other hand, techniques such as minimum/ no-tillage require expensive equipment (although ongoing costs are much lower) and this may further reinforce inequality between better off and poorer farmers (figure 19).

Not only is the environmental and social impact of conservation farming largely positive, but there are many co-benefits associated with the adoption of these techniques. Conservation farming aids in soil conservation and in increasing the carbon levels in the soil which contributes to mitigating climate change in that it acts as a carbon sink. In fact, according to a maize farmer, the Australian government pays farmers if they up the carbon content in their soils - it is a form of carbon trading. Crop rotation is better for biodiversity and soils than monoculture while intercropping leads to a reduction in pests and therefore a reduced dependence on pest control methods which may be harmful to the wider environment. Minimum/ no-tillage also contributes to climate change mitigation, biodiversity, soil health and water conservation while planting trees for shade is a climate change mitigation action and has benefits for biodiversity.

Whether or not the adaptation practice is deemed socially acceptable by farmers is variable, depending not only on the practice itself but the type of farmer. In the case of leaving fields fallow, commercial farmers who are in a position to use this method because they have large farms find that, as a result of groundwater being replenished in the fallow fields, they can plant earlier, before the rains. This means harvesting earlier and therefore receiving a better price for their maize. However, there is resistance amongst small scale and development farmers to letting fields lie fallow. A farmer who is a mentor of development maize farmers spoke of the difficulty: *"When up and coming farmers get land they all want to plough everything to plant maize and sunflowers. Experienced farmers will only plough the land that is appropriate and will refrain from ploughing (and planting) if the weather is not right. Last year was very hot and there was very little rain, so it was a difficult year. The white farmers that previously owned these farms didn't plant on certain fields because the soil was too poor; it is too shallow to hold water. It is only possible to farm in poor soil if the rain is regular (Deep soil holds water well, so it is more resilient to climate change). Planting anything was therefore not sustainable, and they left the*

fields covered in grass that can be used for livestock. Developing farmers are trying to plant everywhere." In addition, small scale farmers are growing food largely for their own food security – they are therefore often not in a position to leave land lying fallow.

Crop rotation is not only practised by small scale farmers in order to provide variety in their diet, but it is also an essential part of commercial wheat farming where wheat is rotated with commercial crops or other food crops. A common crop for wheat farmers to rotate is canola as it is nitrogen fixing and planting canola one year leads to noticeable improvements in the wheat yield the following year as a result of soil improvements (a crop rotation of wheat-canola-wheat-canola gives a 20% higher yield than a wheat monoculture). Canola is also susceptible to entirely different diseases than wheat; alternating the two crops can break disease cycles. In addition, different herbicides are available for use with the two different crops, so weeds are more easily controlled.

Figure 19: Many small scale farmers do not want to give up their livestock and therefore are unable to engage in minimum/ no-till or mulching

Commercial wheat and maize farmers accept minimum-till, but not no till because that would mean less livestock. A wheat farmer stated that he does not think he will ever go to no-till because then he would have to stop farming sheep. Sheep compress the soil and make it necessary to do some sort of tillage. He thinks it would be too financially risky to stop sheep farming because, although the income is lower with sheep, they provide a much more reliable supply of income than crops. Several of the small scale maize and vegetable farmers that had heard of the method stated that they were unwilling to try out minimum-tillage until they knew more about it and they had seen its success on their neighbours' farms. Furthermore, mulching is also not very popular amongst small scale farmers as the need the stubble and organic material to feed livestock.

As has been mentioned above, conservation farming techniques require expensive initial inputs and this makes it difficult for poorer farmers to adopt the methods. In the Eastern Cape, farmers

do not practice minimum-till because *"the scarcity of implements in this area is holding back minimum-till".* The farmers all have to hire and share equipment. The few tractors that are actually owned by farmers in the study area are in very poor condition and have a small horsepower of only about 50 kilowatts, so minimum-till is not possible because big powerful implements are required. Exacerbating the situation is the fact that small scale farmers do not qualify for loans because of the land tenure system - very few black farmers in the Eastern Cape actually own their own land, so they are not able to offer security for a loan.

Figure 20: Unusual mulching material in use on a farm in the Eastern Cape

The above is not to say that conservation farming is impossible in poorer communities. Poor farmers do not have the big tractors needed to pull tines, but they could rotate maize with soya or legumes to allow the deep rooting plants to aerate the soil. Poor farmers would need to spray their no-till crops like everyone else, but they would have to spray by hand, which is possible. They could easily rotate crops to cut down on disease. They could easily do no-till and mulch by chopping maize by hand and leaving the stalks in the land (figure 20). Cattle dumping (of manure) would add nutrients to the land (although cause compaction) and they could focus on mulching on top, therefore not working the soil. If the soil is wet the cattle must be removed because they cause compaction.

Another input to which poorer farmers have limited access is know-how. According to a maize farmer who mentors development farmers: *"For poor smaller scale farmers to do no-till they need access to equipment and education. Very importantly they need financial advice and help planning ahead, marketing, and help with what to do after the harvest. It's also very important that they have a very trustworthy network of support and advice".* Successful commercial farming in South Africa is characterised by highly knowledgeable farmers who have access to the advancements in practices and equipment that occur worldwide. Farmers with access to information are able to engage in a debate about what will work best for them. In contrast, small scale farmers in the Eastern Cape rely on traditional knowledge to inform their methods. There

has been considerable advancement in modern agricultural methods and farmers that employ these methods have great advantages over those still using traditional techniques.

Small scale farmers in particular have received training and support from various institutions, most notably GrainSA and the CDC. For the bigger commercial farmers, access to technology is very important with one maize farmer stating that the internet is VERY important to his farming. He thinks that a lack of education and access to the internet is the biggest thing holding back poor farmers. Opinions on the level and usefulness of government interventions is varied. The government only supports a small number of farmers and only those that belong to a co-operative – they help the co-operative farmers access equipment but they do not provide training. GrainSA does all the training and skills development and they are funded by the Maize Trust, Agri-seed, and the Agricultural Research Council (ARC) – they get no support from the government.

Government does, however, experiment on behalf of wheat farmers and offer them advice. Furthermore, the Department of Agriculture has conducted research and done trials suggesting that it is economically feasible to switch to minimum-tillage as it is cheaper and more sustainable in the long run because it requires less diesel. In contrast to these positive inputs by government, according to a commercial maize farmer who mentors development farmers, one of the biggest problems is that *"government policies in land redistribution are very bad. The equipment that the government provides is BAD quality and promotes soil erosion and soil drying. It is possible to start off with conservation farming, but it has to start with government. I have never seen a situation where no-till wouldn't work. Traditional African methods are actually no-till and organic. Everyone now realises how bad ploughing is and no-till is getting easier and easier because of new pesticides".*

According to a maize farmer interviewed, there is nothing technically stopping women from farming maize, women could drive tractors as well as men, but "*it's just not done. It's not in the culture*". Switching to no-till will not make more or less female jobs. There is less work involved in zero-tillage so females that are in charge of farming will have less work (but so will males who are in charge of farming). Mechanising and scaling up means that additional skills are needed, but they could be provided to men or women.

6.4 Mechanisation

As has already been shown in the discussion of diversification, and conservation farming in particular, mechanical equipment is vital if these practices are to be successful. Economies of scale was not mentioned by the farmers as a specific climate change adaptation practice. However, from the interviews it is clear that bigger farms are more successful and lucrative and therefore able to afford specialised equipment and thus better able to adapt to a changing climate. Mechanisation and the introduction of new technologies is very expensive and usually only the larger farms (in all farming commodities) can afford it (figure 21). For instance, amongst chicken farmers in KZN, huge scale production is regarded as, as one farmer put it, "easier" because it is more efficient to farm big. All the big poultry farms can afford to keep their chickens in controlled environment sheds which results in less of a seasonal and daily variation in temperature and will also, to some extent, protect chickens from increased temperatures

expected under climate change. Along with controlled environment sheds, all poultry farmers at least acknowledge (even if they are not able to employ it themselves) the importance of mechanisation and other forms of technology including circulation fans and ventilation tunnels, evaporative cooling wall pads and irrigating roofs, solar reflective roof paint and climate-sensitive shed design.

However, mechanisation and the introduction of new technologies may only be an adaptation to climate change up to a certain point. Amongst poultry farmers, if the temperature increases beyond a certain point, technology may not be enough and stock densities will need to be reduced. Controlled environment sheds will become more and more expensive to run as it becomes more difficult to overcome the outside environment. This will negatively affect the very large farms which rely on high stock densities more than the smallholder farms. Traditional smallholder birds tend to be more heat and disease resistant so the small farmers will have an advantage if the temperatures climb. Along with expected temperature increases, changes in the amount and timing of rainfall is a real threat under climate change. Modern planters plant the seeds deeper allowing them to access more water. They also leave little furrows on either side of the seed, so that rainwater in funnelled towards the seed. This is known as rainwater harvesting and it allows seeds to benefit from very small amounts of rain. Equipment which enables crop farmers to harvest quickly is another important adaptation - for wheat farmers rainfall during harvesting is catastrophic and so, in order to manage this threat, farmers have increased their harvesting capacity by buying bigger combines so that they can harvest faster. In the poultry sector, decreased water availability will be a problem, especially for mechanised adaptations such as evaporative cooling wall pads and irrigating roofs, because they require a constant supply of water.

Adverse environmental impacts caused by mechanisation in crop farming include, most importantly, the burning of fossil fuels to run the equipment. Amongst poultry farmers, the inputs needed for most of the mechanical adaptations (electricity and/ or water) will also have a negative impact on the environment. The main social impact associated with mechanisation is that it has the potential to widen the gap between ‘haves’ and ‘have nots’. Mechanisation and sophisticated technology is very expensive and so only the wealthiest farmers will have access to it. Furthermore, in order to take advantage of the economies of scale made possible by mechanisation (and described above), farmers who are able to are likely to expand their operations, thereby potentially forcing smaller farmers off their farms. In the Eastern Cape, amongst small scale farmers, people have stopped planting lots of the available farmland because it has become so expensive to plant. It costs about ZAR7000 to plant one hectare of land because there is a lack of farming equipment in the area and farmers have to hire it. People therefore do not farm the land to which they have access. Instead they just use it for communal grazing of cattle. Furthermore, the one hectare of communal land to which each farmer has access is too small to be viable. Farmers should farm about five hectares each. If they had five hectares each they could farm very successful co-operatives and build communal fences, etc.

In poultry farming, mechanisation and the use of technology is very common but most of these technologies rely on inputs such as electricity and/ or water. Although not currently due to climate change, the electricity supply in South Africa is becoming more expensive and less reliable which will have negative consequences for those farmers who rely on electricity-driven

technologies such as circulation fans and tunnel ventilation. At the moment, clean water is readily available as most of the poultry farmers had access to their own boreholes or to relatively cheap municipal water. However, under changing climate conditions, the supply of water is likely to decrease and this will have severe consequences for the poultry famers – not only because it is vital that birds have a constant supply of clean fresh water but also because many of the technologies introduced to keep chickens cool rely on water.

Highly automated/ technologically advanced farming requires farm workers who are relatively well-educated and trained in the use of these machines. This is not always available in South Africa where the majority of farm workers lack the necessary capacity. The same is true in poultry farming - dedicated, knowledgeable, staff are required as constant surveillance is needed: "*Controlled-environment sheds do not always work, you have to keep a close eye on the birds all the time. You need to particularly be more alert when it's hot, you need to keep an eye on the chickens ALL the time."*

Due to the increased urgency and also because of bigger yields, wheat farmers are harvesting more tonnes per hour and a huge problem now is that the grain storage facilities cannot handle the bigger load. They have a big enough total capacity but they cannot get the wheat into the silos fast enough - there is a limit to the intake part of the facility. Because of the increased harvest speed and the longer wait at the silos, farmers need to hire more transporters to take wheat away and this increases the cost of harvesting. One thing that they do to give themselves more time during harvest is to put the wheat into silo bags. This gets it off the land in time.

GrainSA is heavily involved in supporting farmers, especially development and small scale farmers, with accessing mechanised equipment. The organisation assists farmers in putting together the business plans that allow them to receive funding for equipment and helps with buying planters for development farmers. One example of how GrainSA supports farmers is that it has asked John Deere to loan farmers in the Eastern Cape a complete package of equipment and implements for six months. They will get a 50kW tractor, a ripper, a planter, a boom sprayer and a disc. The farmers will have to pay John Deere ZAR1250 per hectare, per month, for the use of the equipment, which is much cheaper than it would be if they had to rent each of those implements. The farmer will use the equipment for his own land and he will contract out to other farmers. After six months John Deere will take back the implements. Then GrainSA will help farmers to get loans from the Land Bank to buy back all of the equipment. They will help the farmers get loans if they have done well on the six-month trial. These loans would be at a low 4% interest and the farmers could pay them back over six or so years. GrainSA is in the process of choosing the most appropriate participants for the scheme. The scheme will be profitable for John Deere and it will help the farmers. Poultry farmers receive support from companies that sell controlled environment and climate-sensitive sheds and the South African Poultry Association provides training and standards.

Figure 21: Small scale farmers have limited access to machinery

Government support is limited. There are grants and loans available from various sources including the government and the Eastern Cape Rural Development Agency. Despite this, according to GrainSA, when they applied for funding for the recapitalisation programme in the Eastern Cape they did not get it because there is a lot of corruption with the provincial government representatives – *"You do not get money from government"*. Government does not help with the acquisition of controlled environment sheds, but they do help black poultry farmers to buy farms, some of which have these sheds already. Many of the poultry farmers interviewed stated that they did not need government support except for a stable, cheap, supply of electricity (which they saw as the responsibility of the government).

As women are so under-represented in commercial wheat and maize farming, mechanical and technological advances in this farming type are unlikely to have an impact, either negative or positive, on women. Amongst small scale farmers, women are also likely to be excluded from this agricultural adaptation practice due to cultural reasons and social constructions of gender roles. Although controlled environment sheds and other poultry sector mechanisation examples do not specifically impact women, there are more women involved in poultry farming than men, so advances in the poultry industry will likely be felt more by women.

6.5 Changing densification

Changing densification is an adaptation practice category which includes changing the plant population and distribution in a field (as practised mainly by maize farmers) and reducing stock density (poultry farmers). In the former, the number of plants grown may be reduced (i.e. fewer plants are grown in a row) and/ or the space between the rows is narrowed. Both forms of changing densification reduce the total yield but the quality of the output is maintained.

Changing the density of crops such as maize is a robust adaptation under expected temperature increases (as long as it does not get too hot!). Growing the rows closer means that the maize

plants form a canopy sooner and this keeps plants and the soil in the shade, so that the sun does not dry out the soil. If it becomes very dry, farmers can lower the plant population in order to ensure that limited resources, such as water, are shared by fewer plants. Poultry farmers will also continue to reduce stocking density but, as temperatures get hotter, farming chickens may simply become uneconomical.

The practice of changing the density of crops and livestock has beneficial, or at least neutral, impacts on the environment. The row width that maize farmers plant is getting narrower; it is now 76cm (instead of 91cm). Narrower rows make weed control easier and fewer herbicides are needed. It also leads to better water usage. It keeps the soil cool which is very important, not just for the crop but for soil moisture content and other organisms living in the soil. With regards to reducing stock density on poultry farms, there are no adverse or advantageous environmental consequences. However, there is the added co-benefit of improved animal welfare. Socially, the impacts could be negative as reducing densities will reduce total yields and thereby negatively impact income and food security. For this reason, the adaptation practice is not popular amongst farmers but they engage in it as they recognise it is an important way to ensure that the quality of their outputs remains high (and is thereby able to attract high prices).

In terms of support, poultry farmers claim that both institutional and government support is not needed. Small scale maize farmers say that they get all (and, as is apparent from preceding sections, not just about this particular adaptation practice) their information from GrainSA and *"call them day and night"* for advice. According to them, GrainSA is very accessible, unlike the government.

6.6 Additions and supplements

Another small adaptation category, additions and supplements, includes supplements given to livestock (poultry); fertiliser use (maize) and vermicast and compost use (maize). All of these practices have the potential to increase outputs. Fertiliser use will not directly enable farmers to adapt to climate change, but the increase in yields could help them to cope with threats from climate change. A small group of farmers in the eastern Free State (4) have started farming worms for the production of vermicast. One farmer claimed that, since using compost/vermicast/ efficient microbes (EM), his soil health is much higher and all his plants are looking better. He believes that you need to keep adding to the pool of good bacteria - if there are lots of good bacteria they reduce the bad bacteria. The use of compost is not widespread, especially amongst small scale farmers because, although it is relatively affordable to buy, the costs associated with transporting it in a large enough volume make it prohibitively expensive.

If used in conjunction with other adaptation practices already discussed, the use of supplements and additions is likely to prove a robust adaptation under change climate conditions. Furthermore, these practices have very limited negative impacts on the wider environment. In fact, the impact is mostly positive with some farmers using compost or manure instead of fertiliser. Compost is said to be better for the soil ecosystem and to result in high maize yields. The social consequences of these practices is also relatively neutral although successfully giving

supplements to livestock requires the input of vets which only better-off farmers can afford. This practice therefore has the potential to widen the inequality divide.

The biggest factor holding farmers back is education. The process must be easily understood by all farmers in order to be taken up successfully. The farmer who is a big proponent of EM and vermicast, is adamant that it could benefit African communities. He thinks that the biological approach to farming is the way to go, but it is not that easy. You need a lot of compost which requires money and time and increases the management pressure because it is effectively another commodity that you then have to farm.

With regards to supplements for chickens, there is some support from feed companies. For fertiliser use, commercial farmers send their soil to laboratories throughout South Africa for testing and some even send soil to international laboratories because they doubt the objectivity of the South African testers. Small scale farmers in the Eastern Cape are assisted in their soil testing by GrainSA who notify them when it is required and then send the samples to appropriate South African laboratories. In the case of vermicast and compost use, small scale farmers have received training on compost making and use from the CDC. Unlike the institutional support, support from government is totally lacking when it comes to the use of additons and supplements (at least in the areas studied).

6.7 Climate change is not the only stressor facing farmers

Many, if not most, of the farmers interviewed were not intentionally adapting to climate change although they may have been doing it without realising. In fact, when prompted, most farmers did not see climate change as the most important stressor they faced and the various groups of farmers expressed a range of different concerns about future threats to their farming. Some of these stressors are an indirect consequence of climate change while others reduce the capacity of farmers to adapt to climate change.

6.7.1 Limited access to finance

For the small scale vegetable and maize farmers the biggest threat was their lack of capital to finance advancements in their farming systems. They worried that without access to funds they would be unable to install much needed fencing and irrigation systems and, in some cases, that they would not be able to afford agricultural inputs such as seeds and fertiliser. The land tenure system ensures that bank loans are out of reach for most of them. There are some grants available from the government, but these are usually aimed at financing co-operatives, not individual farmers. Many of the farmers are very poor, having no real income. Those that also keep day jobs, such as teaching, often spend a large proportion of their salaries on farming inputs - farming in these circumstances is generally not sustainable. The difficulty accessing capital for farming inputs has wide consequences for farmers. It jeopardises their ability to buy seeds, fertiliser and herbicides, and it reduces their capacity for building fences around their crops. Fences are a vitally important aspect of farming in the Eastern Cape because of the large number of livestock allowed to graze on communal land. Without proper fences many farmers reported that livestock had destroyed their entire yield. This was one of the most cited factors farmers gave for not expanding the area under production.

6.7.2 Political situation

The (mostly white) commercial maize and wheat farmers feel that the biggest threat they face is politics. Currently land redistribution in South Africa is on the basis of "willing seller – willing buyer" and white owned farms are not seized without the permission of owners or without compensation. However, as a consequence of statements by members of the political leadership of the country, white farmers worry that the policy will change so that farms are taken from unwilling owners without compensation. A maize farmer interviewed stated that "*the political environment is much more dangerous than climate change."* He worries that the ruling party will lose power and then what extremes they will go to in regaining it. Some farmers stated that they were unwilling to invest anything into the development of the farm because they were afraid that it might be taken away.

Certain commercial farmers also voiced concerns about the cost and demands of farm labour. Some farmers are responding to this threat by increasing their mechanisation and therefore reducing labour demands while others are starting community upliftment schemes or mentoring black farmers.

6.7.3 Economic stressors

The biggest challenge facing poultry farmers (according to the farmers themselves) is not climate change but the price of feed – *"we haven't done anything about climate change, it's all about the maize farmers for us"* – an indirect climate change impact. Some poultry farmers are changing what they feed their birds – one farmer stated that they use more soya than they used to because farmers in South Africa are producing more as the climate is becoming more suitable for growing soya. However, the price of such feed inputs is likely to be at least indirectly related to climate change and its effects on supply.

The South African broiler industry is threatened by imports from other countries, especially Brazil and the USA. In affluent countries, such as the USA, consumers demand large amounts of breast meat and want very little of the other parts of the chicken, they are willing to pay so much for the breasts that it is economically viable in these countries to make all their money on the breasts and treat all the other parts as little better than a waste product. All of these other parts are sold for pet feed or, worryingly for South African farmers, they are exported to South Africa where the demand for other pieces of the bird is high and sold at a price below cost. Many broiler farmers have gone out of business as a result of this and although there are now import controls in place they are insufficient to protect the South African broiler industry. The layer industry has not faced this problem for two reasons. First, it is not easy to import eggs because they cannot be frozen and they are very fragile. Secondly, in South Africa there is a market for the spent layer hens unlike in the USA and more developed countries. Slaughtered layer hens are tough and small, particularly the breasts, but black and Indian consumers like to buy them because they can buy them live - in other countries spent hens are a waste product. Live chickens are preferred in South Africa for cultural and religious reasons. These two factors have given the layer industry the competitive edge and allowed the layer industry to continue in the country.

Poultry farmers also frequently described the challenges they face dealing with the supermarkets that buy their eggs. Supermarkets set the price of eggs and farmers cannot negotiate. Additionally the large supermarket chains have moved towards buying on a much larger scale and in many cases farmers have had to form co-operatives to manage the sales and marketing of their eggs. The general tendency in poultry farming is for farms to get bigger and many farmers expressed the concern that if they could not continually expand they would not remain economically viable, the need to scale up was on of their biggest challenges. According to research participants the minimum viable size for a layer farm is about 20 000 to 25 000 birds, but the very large commercial producers have up to a million birds on a farm.

7 South Africa's National Agricultural Investment Plan

The Comprehensive Africa Agricultural Development Programme (CAADP) is the key strategic plan and programme put forth by the African Union (AU) to guide agricultural development on the continent. Housed within the NEPAD Planning and Coordination Agency, CAADP calls for African governments to sign "Compacts" that outline their strategies to increase national investment in agriculture and establishes a framework for systemic engagement with stakeholders, including bilateral and multilateral development assistance partners and the private sector, toward the mobilization of national and regional agricultural investment (UNDP et al., 2012).

As of June 2012, 40 African countries had engaged in the CAADP process, some 30 had signed CAADP compacts and 23 countries and one region (ECOWAS – the Economic Community Of West African States West Africa) had developed "Investment Plans" that laid out each country's key target areas for national investment and incorporated their desires for private sector investment (Mwangi et al., 2012)

Specifically, each compact includes:

a) A Strategic Agreement (Document) on joint and Collaborative Action on Agriculture;

b) Political and Technical Content

c) A roadmap to Specific Desired Areas of Investment

d) Commitments desired from National Government and Development Partners

e) Defined Roles and Responsibilities

South Africa was only due to sign its own compact (or National Agricultural Investment Plan (NAIP)) in November 2014 (Karombo, 2014). Despite extensive searches, no literature could be found on whether or not this has indeed gone ahead.

8 Conclusion

The South African agricultural sector is diverse, not only in terms of the crops grown but also in terms of the types of farmers who are involved (commercial, development; small scale commercial and small scale subsistence). Due in part to this diversity and also because of the

significant climate changes which farmers are already experiencing, a large number of agricultural adaptation practices have arisen and are being implemented across the country.

It is not possible in a limited study such as this to cover all sub-sectors within the South African agricultural sector and therefore the research has focused on maize, wheat, vegetable and poultry farmers. Furthermore, the intention of the research was not to be able to make generalisations within each of these commodities but rather to undertake targeted, qualitative, research with a small sample of farmers (and others associated with farming) in order to ascertain which adaptation practices are the most common, and the reasons why they are considered the most important, across all four of the commodity groups investigated.

The results of the research have shown that from the vast number of adaptation options practices available to farmers, six main categories (comprising a number of specific adaptation practices) can be identified as being the most beneficial and common across all commodity groups covered: Diversification; Altered timing of farming stages; Conservation farming; Mechanisation/ new technologies; Changing densification and the use of Additions/ Supplements. The research has also made it clear that there are strong linkages between these adaptation practices (as well as with others not included in the analysis). In order to gain the most value from an adaptation strategy, it is beneficial to combine e.g. the links between minimum-till and crop rotation or the importance of combining mechanisation with better storage facilities. Emphasis should be placed on introducing a range of complementary adaptation practices and not just one.

The research has also shown that, despite the diversity of commodities farmed and the different adaptation practices adopted, there are a number of cross-cutting issues. One of the most significinant is the disparity which exists between better off, commercial farmers and poorer, small scale (especially women) farmers. This has far reaching consequences for the uptake of adaptation practices – many options require high levels of education and access to specific, technical, knowledge as well as being expensive to implement (even if ongoing costs are reduced) which means they are largely limited to better off, commercial farmers. Worryingly, because of the underlying inequality which already exists in the country, adaptation practices have the potential to exacerbate this division – a concern that must be taken into account when advocating for the implementation of certain practices. As women farmers are often the poorest and least able to access knowledge and finance, special attention needs to be paid to enabling them to benefit from adaptation practices.

9 References

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Annexes

Annex 1: Commodity scorecards

Commodity: Maize

Practice: Fungicide use (4)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Only one farmer reported having to use fungicide to adapt to the changing climate	**Points** 4

Practice: Cover crops (5)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Only one farmer reported experimenting with cover crops	**Points** 5

Practice: Insurance (5)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Very few farmers take out insurance	**Points** 5

Practice: Irrigation (5)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Irrigation is not commonly employed for maize production in the study group	**Points** 5

Practice: Leaving fields fallow (75)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 6
Will this practice be robust under the projected temperature conditions in the next: 10 / 20/ 50 years?	**Points** 7
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 6
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 6
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 6
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 6
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 5
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 8
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 4

Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 6

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 5
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 5
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 5
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Diversifying farming activities (79)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 7
Will this practice be robust under the projected temperature conditions in the next: 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 7

To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 8
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 6
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 6
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 7
To what extent does this practice change existing (or previous) levels of production and quality of output? • Maize production levels are lower, but not necessarily food production levels	**Points** 4
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 6

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 5
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 4
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 5
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Altered planting and harvesting dates (82)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 8
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 7
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 8
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 6
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 7
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 6
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 6
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 6

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 5
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 4
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 5
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Fertiliser use (82)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 8
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 8
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 8
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 7
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 3

To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 7
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 6
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 6
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 8
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 6

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 6
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 4
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 5
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Alternative Seeds (84)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 8
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 8
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 8
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 6
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 7
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 5
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 7
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 6
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 8
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 6

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 6

Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 4
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 5
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Mechanisation (84)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 8
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 8
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 8
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 8
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 5
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 6
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 8

Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 4
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 8
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 6

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 4
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 4
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 7
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Changing plant population and distribution (86)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 7
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 8

Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10/ 20 / 50 years?	**Points** 8
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 6
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 7
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 7
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 7
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 6
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 8
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 6

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 6
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 5
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 5

BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Vermicast and Compost use (88)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 6
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 8
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 8
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 8
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 10
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 8
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 6
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 6
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 9
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 6

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 5
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 3
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 5
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Crop Rotation (91)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 8
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 8
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 8

To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 8
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 7
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 6
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 6
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 6

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 6
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 4
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 5
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice? • Crop rotation is better for biodiversity and soils than monoculture	**Points** 5

Practice: Minimum/ no-tillage (95)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 8
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 8
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 9
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 10
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 9
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 7
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 7
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 5
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 7
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 6

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 4

Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 3
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 5
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice? • Climate change mitigation, biodiversity, soil health, water conservation	**Points** 7

Commodity: Poultry

Practice: Controlled environment trucks (4)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Farmers are not yet using controlled environment trucks, but some mentioned that it would be an option if climate change were to negatively impact them	**Points** 4

Practice: Free Range Farming (4)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • I only came across one very small free-range farmer who had 7000 birds. All the others reported that it is not possible to make a living with free-range farming	**Points** 4

Practice: Making their own feed (4)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Only 2 farmers make their own feed, with few benefits	**Points** 4

Practice: Stopping poultry farming (4)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Farmers mostly feel that they have no choice but to continue poultry farming no matter how badly the industry is affected	**Points** 4

Practice: Cold Drinking Water (5)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Few farmers engage in this practice	**Points** 5

Practice: Feed alternatives (5)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • If maize became too expensive or was no longer available wheat could be used as an alternative, however this is not being done yet	**Points** 5

Practice: Moving to a cooler site (5)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Most farmers were unable or unwilling to move to a cooler site because of an unfavourable climate, although it was mentioned as a possible adaptation.	**Points** 5

Practice: Poultry genetics (5)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Poultry genetics have improved yields over time, but they have not been focused on adapting to climate yet. Some farmers suggested that this might be possible in the future.	**Points** 5

Practice: Diversified income from off farm activities (50)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 7
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 10
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 10
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 10
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** N/A
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** N/A
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 7
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** N/A
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 1

Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 5

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** N/A
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** N/ A
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** N/A
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Sourcing feed worldwide (74)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Feed is supplied by about 5 large feed companies, they source their ingredients worldwide	**Points** 8
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years? • Feed will continue to come from the best producing areas, even under climate change conditions	**Points** 7
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 7

To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)? • Transporting feed worldwide uses a large amount of energy	**Points** 4
To what extent does the use of this adaptation by farmers have adverse social consequences within society? • Sourcing maize worldwide damages the South African maize industry and leads to negative feelings between maize and poultry farmers	**Points** 4
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 7
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice? • Feed is supplied by feed companies	**Points** 10
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 1
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?) • Layers are competitive, broilers are not.	**Points** 5

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions? • Companies supply feed and determine recipes	**Points** 6
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 3
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 5
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Controlled Environment Sheds (76)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Most of the farmers interviewed did not have controlled environment sheds, but they said that this would be the best way to adapt to a changing climate.	**Points** 6
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years? • Yes, but it will entail high financial costs	**Points** 10
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years? • Although it doesn't address water usage it will mean that current water reliant adaptations will no longer be used	**Points** 8
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 8
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)? • Requires very high energy usage	**Points** 3
To what extent does the use of this adaptation by farmers have adverse social consequences within society? • Only very wealthy farmers are able to afford controlled environment sheds	**Points** 3
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale) • There are chicken welfare issues associated with controlled environment sheds	**Points** 6
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice? • They require the same inputs, but different technical knowledge and have high installation costs	**Points** 5
To what extent does this practice change existing (or previous) levels of production and quality of output? • Both production and quality can be higher in controlled environment sheds, particularly during very hot weather. Farmers suffer fewer heat mortalities in controlled environment sheds.	**Points** 9
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 6

• These sheds will help farmers to be more competitive than they are now, but it may not be enough in the long term (because of high energy costs and low poultry prices)	

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions? • There are several companies in South Africa that sell controlled environment chicken sheds and these companies provide support to their clients	**Points** 6
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice? • Government does not help with the acquisition of controlled environment sheds, but they do help black farmers to buy farms, some of which have these sheds already	**Points** 3
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women? • Although controlled environment sheds don't specifically impact women, there are more women involved in poultry farming than men, so advances in the poultry industry will likely be felt more by women.	**Points** 3
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Diversified farming income (76)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 7
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 10
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10/ 20 / 50 years?	**Points** 8
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 7

To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)? • Differs depending on the other farming activity	**Points** 5
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 6
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale) • Farmers are often able to use waste as an input, like chicken manure for cattle production.	**Points** 8
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 6
To what extent does this practice change existing (or previous) levels of production and quality of output? • Levels of poultry production are much the same	**Points** 3
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 5

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 4
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 4
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 3
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Contract farming (77)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 6
Will this practice be robust under the projected temperature conditions in the next 10/ 20 / 50 years?	**Points** 7
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10/ 20 / 50 years?	**Points** 7
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10/ 20 / 50 years?	**Points** 9
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)? • Slightly more transport than if no contract farming was taking place, but otherwise the same	**Points** 6
To what extent does the use of this adaptation by farmers have adverse social consequences within society? • Both parties benefit from the arrangement	**Points** 7
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 5
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 5
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 5
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 5

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions? • Farmers organisations help farmers connect with each other	**Points** 7

Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 3
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 5
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Wetting Chickens (78)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 7
Will this practice be robust under the projected temperature conditions in the next 10/ 20 / 50 years?	**Points** 7
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10/ 20 / 50 years? • If water availability is low or humidity is very high this practice will not be robust	**Points** 6
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10/ 20 / 50 years?	**Points** 7
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)? • Wastes water	**Points** 5
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 8
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale) • Some farmers choose not to wet the chickens because it is not good for them, especially for litter to be wet and for humidity to be increased	**Points** 6

Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice? • They have to know exactly how much water to use so that they will not do the chickens any harm	**Points** 7
To what extent does this practice change existing (or previous) levels of production and quality of output? • Yields remain high when conditions are hot	**Points** 5
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?) • Broilers are not competitive, layers are.	**Points** 5

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services).	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions? • Support is not needed	**Points** 5
Government support (extension services, policy environment, national strategies).	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 5
Positive impact on women.	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 5
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives).	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Supplements in feed (79)

Proof of concept (local level, proven track record).	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • A few farmers mentioned this practice	**Points** 6
Will this practice be robust under the projected temperature conditions in the next 10/ 20 / 50 years?	**Points** 8

Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10/ 20 / 50 years?	**Points** 8
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10/ 20 / 50 years?	**Points** 8
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 8
To what extent does the use of this adaptation by farmers have adverse social consequences within society? • Only really used by people with access to vets and technical knowledge	**Points** 6
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 6
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice? • Technical knowledge is missing on what to give chickens	**Points** 6
To what extent does this practice change existing (or previous) levels of production and quality of output? • Can strengthen chicken immune systems	**Points** 6
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 5

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions? • There is some support from feed companies **Points** 4
Government support (extension services, policy environment, national strategies)
To what extent does government support exist to enable the effective implementation of this adaptation practice? **Points** 3
Positive impact on women
What effect does this adaptation practice have on the livelihoods of women? **Points** 5

BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)

Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Communal pack-shed or communal sales and marketing (84)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 7
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 10
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 10
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 10
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 8
To what extent does the use of this adaptation by farmers have adverse social consequences within society? • May lead to a reduction in jobs	**Points** 5
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 8
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 6
To what extent does this practice change existing (or previous) levels of production and quality of output? • The production side is largely unaffected	**Points** 2
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 5

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions? • Co-operatives exist for farmers to organize themselves	**Points** 7
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 1
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 5
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Irrigating Roofs (85)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 8
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 10
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 5
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 7
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)? • A large amount of water is wasted	**Points** 5
To what extent does the use of this adaptation by farmers have adverse social consequences within society? • May have adverse consequences for society in times of drought	**Points** 7

Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 8
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 9
To what extent does this practice change existing (or previous) levels of production and quality of output? • Yields are higher	**Points** 6
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?) • Broilers are not competitive, layers are	**Points** 5

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 5
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 5
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 5
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Withholding or encouraging feed at different times of the day (85)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 6

Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 8
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 8
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 8
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 9
To what extent does the use of this adaptation by farmers have adverse social consequences within society? • Feeding chickens at night means more people working at night	**Points** 6
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale) • Feeding the chickens at irregular times is inconvenient to farmers, but they choose to if outputs improve	**Points** 6
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice? • Feed suppliers can give them the information they need and supply them with suitable feeds	**Points** 7
To what extent does this practice change existing (or previous) levels of production and quality of output? • Can ensure that outputs stay high during hot periods, and that heat mortalities are reduced	**Points** 7
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 5

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions? • Feed suppliers give farmers advice and provide the appropriate feed.	**Points** 7
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 3

Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 5
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Solar reflective roof paint (88)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • This is a relatively recent adaptation	**Points** 6
Will this practice be robust under the projected temperature conditions in the next 10/ 20 / 50 years?	**Points** 10
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 9
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years? • Extreme weather may reduce the life of the paint	**Points** 8
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)? • Production of the paint may have adverse impacts	**Points** 6
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 8
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 9
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 6

• Paint is expensive to buy, but requires no recurring costs	
To what extent does this practice change existing (or previous) levels of production and quality of output? • Output may continue to be high even during hot periods, heat mortalities are reduced	**Points** 7
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 5

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions? • Paint suppliers supply the solar reflective paint	**Points** 6
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 3
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 5
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Reducing Stocking Density (89)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 6
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years? • Farmers will continue to reduce stocking density but it is unlikely to be effective enough against increased temperatures	**Points** 7
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 7

To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)? • No adverse environmental consequences	**Points** 10
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 10
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale) • Reducing stocking density means reducing the number or total chickens and therefore reducing outputs.	**Points** 3
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 10
To what extent does this practice change existing (or previous) levels of production and quality of output? • Quality of the output is the same, but the total output is reduced.	**Points** 3
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 5

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions? • Institutional support is not needed	**Points** 5
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice? • Governmental support is not needed	**Points** 5
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 5
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice? • Improved animal welfare	**Points** 6

Practice: Circulation Fans (92)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Circulation fans are one of the most popular and cost effective adaptations used by farmers. Many farmers also have tunnel ventilation.	**Points** 10
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years? • Fans will be enough in some cool areas, but they will not be effective in marginal areas like coastal Durban	**Points** 4
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years? • Circulation fans and tunnel ventilation do not require water	**Points** 10
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 10
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)? • Fans require electricity to run, although they can be turned off when the weather is cool	**Points** 6
To what extent does the use of this adaptation by farmers have adverse social consequences within society? • There are no adverse social consequences and most farmers can afford to install and run the circulation fans, many can afford to install tunnel ventilation	**Points** 7
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale) • The fans make the chickens healthier, they are very easy to use and they don't change farming practices	**Points** 10
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice? • Circulation fan inputs are readily available to everyone, simple household ceiling fans can be used. Tunnel ventilation typically comes from a shed design company and can be expensive	**Points** 10
To what extent does this practice change existing (or previous) levels of production and quality of output? • Quality of the output doesn't change, but quality is regular even during extreme heat and heat mortalities are low	**Points** 7
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?) • Layer production is currently competitively using these fans, broiler production is not competitive	**Points** 5

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions? • No support from institutions is needed	**Points** 5
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice? • Government support is not needed except in the provision of electricity, electricity is both prohibitively expensive and unreliably supplied	**Points** 3
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women? • Most poultry workers are women, so any benefits help them	**Points** 5
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Climate Sensitive Shed Design (95 points)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • All of the farmers use some form of shed design that allows them to manage the impact of climate (including orientation, insulation, open sides, curtains, high roofs)	**Points** 10
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years? • Yes in most areas studied, in marginal areas like at the coast shed design will not be enough	**Points** 6
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next10 / 20 / 50 years? • Yes, shed design features do not rely on water	**Points** 10
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years? • Mostly yes, droughts and floods are not likely to affect sheds whether they are climate sensitive or not	**Points** 6
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 9

• The only way sheds may have negative environmental consequences is the materials they use, including concrete and insulation.	
To what extent does the use of this adaptation by farmers have adverse social consequences within society? • There are no adverse social consequences of climate sensitive shed design	**Points** 10
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale) • These measures are highly acceptable to farmers and all farmers are able to adopt some features of climate sensitive shed design	**Points** 10
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice? • All farmers have access to the required inputs for this adaptation, however it does require some knowledge.	**Points** 6
To what extent does this practice change existing (or previous) levels of production and quality of output? • Output quality and quantity are higher when chickens are comfortable, heat mortalities are lower	**Points** 7
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?) • Layer production is currently competitive because of the market for spent hens, broiler production is not competitive even using climate sensitive shed design	**Points** 4

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions? • Companies that design and sell sheds give farmers all the necessary information and support with shed design, the South African Poultry Association provides training and standards	**Points** 7
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 5
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women? • Benefits are not specific to women, but women are highly involved in the poultry industry so all benefits support them.	**Points** 5
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Evaporative Cooling Wall Pads ("wet walls") (95)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Farmers found these walls to be effective except in cases where very high humidity was a problem	**Points** 7
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years? • Wet walls are very effective, especially in dry areas	**Points** 9
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years? • Wet walls require a constant supply of water	**Points** 7
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 10
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)? • Wet walls require electricity and a large amount of water	**Points** 7
To what extent does the use of this adaptation by farmers have adverse social consequences within society? • Wet walls are expensive to install and run	**Points** 7
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 10
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice? • Wet walls require technical knowledge, but this is provided by the shed design companies	**Points** 7
To what extent does this practice change existing (or previous) levels of production and quality of output? • Production continues during extremely hot weather	**Points** 8
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?) • Layers are competitive, broilers are not.	**Points** 5

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions? • Shed design companies provide the technical knowledge and expertise needed.	**Points** 8
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 5
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 5
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Planting Trees For Shade (97)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Some farmers reported that planting trees over the years has helped them keep their sheds cool	**Points** 7
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years? • Trees will thrive but they will not be enough to keep temperatures down	**Points** 6
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10/ 20 / 50 years?	**Points** 6
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 7
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 10
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 10

Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 8
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 9
To what extent does this practice change existing (or previous) levels of production and quality of output? • Heat mortalities may be slightly lower	**Points** 6
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 5

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions? • Institutional support is not needed	**Points** 5
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice? • Government support is not needed	**Points** 5
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 5
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice? • Climate change mitigation and benefits for biodiversity	**Points** 8

Commodity: Small scale (Maize and Vegetables)

Practice: Composting (4)

Proof of concept (local level, proven track record).....	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Only one farmer in the study group mentioned composting	**Points** 4

Practice: Liquid manure (4)

Proof of concept (local level, proven track record).....	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Although this is quite a popular adaptation it is not likely to have an impact on climate change resilience	**Points** 4

Practice: Organic pest control (4)

Proof of concept (local level, proven track record).....	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Several farmers are using this method but it is unlikely to increase their resilience to climate change	**Points** 4

Practice: Stopping crop farming in favour of livestock (4)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • This adaptation was uncommon and does not contribute to adaptations in the vegetable farming sector	**Points** 4

Practice: Relying on grants and handouts from government (67)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 7
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 5
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 5
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 5
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 8
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 4
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 6
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 6
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 6

Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 1

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 6
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 7
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 1
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Altered planting date (68)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 6
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 5
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 5

To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 8
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 4
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 6
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 7
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 5
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 1

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 6
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 4
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 4
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Switching to more drought resistant crop types (72)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 6
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 8
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 7
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 8
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 6
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 5
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 7
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 7
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 1

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 5

Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 4
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 1
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Herbicides (74)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 6
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 6
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 4
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 6
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 5

Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 6
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 9
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 1

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 7
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 6
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 4
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Irrigation (82)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 8
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 8

Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 8
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 6
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 8
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 10
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 4
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 9
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 1

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 5
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 5
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 3

BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Mechanisation (82)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 7
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 8
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 8
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** **8**
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 5
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 5
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 9
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 5
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 8
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 1

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 6
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 6
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 6
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Mulching (82)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 7
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 9
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 9
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 9
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 7

Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 6
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 6
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 8
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 1

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 6
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 3
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 4
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Water harvesting with a planting circle (82)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 7
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 10
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 8
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 5
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 7
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 7
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 7
To what extent does this practice change existing (or previous) levels of production and quality of output? • Increased yields but in a very small area	**Points** 8
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 1

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 7

Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 3
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 5
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Crop rotation (90)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 6
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 6
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 10
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 8
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 6

Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 7
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 7
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 1

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 6
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 5
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 7
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 7

Practice: Intercropping (90)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 7
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 9

Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 7
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 10
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 8
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 6
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 6
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 8
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 1

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 5
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 3
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** 6
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 7

Commodity: Wheat

Practice: Cover crops (5)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Few farmers use cover crops because they don't directly earn any money	**Points** 5

Practice: Different cultivars (5)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Cultivars with slight differences are used but not to the satisfaction of farmers. Improvements have been too small and too slow and farmers feel that they have been let down by the availability of seeds.	**Points** 5

Practice: Harvesting early and drying artificially (5)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Few farmers employ this strategy because of the cost involved with drying wheat artificially	**Points** 5

Practice: Income diversification from off farm activities (5)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Most farmers didn't have any off farm income because they engage in a wide range of different farming within the wheat production system	**Points** 5

Practice: Insurance (5)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season? • Very few farmers have their crops insured against climate related risks because of the high cost and relatively low level of risk	**Points** 5

Practice: Storing their own wheat (72)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 6
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 7
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 8
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 7

Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 6
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 7
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 4
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 6

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 4
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 4
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** -1
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Increased harvesting capacity to harvest faster (81)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 8
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 9
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 9
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 7
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 8
To what extent does the use of this adaptation by farmers have adverse social consequences within society? • Harvesting faster requires bigger equipment which only wealthy farmers have access to	**Points** 5
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 7
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 6
To what extent does this practice change existing (or previous) levels of production and quality of output? • This will prevent losses from rain during harvest, but it wont actually increase yields	**Points** 7
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 7

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 4

Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 5
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** -1
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Alternative cash crops and cash crop rotation (90)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 7
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 8
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)? • Slightly lower use of fertiliser than if only doing wheat	**Points** 7
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 8
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 7

Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 6
To what extent does this practice change existing (or previous) levels of production and quality of output? • Wheat yields per hectare increase, but fewer hectares are planted	**Points** 7
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 8

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 6
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 6
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women? • Women are excluded from wheat and cash crop production	**Points** -1
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice? • Much better for soil than repeated wheat cropping	**Points** 7

Practice: Modern planter (90)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 7
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 7

Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 9
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 9
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 9
To what extent does the use of this adaptation by farmers have adverse social consequences within society? • Modern planters are expensive and may alienate less wealthy farmers	**Points** 5
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 9
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 6
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 10
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 9

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 6
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 5
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** -1

BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Livestock farming (92)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 10
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 6
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 8
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 7
To what extent does the use of this adaptation by farmers have adverse social consequences within society? • Farmers are more financially resilient	**Points** 8
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 9
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 9
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 5
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 8

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 6
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 6
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women? • There are more women involved in livestock farming than wheat farming	**Points** 3
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Long and short improved pasture rotation (98)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 10
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 9
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 / 50 years?	**Points** 7
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 10
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?	**Points** 9
To what extent does the use of this adaptation by farmers have adverse social consequences within society?	**Points** 8

Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)	**Points** 7
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?	**Points** 7
To what extent does this practice change existing (or previous) levels of production and quality of output?	**Points** 8
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 7

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 6
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice? • They experiment on behalf of farmers and offer them advice	**Points** 7
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women? • There are slightly more women involved in livestock production than in cropping	**Points** 3
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice?	**Points** 0

Practice: Minimum/ no-tillage (102)

Proof of concept (local level, proven track record)	
To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?	**Points** 9
Will this practice be robust under the projected temperature conditions in the next 10 / 20 / 50 years?	**Points** 9
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10 / 20 50 years?	**Points** 10
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10 / 20 / 50 years?	**Points** 10
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)? • Less fertiliser, erosion, fuel, more herbicide	**Points** 9
To what extent does the use of this adaptation by farmers have adverse social consequences within society? • Requires expensive equipment but ongoing costs are much lower. May reinforce inequality	**Points** 5
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale) • They accept minimum-till, but not no-till because that would mean less livestock. Some are not willing to leave stubble.	**Points** 7
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice? • Everything is easy to obtain except the equipment	**Points** 5
To what extent does this practice change existing (or previous) levels of production and quality of output? • Yields are higher and resilience to climate stressors is higher	**Points** 9
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)	**Points** 8

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services)	
To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?	**Points** 6
Government support (extension services, policy environment, national strategies)	
To what extent does government support exist to enable the effective implementation of this adaptation practice?	**Points** 6
Positive impact on women	
What effect does this adaptation practice have on the livelihoods of women?	**Points** -1
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives)	
Are there additional co-benefits that result from the adoption of this adaptation practice? • Increased carbon sequestered in soils, less fuel used, farming ecosystem supports a much higher number of organisms	**Points** 10

Annex 2:

Table 5: Scoring for all commodity types

Adaptation practice	Commodity/ farming type			
	Maize (commercial and small-scale)	Poultry (commercial and small-scale)	Small scale (vegetables and maize)	Wheat (commercial)
Liquid manure	-	-	4	-
Organic pest control	-	-	4	-
Pesticide (fungicide/ herbicide) use	4	-	74	-
Stopping farming	-	4	-	-
Controlled environment trucks	-	4	-	-
Free range farming	-	4	-	-
Making their own feed	-	4	-	-
Feed alternatives	-	5	-	-
Moving to a cooler site	-	5	-	-
Genetic modification	-	5	-	-
Cover crops	5	-	-	5
Insurance	5	-	-	5
Irrigation	5	-	82	-
Cold drinking water	-	5	-	-
Leaving fields fallow	75	-	-	-
Off farm income	-	50	-	5
Government grants and handouts	-	-	67	-
Storing own wheat	-	-	-	72
Sourcing feed worldwide	-	74	-	-
Controlled environment sheds	-	76	-	-
Diversifying farming activities/ income	79	76	4[3] and 72[4]	90[5] and 92[6]
Contract farming	-	77	-	-
Wetting chickens	-	78	-	-
Supplements in feed	-	79	-	-
Altered planting and harvesting dates	82	-	68	5[7]
Fertiliser use	82	-	-	-
Communal farming/ sales and marketing	-	84	-	-
Alternative seeds/ different cultivars	84	-	-	5
Water-harvesting with a planting circle	-	-	82	-
Mulching	-	-	82	-
Mechanisation	84	-	82	81[8] and 90[9]

[3] Stopping crop farming in favour of livestock
[4] Switching to more drought resistant crop types
[5] Alternative cash crops
[6] Livestock farming
[7] Harvesting early and drying artificially
[8] Increasing harvesting capacity to harvest faster
[9] Modern planter

Irrigating roofs	-	85	-	-
Change in feeding quantities and times	-	85	-	-
Changing plant population/ distribution	86	-	-	-
Solar reflective roof paint	-	88	-	-
Vermicost and compost use	88	-	4	-
Reducing stocking density	-	89	-	-
Crop rotation	91	-	90	98
Intercropping	-	-	90	-
Circulation fans and tunnel ventilation	-	92	-	-
Minimum/ no-tillage	95	-	-	102
Climate sensitive shed design	-	95	-	-
Evaporative cooling wall pads	-	95	-	-
Planting trees for shade	-	97	-	-

Annex 3:

Table 6. Most common/ top ranked adaptation practices

Adaptation practice		Commodity/ farming type			
		Maize (commercial and small-scale)	Chickens (commercial and small-scale)	Small scale (vegetables and maize)	Wheat (commercial)
Diversification: of farming activities/ types of farming/ sources of income/ seed varieties	Diversifying farming activities/ income	79	76		
	Switching to more drought resistant crops			72	
	Diversifying to alternative cash crops				90
	Diversifying to livestock farming			4	92
	Alternative seeds/ different cultivars	84			5
	Stopped farming		4		
	Off farm income		50		5
Altered timing of farming stages	Altered planting and harvesting dates	82		68	
	Change in feeding quantities and times		85		
	Harvesting early and drying artificially				5
Conservation farming	Leaving fields fallow	75			
	Water harvesting with a planting circle			82	
	Mulching			82	
	Crop rotation	91		90	98
	Intercropping			90	
	Minimum/ no-tillage	95			102
	Planting trees for shade		97		
Mechanisation/ new technologies	Mechanisation	84		82	
	Increasing harvesting capacity to harvest faster				81
	Modern planter				90
	Controlled environment sheds		76		

	Circulation fans and tunnel ventilation		92		
	Evaporative cooling wall pads		95		
	Solar reflective roof paint		88		
	Climate sensitive shed design		95		
	Irrigating roofs		85		
Changing densification	Changing plant population/ distribution	86			
	Reducing stock density		89		
Additions/ supplements	Supplements in feeds		79		
	Fertiliser use	82			
	Vermicast and compost use	88		4	
	Liquid manure			4	

Annex 4: Adaptation practices scorecards

Practice: Diversification

Diversifying farming activities/ income (Maize: 79/ Poultry: 76)
Switching to more drought resistant crops (Small scale: 72)
Diversifying to alternative cash crops (Wheat: 90)
Diversifying to livestock production (Small scale: 4/ Wheat: 92)
Alternative seeds/ different cultivars (Maize: 84/ Wheat: 5)
Stopped farming (Poultry: 4)
Off farm income (Poultry: 50/ Wheat: 5)

Proof of concept (local level, proven track record): To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?		
Diversifying farming activities/ income Mentioned by 3 of the 20 farmers interviewed (Poultry) Amongst maize farmers, 6 had diversified their activities and income (Maize) *Switching to more drought resistant crops* They do the potatoes infrequently, but they may plant potatoes again if it is dry because potatoes do well during droughts (Small scale) He does not irrigate the potatoes because they can survive without irrigation (Small scale) *Diversifying to alternative cash crops* He used to plant only maize, but he stopped because his land was too small to grow enough maize to sell and make money. He prefers spinach as a cash crop because it grows well and he is able to sell it for a good price. He sells it to Spar, Pick 'n Pay and on the streets. If there is a big demand, like in the winter it is very easy to sell spinach (Small scale)	**Points** 7 (Maize) 7 (Poultry) 6 (Small scale) 7 (Wheat) 4 (Small scale) 10 (Wheat) 5 (Wheat) 8 (Maize) 4 (Poultry) 5 (Wheat) 7 (Poultry)	**Median** **7**

Diversifying to livestock production This adaptation was uncommon and does not contribute to adaptations in the vegetable farming sector (Small scale) All of the wheat farmers in the Western Cape study group keep either cattle or sheep, or both (Wheat) "During a very dry season your cattle and sheep pull you through" (Maize) Farmers are moving back into cattle farming because they make more money. He thinks that sunflower and maize lands will become grasslands, especially in marginal areas (Maize) *Alternative seeds/ different cultivars* Cultivars with slight differences are used but not to the satisfaction of farmers. Improvements have been too small and too slow and farmers feel that they have been let down by the availability of seeds (Wheat) Most of the maize farmers interviewed said that they have experimented with different seeds in an effort to achieve higher yields (Maize) Almost all of the commercial maize farmers had started growing GM seeds (higher yields) (Maize). Use Monsanto seeds, they have done so for a long time because they are drought tolerant (Maize – small scale) Small scale farmers who grow maize have in recent years stopped saving seeds and replanting them each year as was traditional in the area. Due partly to the training from GrainSA they have adopted commercially available high yielding seeds, which they replace annually (Maize) These are not a new adaptation and farmers have been using them for a long time (Wheat) They have had improved yields in wheat over the years, but not in the same leaps and bound that they have had in maize. Wheat is stagnating because breeding programmes have not really focused on wheat. In Australia they (Monsanto and Beyer) have recently found a drought resistant wheat variety and in the future they may make Round-up Ready wheat, but so far there are no GM wheat varieties. Round-up Ready Maize was the maize industry's saving grace. They have had double haploid		

breeding of wheat for a long time, but no genetic engineering yet. He thinks that part of the reason that there hasn't been any scientific development of wheat is that there hasn't been any wheat loyalty programme in place, so there is no incentive for breeders. If there was an end product royalty system (instead of a delivery system) then breeders would be funded and there would be an incentive for them to produce better wheat (Wheat). *Stopped farming* Farmers mostly feel that they have no choice but to continue poultry farming no matter how badly the industry is affected (Poultry). *Off farm income* Most farmers didn't have any off farm income because they engage in a wide range of different farming within the wheat production system (Wheat)		
Will this practice be robust under the projected temperature conditions in the next 10, 20, 50 years?		
All: One of the most common adaptation practice which will become increasingly necessary as the temperatures increase. *Diversifying farming activities/ income* You can always sell cattle if the weather is bad, unlike a crop, which will not make any money back if the crop fails (Maize) Farmers around Hoedspruit are not even bothering to plant maize at the moment because it is so hot. She thinks they will switch to game farms instead because they are more lucrative and not so affected by the weather (Maize) *Diversifying to alternative cash crops* If the climate becomes less predictable having a variety of different cash crops could help farmers to have more stable income (Wheat) *Diversifying to livestock production* Livestock on the other hand offer a more steady income, the potential profits are not as high but if the weather is bad or any other factor is negatively influencing the livestock it is possible to sell them and recoup the input costs.	**Points** 7 (Maize) 10 (Poultry) 7 (Small scale) 7 (Wheat) 7 (Wheat) 8 (Maize) 10 (Poultry)	**Median** **7**

Alternative seeds/ different cultivars Shorter length cultivars have potential as an adaptation to climate change because they can be planted late but still be harvested at the optimal harvest time. The downside of shorter growers is that they are generally lower yielding than longer growers (Maize). GM seeds such as Monsanto are drought resistant (Maize – small scale)		
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10, 20, 50 years?		
Diversifying farming activities/ income You can always sell cattle if the weather is bad, unlike a crop, which will not make any money back if the crop fails (Maize) *Switching to more drought resistant crops* Several small scale vegetable farmers in the Eastern Cape reported that they are now planting more potatoes than previously, largely because potatoes "do well during droughts". In addition to potatoes, butternuts "do very well in dry soil" and are sometimes planted in preference to previously popular crops for this reason (Small scale) *Diversifying to alternative cash crops* If the climate becomes less predictable having a variety of different cash crops could help farmers to have more stable income (Wheat) *Diversifying to livestock production* Livestock on the other hand offer a more steady income, the potential profits are not as high but if the weather is bad or any other factor is negatively influencing the livestock it is possible to sell them and recoup the input costs. Farmers should be thinking about switching to cattle because it is less risky. It costs a lot to plant your land and if the crop fails you can lose your farm. Cattle is better because although it's slower you can never lose your farm, if you have a bad year you can sell back your cattle, but you can never sell back your seeds (Maize) *Alternative seeds/ different cultivars* Shorter length cultivars have potential as an adaptation to climate change because they can be planted late but still be harvested at the optimal harvest time. The downside of shorter growers is that they are generally lower yielding than longer growers (Maize).	**Points** 7 (Maize) 8 (Poultry) 8 (Small scale) 7 (Wheat) 6 (Wheat) 8 (Maize) 10 (Poultry)	**Median** **8**

Some GM seeds (Ultrafast maize seeds – shorter maturing seed) are heavily dependent on irrigation - "if you lose your irrigation for as little as 2 days, you lose your crop" The short growing cultivars may be of use if climate change results in a shorter rainy season, but farmers are not happy about them because of the lower yields they give (Wheat)		
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10, 20, 50 years?		
All: There have also been more storms and more incidences of heavy rain. This is not good for the maize because it grows in sandy soil and cannot hold moisture. Therefore the yield that they are managing to get has dropped. They get about 4 tonnes per hectare. There is nothing they can do about this because they have very sandy soil (Maize) She grows a variety of vegetables in a garden next to her house. She usually irrigates with tap water and a hosepipe, but the reservoir runs dry during the winter so they have no tap water between March and June. She has a water tank that she uses for her drinking water. She is using a little bit of her drinking water to irrigate the baby vegetables (Small scale) *Diversifying farming activities/ income* You can always sell cattle if the weather is bad, unlike a crop, which will not make any money back if the crop fails (Maize) One farmer suggested that he would start farming poultry if his maize stopped being profitable. In the western Free State several farmers stated that they would switch to farming sunflowers if maize stops being feasible. Sunflowers do well in shallow soil and require less water than maize. Sorghum is another potential alternative crop because it has a very low water requirement, even lower than sunflowers (Maize). *Diversifying to alternative cash crops* If the climate becomes less predictable having a variety of different cash crops could help farmers to have more stable income (Wheat) *Diversifying to livestock production* Livestock on the other hand offer a more steady income, the potential profits are not as high but if the weather is bad or any other factor is negatively influencing the livestock it is possible to sell them and recoup the input costs.	**Points** 7 (Maize) 7 (Poultry) 7 (Small scale) 8 (Wheat) 8 (Wheat) 6 (Maize) 10 (Poultry)	**Median** **7**

Alternative seeds/ different cultivars Shorter length cultivars have potential as an adaptation to climate change because they can be planted late but still be harvested at the optimal harvest time. The downside of shorter growers is that they are generally lower yielding than longer growers (Maize).		
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?		
Diversifying farming activities/ income Differs depending on the other farming activity. One of the farmers interviewed had diversified into making concrete which is not good for the environment (Poultry) *Diversifying to alternative cash crops* Slightly lower use of fertilizer than if only doing wheat (Wheat) Cash crop rotation also has other benefits, particularly in the case of canola. Canola is nitrogen fixing and planting canola one year leads to noticeable improvements in the wheat yield the following year as a result of soil improvements. Canola is also susceptible to entirely different diseases than wheat; alternating the two crops can break disease cycles. In addition, different herbicides are available for use with the two different crops, so weeds are more easily controlled (Wheat). *Alternative seeds/ different cultivars* Introduction of GM seeds into the environment may have negative consequences (Maize)	**Points** 8 (Maize) 5 (Poultry) 8 (Small scale) 7 (Wheat) 7 (Wheat) 5 (Maize) n/a (Poultry)	**Median** **7**
To what extent does the use of this adaptation by farmers have adverse social consequences within society?		
All: Diversifying is an adaptation practice which allows farmers to continue farming and producing food. In this way, not only are the livelihoods of the farmers and their workers safe-guarded but food security for the wider population is maintained. *Switching to more drought resistant crops* Food security is improved (Small scale)	**Points** 6 (Maize) 6 (Poultry) 6 (Small scale) 8 (Wheat) 8 (Wheat) 5 (Maize)	**Median** **6**

Diversifying to alternative cash crops Stabilizes farmers income (Wheat) *Diversifying to livestock production* Farmers are more financially resilient (Wheat) *Alternative seeds/ different cultivars* Although they have to pay for these seeds they experience a substantial increase in yields (Maize) However, the highly political and controversial status of GM seeds may reduce their usefulness as an adaptation. Opposition to GM food crops is related to concerns over human and environmental health, food sovereignty, and because of the commercial nature of GM seed development and sales. GM seeds are illegal in several African countries and some African leaders have gone as far as to reject GM food aid. In this context, the potential for GM seeds as a climate change adaptation is uncertain (Maize) The short growing cultivars may be of use if climate change results in a shorter rainy season, but farmers are not happy about them because of the lower yields they give (Wheat)	n/a (Poultry)	
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)		
All: According to a farmer who only grows one type of vegetable - he knows that it is not ideal to only farm spinach, he would like to diversify, but at the moment he does not have the land or resources. He would also like to have more livestock if he could. When his new land is ready he will also plant spinach there. He likes spinach because the plant continues to grow after it has been harvested, unlike cabbage. He would also like to grow maize, if he had more land, especially because it could help with feeding his cattle. He is going to try to save for more land (Small scale) *Diversifying farming activities/ income* Farmers are often able to use waste as an input, like chicken manure for vegetable production or on pastures for cattle production (Poultry)	**Points** 6 (Maize) 7 (Poultry) 5 (Small scale) 7 (Wheat) 9 (Wheat) 7 (Maize) 7 (Poultry)	**Median** **7**

Also sell waste to neighbouring farms (Poultry) Only mentioned by 3 of the 20 farmers interviewed (Poultry) If he treats his fields differently then, no matter what the rainfall pattern is like, some of the fields will always be ready for planting at the right time. This is harder for emerging farmers to do because they don't have a lot of land. Farms are so big now days that it is going to be hard for farmers to compete on the free market. Emerging farmers have a very steep hill to climb, it's much harder to come from nothing than it used to be (Maize) *Switching to more drought resistant crops* Switching to more drought resistant crops will be an important adaptation in the future because it will allow food security to be maintained in a changing climate. Potatoes are a popular food among Eastern Cape farmers and they are willing to switch to these, however an adaptation of this type is only possible if the replacement crop is socially and culturally acceptable (Small scale) She has been doing the potato maize rotation for 2 years. She chose to do potatoes because of droughts; potatoes don't need a lot of water. Before she started planting potatoes she used to just leave the field empty when the maize had been harvested. She also likes to grow potatoes because she likes to eat them and there is a high demand in the area for them (Small scale) *Diversifying to alternative cash crops* Rotation of all of these crops has advantages for income security, in a year when one of the crops does badly or the selling price is low, it is likely that the other crops will not do similarly badly and they will provide an alternative income for the farmer (Wheat) But canola makes the soil healthier and breaks the wheat/barley cycle (barley and wheat are very similar and have the same options for herbicides etc.). They were able to spray canola with a herbicide that would kill other grains (wheat and barley) and thereby break the disease cycle. Suddenly people had options for their crop production. With the three crops as viable options (wheat, barley and canola) farmers could play around with the amount of each they planted, depending on the income generating capability of each (Wheat)		

Diversifying to livestock production All of the wheat farmers in the Western Cape study group keep either cattle or sheep, or both (Wheat) *When I asked about the fact that you earn more per hectare on crops than you do on livestock.* Francois said that for him it would be too risky to stop farming sheep because sheep protect you in a bad year. They may not make the most per hectare, but the income from sheep is reliable. Economies of scale allow him to keep the sheep and not put more crops in. He has such a large farm that he can afford to earn less per hectare (Wheat) Has an impact on the ability to fully engage in conservation agriculture – cannot keep livestock and engage in no-tillage. *Alternative seeds/ different cultivars* Small scale farmers who grow maize have in recent years stopped saving seeds and replanting them each year as was traditional in the area (Maize) These different cultivars vary in growing time by a few weeks and they can help farmers to efficiently utilise the entire growing season. Shorter length cultivars have potential as an adaptation to climate change because they can be planted late but still be harvested at the optimal harvest time. The downside of shorter growers is that they are generally lower yielding than longer growers (Maize). In his maize planting he used to target 3 tonnes per hectare and he now targets 6 tonnes, so he has doubled maize production in 30 years. He attributes this mostly to better seed varieties and breeding. The varieties that are used now are faster than the ones they used in the past (Maize) The short growing cultivars may be of use if climate change results in a shorter rainy season, but farmers are not happy about them because of the lower yields they give (Wheat)		
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?		
All: “Education is the biggest stumbling block for poor farmers”.	**Points** 7 (Maize) 6 (Poultry)	**Median** **7**

Alternative seeds/ different cultivars There are a wide variety of different seed options (Maize). Many farmers stated that there has not been enough seed development in South African wheat farming because it is too small an industry; and they compared the huge advances in maize seeds to the small ones for wheat. There is not currently a GM wheat variety available, although it was mentioned that Monsanto and others have recently found a drought resistant wheat variety in Australia and that at some point they may make a GM version (Wheat) BT needs you to plant 5% non GM as a refuge for bugs so that the go and breed in there and are not forced to breed in the GM maize, leading to superbugs. At the moment farmers need to know this when planting BT maize and they need to plant separate refuge areas. GM is dramatically more expensive than non GM, approximately twice the price. Only about 1% of farmers around here use GM seeds because they are new and farmers want to see what they can do before they start using them (Small scale) The seeds they use are changing, she used to save seeds and replant each year, but she does not save seeds anymore, now she buys each year. There is a catalogue that tells you what the best seeds are for the area. Buying seeds is a safer option because they are well tested and it is easy to estimate the expected yield, if you plant bought seeds you know you will get a yield of a certain amount. She buys the best available seeds for her area, no matter the cost. For the last two years she has bought Roundup ready seeds. They are very good in the area because they are disease free and drought resistant. Also, Roundup herbicide is very easy to use because it is applicable in all situations. She learnt about Roundup ready seeds through the GrainSA training courses, and she also got information directly from Pannar (Small scale)	7 (Small scale) 7 (Wheat) 9 (Wheat) 6 (Maize) n/a (Poultry)	
To what extent does this practice change existing (or previous) levels of production and quality of output?		
Diversifying farming activities/ income Maize production levels are lower, but not necessarily food production levels (Maize) Levels of poultry production are much the same (Poultry)	**Points** 4 (Maize) 3 (Poultry) 7 (Small scale) 7 (Wheat)	**Median** **5**

Diversifying to alternative cash crops Wheat yields per hectare increase, but fewer hectares are planted (Wheat) *Alternative seeds/ different cultivars* Achieve higher yields (Maize) Shorter growing cultivars produce lower yields (Wheat)	5 (Wheat) 8 (Maize) 1 (Poultry)	
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)		
Alternative seeds/ different cultivars Illegal in some countries (Maize)	**Points** 6 (Maize) 5 (Poultry) 1 (Small scale) 8 (Wheat) 8 (Wheat) 6 (Maize) 5 (Poultry)	**Median** **6**

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services) : To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?		
All: One female small scale farmer stated that she will continue to farm even if the weather changes as long as someone shows them how to. Both GrainSA and the Department of Agriculture train them at the moment and she thinks that both entities should be responsible for training them. She is happy to have two different groups training her because they both train her in different things (Small scale) *Alternative seeds/ different cultivars* Support of GrainSA (training and advice) (Maize)	**Points** 5 (Maize) 4 (Poultry) 5 (Small scale) 6 (Wheat) 6 (Wheat) 6 (Maize) n/a (Poultry)	**Median** **5.5**

Many farmers stated that there has not been enough seed development in South African wheat farming because it is too small an industry; and they compared the huge advances in maize seeds to the small ones for wheat. There is not currently a GM wheat variety available, although it was mentioned that Monsanto and others have recently found a drought resistant wheat variety in Australia and that at some point they may make a GM version (Wheat) The seed producers are planning on mixing in 5% of non BT maize directly into the BT maize which would mean that farmers would lose 5% of their plants to BT but that they would have the choice not to plant to refuge maize and superbugs would not occur. This would be a good thing for uneducated farmers (Maize) GrainSA supports the uptake of GM seeds because of their potential for disease control and higher yields (Small scale) They ask at the nurseries what the correct seed is, which seeds they buy depends on the person at the nursery. GrainSA helped them by telling them what type of soil they have. GrainSA helps them a lot and they are really just a phone call away. They are using Roundup ready seeds for the first time now. They planted a trial plot with the help of GrainSA. The trial plot has got a much better yield than the other maize so they are going to plant Roundup ready seeds again. GrainSA is negotiating with Monsanto that they will sell Roundup ready seeds to the developing farmers at the same price as non-GM seeds. GrainSA is trying to develop a partnership with GrainSA (*They didn't explain how Monsanto benefits from this arrangement and why they would be willing to do it*) (Small scale)		
Government support (extension services, policy environment, national strategies): To what extent does government support exist to enable the effective implementation of this adaptation practice?		
All: The function of ECRDA as mandated by the SA government is to uplift emerging farmers, to close the gap between the commercial farmers and the developing ones. They do this by injecting money into infrastructure, for things like irrigation and anything else to do with agriculture. They buy the equipment that the farmers need to mechanise based on a business plan submitted by the farmer, or they provide the money to buy seeds, fertiliser, herbicides, or medicine. Or they provide the money needed to hire equipment for farming. This money comes in the form of a loan and the eligibility of the farmers is determined by the business plan. They give loans and not grants. Loans from the ECRDA are awarded purely on the practicality, viability and feasibility of the business plan submitted by the farmer. These loans are open to people who do not have the title deeds to the land on which they farm (as is the case for most farmers in the Eastern Cape). In the case that a farmer is applying for a loan to farm communal land they need a letter from the traditional leaders stating that they have Permission To Occupy (PTO) the land. A few farmers do also have title deeds. There is flexibility about which farmers to give loans to, there are no	**Points** 4 (Maize) 4 (Poultry) 4 (Small scale) 6 (Wheat) 6 (Wheat) 4 (Maize) n/a (Poultry)	**Median** **4**

strict criteria. Getting a loan from the ECRDA is not like getting one from the bank, because farmers do not need to won collateral for surety. The interest rates on loans offered by the ECRDA are usually between 1 and 3% lower than the interest rates offered by the banks. ECRDA uses both simple and compound interest rates. They also assist farmers who are faced with challenges such as drought. The ECRDA has experts available to advise farmers; they are agronomists for cropping, animal husbandry, SMMEs, marketing etc. There are also Rural Development Officers. Although the ECRDA does not give grants they are in partnerships with other entities and they are able to refer the farmers to places that they can get grants. One place that gives grants is the Department of Agriculture. For example there is a scheme whereby the government pays R7000 of the inputs required to plant 1ha of maize and for each R7000 the farmers but in the remaining R1800. There are also grants from the government for fencing, and for improving the quality of livestock buy buying high quality bulls and heifers to breed with. Some NGOs also give grants. The awarding of grants depends on the criteria of the institution offering it Any scale of farming or any other business that creates jobs is eligible for funding, but the focus of the ECDRA is on developing farmers. *Diversifying to alternative cash crops* The Department of Agriculture is also doing research into triticale, a wheat/rye hybrid, as a potential alternative crop because it can be grown in marginal areas that are not suitable for wheat (Wheat). *Alternative seeds/ different cultivars* Government provides GM seeds for higher yields directly to the farmers The researchers must help the farmers (and come up with drought resistant GM seeds). The problem is that they do not have the money to do the research. The government is not involved (when prompted), the previous government was big on research and development but this one is not (Maize) He thinks it is very sad that all research and development is private. Companies just promote their own products, products are more expensive and you may not be getting accurate information (Maize)		

They use the red seed (*the colour of the bag, he doesn't know what type it is*) because that is what the government gives them. GrainSA has advised them to use Roundup ready seeds but they don't because they just use what the government gives them. There is also a problem that some of the shops don't have Roundup ready seeds. If he farmed on his own he would buy Roundup ready seeds (Small scale). The only difference in farming since 1992 is that they have to plant later now because they are waiting for seeds from the government. When they planted on their own they planted earlier, now there is a delay in getting seeds from the government so they have to plant later. This causes a great reduction in yield. They met the government a while ago and told them that planting late isn't good and showed them the decreased yield. Now they will wait and see what the government does. They cannot buy their own seeds because they don't have the funds, they rely on the government for that (Small scale) The Western Cape government sends extreme weather warnings for farmers. Farmers adapt by using different length cultivars, they choose these based on the growing history of the area (Wheat)		
Positive impact on women: What effect does this adaptation practice have on the livelihoods of women?		
All: … in general men farm to sell. You don't find commercial female farmers. When women farm it is just gardens for their own consumption and they don't sell it. He doesn't know why they don't farm because they are unemployed. (*on my prompting)* Maybe it's because they don't have access to land, or for cultural reasons because the man should be responsible for providing (Small scale) Generally there is still a gender problem in African countries because traditionally women don't lead. The government is trying to rectify this but he [representative from ECRDA] thinks it is still a problem. He thinks that women farming in the Eastern Cape still sometimes get a bad attitude from people. He believes that this problem still exists. This office doesn't discriminate on loans because they have already been transformed. They are a government entity so they are not allowed to discriminate (Small scale) *Diversifying to alternative cash crops* Women are excluded from wheat and cash crop production (Wheat) *Diversifying to livestock production* There are more women involved in livestock farming than wheat farming (Wheat)	**Points** 5 (Maize) 3 (Poultry) 1 (Small scale) -1 (Wheat) 3 (Wheat) 5 (Maize) n/a (Poultry)	**Median** **3**

BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives): Are there additional co-benefits that result from the adoption of this adaptation practice?		
Diversifying to alternative cash crops Much better for the soil than repeated wheat cropping (Wheat)	**Points** 7 (Wheat)	**Median** **7**

Practice: Altered timing of farming stages

Altered planting and harvesting dates (Maize: 82/ Small scale: 68)
Change in feeding quantities and times (Poultry: 85)
Harvesting earlier and drying artificially (Wheat: 5)

Proof of concept (local level, proven track record): To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?		
Altered planting and harvesting dates Altering the planting date for different crops is an adaptation that is undertaken by small scale vegetable farmers unconsciously. This is mostly determined by the arrival of the first rain of the season, and by subsequent rainfall during the rainy season (Small scale) Vegetables farmers are not able to predict when rains will fall/ plan accordingly (Small scale) Amongst maize farmers, one of the easiest and most common adaptations that occurs is altering planting and harvesting dates (Maize) The ground needs to be moist when you plant so they have to wait until there has been enough rain (Maize) *Change in feeding quantities and times* An adaptation used by 4 of the 20 poultry farmers interviewed (Poultry) *Harvesting earlier and drying artificially* Few farmers employ this strategy because of the cost involved with drying wheat artificially (Wheat)	**Points** 8 (Maize) 6 (Small scale) 6 (Poultry) 5 (Wheat)	**Median** **6**
Will this practice be robust under the projected temperature conditions in the next 10, 20, 50 years?		
Altered planting and harvesting dates Planting can only be delayed for a short period as it has impacts on when the crop is harvested/ the length of the season and therefore the yield of the crop (Maize/ Small scale)	**Points** 7 (Maize) 7 (Small scale)	**Median** **7**

Change in feeding quantities and times As long as this practice is combined with other adaptation practices such as controlled environment sheds, etc.	8 (Poultry)	
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10, 20, 50 years?		
Altered planting and harvesting dates Planting can only be delayed for a short period as it has impacts on when the crop is harvested/ the length of the season and therefore the yield of the crop (Maize/ Small scale) If the climate continues to change and it gets very bad for maize, they will have to switch crops, probably to sunflowers. This would be catastrophic considering what a staple crop maize is in southern Africa (Maize) *Change in feeding quantities and times* This practice is not affected by the availability or not of water (Poultry)	**Points** 7 (Maize) 5 (Small scale) 8 (Poultry)	**Median** **7**
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10, 20, 50 years?		
Altered planting and harvesting dates Planting can only be delayed for a short period as it has impacts on when the crop is harvested/ the length of the season and therefore the yield of the crop (Maize/ Small scale) *Change in feeding quantities and times* This practice is not affected by extreme events (Poultry)	**Points** 7 (Maize) 5 (Small scale) 8 (Poultry)	**Median** **7**
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?		
All: No adverse environmental consequences	**Points** 8 (Maize) 8 (Small scale) 9 (Poultry)	**Median** **8**
To what extent does the use of this adaptation by farmers have adverse social consequences within society?		
Altered planting and harvesting dates Can impact negatively on the length of the growing season and therefore the size of the yield which will, in turn, impact income and food security negatively (Maize/ Small scale)	**Points** 6 (Maize) 4 (Small scale)	**Median** **6**

Change in feeding quantities and times Feeding chickens at night means more people working at night (Poultry)	6 (Poultry)	
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)		
Altered planting and harvesting dates Altering the planting date for different crops is an adaptation that is undertaken by small scale vegetable farmers unconsciously (Small scale) Amongst maize farmers, one of the easiest and most common adaptations that occurs is altering planting and harvesting dates (Maize) Planting later also means that farmers get paid late and this is a problem for some (Maize) By planting late, farmers also run the risk of running into bad/ unsuitable weather later in the season (Maize) Bigger farms don't have the luxury of waiting for the perfect conditions to start planting because it takes so long to plant (Maize) *Change in feeding quantities and times* Feeding the chickens at irregular times is inconvenient to farmers, but they choose to if outputs improve (Poultry) Only 4 of the 20 poultry farmers interviewed mentioned this adaptation (Poultry)	**Points** 7 (Maize) 6 (Small scale) 6 (Poultry)	**Median** **6**
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?		
Altered planting and harvesting dates The farmers in the study group were not able to suggest a changing pattern in rainfall over time, and had no ability to plan for or predict rainfall. This is not likely to be a very successful adaptation because although it has the potential to change the timing of yields, it will probably not increase overall seasonal yields.	**Points** 6 (Maize) 7 (Small scale) 7 (Poultry)	**Median** **7**

When they plant late they also have to plant faster and change maize varieties (and sometimes developing farmers do not have enough implements for this). Seeds are expensive and you have to plan in advance which ones you are going to buy. You have to order early, all the seed varieties will sell out if you leave it too late to order. Developing farmers often do not have the knowledge to use the right seeds and inputs; you need to know how to use the chemicals. *Change in feeding quantities and times* Feed suppliers can give them the information they need and supply them with suitable feeds (Poultry)		
To what extent does this practice change existing (or previous) levels of production and quality of output?		
Altered planting and harvesting dates Can impact negatively on the length of the growing season and therefore the size of the yield (Maize/ Small scale) *Change in feeding quantities and times* Can ensure that outputs stay high during hot periods, and that heat mortalities are reduced (Poultry)	**Points** 6 (Maize) 5 (Small scale) 7 (Poultry)	**Median** **6**
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)		
	Points 6 (Maize) 1 (Small scale) 5 (Poultry)	**Median** **5**

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services): To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?		
Altered planting and harvesting dates Difficult for less well-off and less well educated farmers to gain access to weather data in order to plan when to start planting *Change in feeding quantities and times* Feed suppliers give farmers advice and provide the appropriate feed.	**Points** 5 (Maize) 6 (Small scale) 7 (Poultry)	**Median** **6**
Government support (extension services, policy environment, national strategies): To what extent does government support exist to enable		

the effective implementation of this adaptation practice?		
All: No government support mentioned by the farmers interviewed.	**Points** 4 (Maize) 4 (Small scale) 3 (Poultry)	**Median** **4**
Positive impact on women: What effect does this adaptation practice have on the livelihoods of women?		
Change in feeding quantities and times As most poultry farm workers are women, this adaptation practice will impact on them the most. Possibly a negative impact as women have other roles to play in the home and it is difficult for them to work at night (Poultry)	**Points** 5 (Maize) 6 (Small scale) 5 (Poultry)	**Median** **5**
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives): Are there additional co-benefits that result from the adoption of this adaptation practice?		
	Points	**Median**

Practice: Conservation farming

Leaving fields fallow (Maize: 75)
Water harvesting with a planting circle (Small scale: 82)
Mulching (Small scale: 82)
Crop rotation (Maize: 91/ Small scale: 90/ Wheat: 98)
Intercropping (Small scale: 90)
Minimum/ no-tillage (Maize: 95/ Wheat: 102)
Planting trees for shade (Poultry: 97)

Proof of concept (local level, proven track record): To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?		
Leaving fields fallow This practice was not widespread and modern agriculture has tended towards rather using crop rotation, especially with nitrogen-fixing crops, to improve soils. Leaving fields fallow for a year means that every year only half of the fields are planted, and only farmers with very large farms and an excess of land are able to do this (Maize) *Water harvesting with a planting circle* Installing planting circles is relatively labour intensive and it does not lead to very efficient production in terms of plant density. Water harvesting with a planting circle is therefore only a feasible adaptation for small-scale vegetables farmers, particularly those with large families and therefore enough available labour. *Mulching* Mulching has been embraced by several maize farmers in the Free State, and by a few in the Eastern Cape (7 in total) To manage dry periods they need to keep the maximum possible stubble on the land, this works very well preserving moisture in a dry year (but land is too dry in wet years?). Land is too wet at the start of the season. Organic matter is very important for the soil but this is quite an arid environment (Maize)	**Points** 6 (Maize) 7 (Small scale) 7 (Small scale) 8 (Maize) 6 (Small scale) 10 (Wheat) 7 (Small scale) 8 (Maize) 9 (Wheat) 7 (Poultry)	**Median** **7**

Crop rotation Crop rotation is practiced among both the commercial maize farmers in the Free State and the small scale maize farmers in the Eastern Cape (4 in total) (Maize) The do crop rotation because it minimises disease, improves soil structure and increases nitrogen in the soil if you rotate with nitrogen fixing crops (beans, peas, legumes) (Small scale) Crop rotation has always been part of wheat farming – need different crops to replenish vital nutrients in the soil or else the wheat will not grow. Not done as a specific climate change adaptation (Wheat) *Intercropping* Many of the small scale vegetable farmers interviewed practiced intercropping (Small scale) She does intercropping to confuse insects. She does this by planting just one row of a crop, and then one row of each of the others, so there is nowhere where there is a large area planted with the same crop (Small scale) *Minimum/ no-tillage* Although the commercial farmers in the Free State have embraced minimum-tillage and are moving towards practices of conservation agriculture, this is not the case in the Eastern Cape (Maize). All of the farmers interviewed in the Western Cape have stopped ploughing in favour of minimum-tillage approaches (Wheat) *Planting trees for shade* Some farmers (3 of the 20 interviewed) reported that planting trees over the years has helped them keep their sheds cool (Poultry)		
Will this practice be robust under the projected temperature conditions in the next 10, 20, 50 years?		
All: Conservation agricultural adaptation practices are well recognized as providing the best options for farmers to continue farming under conditions of increased temperature caused by climate change.	**Points** 7 (Maize) 7 (Small scale) 7 (Small scale)	**Median** **7**

Planting trees for shade Trees will thrive but they will not be enough to keep temperatures down (Poultry)	7 (Maize) 7 (Small scale) 9 (Wheat) 9 (Small scale) 8 (Maize) 9 (Wheat) 6 (Poultry)	
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10, 20, 50 years?		
All: Conservation agricultural adaptation practices are well recognized as providing the best options for farmers to continue farming under conditions of changed water availability due to climate change. *Leaving fields fallow* Allows ground water to be replenished (Maize). *Mulching* Mulching will be a successful adaptation in the future because it requires otherwise unused resources and it can greatly enhance the potential for farming in dry conditions (Small scale) However, under very dry conditions, mulching is no longer as effective – already wheat farmers in the Swartland sometimes reported that they could not leave it all in place because the total lack of summer rainfall in the region means that the stubble does not decompose at all and planting the following season is almost impossible with all of the material still there (Wheat) *Crop rotation* Reduces the number of weeds – able to use a variety of herbicides with the different crops - weed control is very important in the context of climate change because weeds have a higher water requirement and can outcompete crops for moisture. Small scale farmers are rotating the vegetables they plant – require a lot of water so rely on rain or irrigation from nearby rivers (Small scale)	**Points** 6 (Maize) 10 (Small scale) 9 (Small scale) 7 (Maize) 7 (Small scale) 7 (Wheat) 7 (Small scale) 9 (Maize) 10 (Wheat) 6 (Poultry)	**Median** **7**

They [small scale farmers who grow a variety of vegetables] really depend on the rain, if it comes late their yield will be bad and if it comes early they will have a good harvest. The yield depends entirely on the weather (Small scale) *Intercropping* Reduces the number of weeds - weed control is very important in the context of climate change because weeds have a higher water requirement and can outcompete crops for moisture. *Minimum/ no-tillage* Reduces the number of weeds - weed control is very important in the context of climate change because weeds have a higher water requirement and can outcompete crops for moisture. Farmers reported that they are able to plant much earlier in the season since they have been doing minimum-tillage because soil moisture is conserved. In addition, they are better able to withstand mid-winter drought (Wheat) According to one wheat farmer, the minimum-till system that they adopted long ago helps to retain moisture in the soil. In the last ten years they have had higher yields than the long-term average and he attributes it mainly to minimum-till and no-till. He showed a graph with yield plotted against rainfall. Before about 1990 (when they were ploughing) yield tracked closely with rainfall (and the yield line was below the rainfall line on the graph). Then they started doing minimum-till with a light tine and the yield line went above the rainfall line on the graph. In about 2000 they switched to full no-till which utilised knifepoint planting and caused very little disturbance. After this the yields were even higher, and further from the rainfall line on the graph (Wheat).		
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10, 20, 50 years?		
All: Drought and access to water may become a problem → you need to catch more rain (with deeper loose soil), look after the moisture in the soil, and then kill weeds so that they don't use up all of the moisture in the soil (Maize) *Minimum/ no-tillage* There have been marked improvements in the ability of the soil to capture and retain water since farmers started practicing minimum-tillage, which has important implications for adaptation to climate change, particularly in light of the predicted intensity of storms	**Points** 6 (Maize) 8 (Small scale) 9 (Small scale) 8 (Maize) 6 (Small scale) 10 (Wheat) 7 (Small scale)	**Median** **8**

With the minimum-till system and leaving stubble like a blanket on the land the rain doesn't really cause soil erosion like it used to (Wheat)	10 (Maize) 10 (Wheat) 7 (Poultry)	
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?		
Leaving fields fallow Positive impact on the wider environment – allows ground water supplies to be replenished (Maize) *Crop rotation* Crops selected because they are nitrogen fixing and/or they are deep rooting and there-fore aerate the soil (Maize) *Intercropping* Reduces the number of weeds - weed control is very important in the context of climate change because weeds have a higher water requirement and can outcompete crops for moisture. Farmers can reduce their use of harmful pesticides *Minimum/ no-tillage* Less fertilizer, erosion, fuel, more herbicide (Maize/ Wheat) But some farmers use pesticides to remove weeds which may be harmful to the environment (Wheat)	**Points** 6 (Maize) 5 (Small scale) 9 (Small scale) 8 (Maize) 10 (Small scale) 9 (Wheat) 10 (Small scale) 9 (Maize) 9 (Wheat) 10 (Poultry)	**Median** **9**
To what extent does the use of this adaptation by farmers have adverse social consequences within society?		
Water harvesting with a planting circle Improves yields and therefore also improves food security and income (Small scale) *Intercropping* Intercropping has additional benefits in that plants with complementary water and nutrient requirements may be planted together thus ensuring better usage of resources and therefore higher yields. *Minimum/ no-tillage* Requires expensive equipment but ongoing costs are much lower. May reinforce inequality (Maize/ Wheat)	**Points** 6 (Maize) 7 (Small scale) 7 (Small scale) 8 (Maize) 8 (Small scale) 8 (Wheat) 8 (Small scale) 7 (Maize)	**Median** **7.5**

	5 (Wheat) 10 (Poultry)	
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)		
Leaving fields fallow As a result of groundwater being replenished in the fallow fields, they can plant earlier, before the rains – this means harvesting earlier and therefore receiving a better price for the maize. There is resistance amongst small scale/ development maize farmers to letting fields lie fallow. A farmer who is a mentor of development farmers spoke of the difficulty: When up and coming farmers get land they all want to plough everything to plant maize and sunflowers. Whereas white experienced farmers will only plough the land that is appropriate and will refrain from ploughing (and planting) if the weather is not right. Last year was very hot and there was very little rain, so it was a difficult year. The white farmers that previously owned these farms didn't plant on certain fields because the soil was too poor; it is too shallow to hold water. It is only possible to farm in poor soil if the rain is regular. (Deep soil holds water well, so it is more resilient to climate change) Planting anything was therefore not sustainable, and they left the fields covered in grass that can be used for livestock. Developing farmers are trying to plant everywhere. Only 2 maize farmers interviewed stated that they use this method (Maize) Small scale farmers are growing food for their own food security – are often not in a position to leave land lying fallow (Small scale) *Crop rotation* Rotated with commercial crops or other food crops A crop rotation of wheat-canola-wheat-canola gives a 20% higher yield than a wheat monoculture (Wheat) *Minimum/ no-tillage* Almost all of the maize farmers interviewed employed at least minimum-tillage (Maize)	**Points** 5 (Maize) 7 (Small scale) 9 (Small scale) 7 (Maize) 6 (Small scale) 7 (Wheat) 6 (Small scale) 7 (Maize) 7 (Wheat) 8 (Poultry)	**Median** **7**

They accept minimum-till, but not no-till because that would mean less livestock (Maize - commercial/ Wheat). Several of the farmers that had heard of this approach stated that they were unwilling to try out minimum-tillage until they knew more about it and they had seen its success on their neighbour's farms (Maize – small scale) Some are not willing to leave stubble (Wheat) A wheat farmer stated that he doesn't think he will ever go to no-till because on a no-till system you have to stop farming sheep. Sheep compress the soil and make in necessary to do some sort of tillage. He thinks it would be too financially risky to stop sheep farming because although the income is lower with sheep, they have a much more reliable supply of income than crops (Wheat). Minimum-till is still new for us; people don't practice it here yet. He may do so in the future, but he hasn't been taught about it yet. There is a neighbouring farmer who has been taught about minimum-till but he hasn't started yet because he is still employed. Mr X and the other farmers are waiting to see how it goes for their neighbour before they think about trying it (Small scale) *Planting trees for shade* Only adopted by 3 of the 20 farmers interviewed - is was mentioned that the conventional wisdom used to be against planting trees because although they provide shade they also prevent airflow and may house wild birds that are disease reservoirs (Poultry).		
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?		
All: Poor farmers do not have the big tractors needed to pull tines, but they could rotate maize with soya or legumes to allow the deep rooting plants to aerate the soil (roots need a balance or water, soil AND air, they have to have all 3). Poor farmers would need to spray their no-till crops like everyone else does but they would have to spray by hand, which is possible. They could easily rotate crops to cut down on disease. They could easily do no-till and mulch by chopping maize by hand and leaving the stalks in the land. Cattle dumping would add nutrients to the land (although cause compaction) and they could focus on mulching on top, therefore not working the soil. If the soil is wet the cattle MUST be removed because they cause compaction (If you are doing no-till).	**Points** 8 (Maize) 7 (Small scale) 6 (Small scale) 6 (Maize) 7 (Small scale) 7 (Wheat)	**Median** **6.5**

Black farmers don't have capital and they done qualify for loans because of the land tenure system - they do not have title deeds. Very few black farmers in the Eastern Cape actually own land, so they don't have security (Small scale) The farmers believe that they have all the knowledge they need to farm from the GrainSA training, but they lack the funds that they need to follow GrainSA's advice (Small scale) *Water harvesting with a planting circle* Some farmers had received training (Small scale) *Mulching* They don't leave the stubble because they need it for their livestock for feed. She knows compaction is bad, but they let the young cattle graze on the stubble in the field and they collect stalks to feed to big cattle off the field (Small scale) She would like to mulch all of her vegetables but there is not that much mulching material available. She is mulching with straw and it's mostly on her spinach (Small scale) *Minimum/ no- tillage* Everything is easy to obtain except the equipment (Wheat) For poor smaller scale farmers to do no-till they need access to equipment and education. Very importantly they need financial advice and help planning ahead, marketing, and help with what to do after the harvest. It's also very important that they have a very trustworthy network of support and advice (Maize) People do not practice minimum-till here because "the scarcity of implements in this area is holding back minimum-till". (Small scale) The farmers all have to hire and share equipment. The few tractors that are actually owned by farmers here are in very poor condition and have a small horsepower of only about 50 kilowatts, so minimum-till is not possible because you need big powerful implements over the land (Small scale)	6 (Small scale) 5 (Maize) 5 (Wheat) 9 (Poultry)	

Planting trees for shade Required inputs are minimum (Poultry)		
To what extent does this practice change existing (or previous) levels of production and quality of output?		
Water harvesting with a planting circle Increased yields but in a very small area (Small scale) *Crop rotation* Improves quality of soil and therefore increases yields (Maize) *Minimum/ no-tillage* Yields are higher and resilience to climate stressors is higher (Wheat) *Planting trees for shade* Heat mortalities may be slightly lower (Poultry)	**Points** 4 (Maize) 8 (Small scale) 8 (Small scale) 6 (Maize) 7 (Small scale) 8 (Wheat) 8 (Small scale) 7 (Maize) 9 (Wheat) 6 (Poultry)	**Median** **7.5**
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)		
Water harvesting with a planting circle No, too small an area is impacted by the adaptation practice (Small scale)	**Points** 6 (Maize) 1 (Small scale) 1 (Small scale) 6 (Maize) 1 (Small scale) 7 (Wheat) 1 (Small scale) 6 (Maize) 8 (Wheat) 5 (Poultry)	**Median** **5.5**

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services): To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?		
All: GrainSA provides training and advice on a variety of conservation farming methods. … emphasised that technology and the internet is VERY important to his farming. He thinks that a lack of education and access to the internet is the biggest thing holding poor farmers back (Maize) Training by the CDC - The methods that the CDC taught them have made a great difference, she is able to produce a lot of food. They have addressed their food security and the locals even come here to buy vegetables from her. The quality of the vegetables is also higher. The CDC teaches them at farmers' days, on the request of the farmers (Small scale) Institutional support is not needed (Poultry) *Water harvesting with a planting circle* Training provided by the CDC (Small scale) *Mulching* Amongst vegetable farmers in the Eastern Cape the CDC actively promotes mulching as a way to conserve moisture in the soil and increase resilience to dry periods	**Points** 5 (Maize) 7 (Small scale) 6 (Small scale) 6 (Maize) 6 (Small scale) 6 (Wheat) 5 (Small scale) 4 (Maize) 6 (Wheat) 5 (Poultry)	**Median** **6**
Government support (extension services, policy environment, national strategies) : To what extent does government support exist to enable the effective implementation of this adaptation practice?		
All: He said that the biggest problem is that government policies in land redistribution are very bad. The equipment that the government provides is BAD quality and promotes soil erosion and soil drying. It is possible to start off with conservation farming, but it has to start with government. He has never seen a situation where no-till wouldn't work. Traditional African methods are actually no-till and organic. Everyone now realises how bad ploughing is and no-till is getting easier and easier	**Points** 5 (Maize) 3 (Small scale) 3 (Small scale) 4 (Maize) 5 (Small scale)	**Median** **4.5**

because of new pesticides. The development wing of GrainSA is very good and is gaining momentum, but they get no support from government (Maize) (*I asked if the government supports farmers at all)* They only support a very very small number of farmers, maybe 10 in the whole of the Eastern Cape. They help those famers access equipment, but they don't give any training. GrainSA does all the training and skills development; they are funded by the Maize Trust, Agri seed, and ARC (Small scale) The government lends them the equipment. The government only lends equipment to co-ops, not to individual farmers (Small scale) *Crop rotation* They experiment on behalf of the farmers and offer them advice (Wheat) Both the CDC and GrainSA promoted crop rotation to farmers (Small scale) *Intercropping* Training provided by the CDC (Small scale) *Minimum/ no-tillage* However the Department of Agriculture has conducted research and done trials suggesting that it is economically feasible to switch, and minimum-tillage is cheaper and more sustainable in the long run because it requires less diesel. *Planting trees for shade* Government support is not needed (Poultry)	7 (Wheat) 3 (Small scale) 3 (Maize) 6 (Wheat) 5 (Poultry)	
Positive impact on women: What effect does this adaptation practice have on the livelihoods of women?		
All: There is nothing technically stopping women from farming maize, women could drive tractors as well as men, but it is just not done. It is not in the culture. Switching to no-till will not make more OR less female jobs. There is less work involved in zero-tillage so females that are in charge of farming will have less work (but so will males who are in charge of farming). Mechanising and scaling up means that additional skills are needed, but they could be men or women (Maize)	**Points** 5 (Maize) 5 (Small scale) 4 (Small scale) 5 (Maize)	**Median** **5**

Crop rotation There are slightly more women involved in livestock production than in cropping (Wheat) *Minimum/ no-tillage* Women are not involved in maize because it is very heavy and mechanical, and also requires very long hours (women would therefore be more suited to no-till, so this adaptation may benefit them, although they would have to spend a lot of time weeding) (Maize)	7 (Small scale) 3 (Wheat) 6 (Small scale) 5 (Maize) -1 (Wheat) 5 (Poultry)	
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives): Are there additional co-benefits that result from the adoption of this adaptation practice?		
All: Most of the conservation agricultural practices have been adopted not because of climate change but because they are simply regarded as being "better" – less time intensive; less fuel needed An added benefit of soil conservation, and in particular upping the carbon levels in the soil, is that is contributes to mitigating CC (Carbon sink). The Australian government pays farmers if they up their carbon content in their soils, it is a form of carbon trading (Maize) *Crop rotation* Crop rotation is better for biodiversity and soils than monoculture (Maize) *Intercropping* Leads to a reduction in pests and therefore a reduced dependence on pest control methods which may be harmful to the wider environment (Small scale) *Minimum/ no-tillage* Climate change mitigation, biodiversity, soil health, water conservation (Maize) Increased carbon sequestered in soils, less fuel used, farming ecosystem supports a much higher number of organisms (Wheat) *Planting trees for shade* Climate change mitigation and benefits for biodiversity (Poultry)	**Points** 5 (Maize) 7 (Small scale) 7 (Small scale) 7 (Maize) 10 (Wheat) 8 (Poultry)	**Median** **7**

Practice: Mechanisation

Mechanisation (Maize: 84/ Small scale: 82)
Increasing harvesting capacity to harvest faster (Wheat: 81)
Modern planter (Wheat: 90)
Controlled environment sheds (Poultry: 76)
Circulation fans and ventilation tunnels (Poultry: 92)
Evaporative cooling wall pads (Poultry: 95)
Solar reflective roof paint (Poultry: 88)
Irrigating roofs (Poultry: 85)
Climate sensitive shed design (Poultry: 95)

Proof of concept (local level, proven track record): To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?		
Mechanisation Mechanisation is a very important adaptation for small scale farmers. The international farming community accepts that mechanisation is vital for increasing productivity and if small scale farmers are to successfully adapt to climate change mechanisation must be part of the process (Small scale) *Increasing harvesting capacity to harvest faster* The only time they can't cope with intense rain is during harvest time, then it is a huge problem. In recent years it has rained a lot in harvest time, which can cause all sorts of problems in the wheat, including mould. As a consequence of this farmers have to have a bigger capacity to harvest faster (Wheat) *Controlled environment sheds* Most of the farmers interviewed did not have controlled environment sheds, but they said that this would be the best way to adapt to a changing climate (Poultry)	**Points** 8 (Maize) 7 (Small scale) 8 (Wheat) 7 (Wheat) 6 (Poultry) 10 (Poultry) 7 (Poultry) 6 (Poultry) 8 (Poultry) 10 (Poultry)	**Median** **7.5**

Circulation fans and ventilation tunnels Circulation fans are one of the most popular and cost effective adaptations used by farmers. Many farmers also have tunnel ventilation (Poultry) Circulation fans are a simple adaptation that farmers started using in the 1990's and early 2000's. *Evaporative cooling wall pads* Farmers found these walls to be effective except in cases where very high humidity was a problem (Poultry) *Solar reflective roof paint* This is a relatively recent adaptation (Poultry) *Climate sensitive shed design* All of the farmers use some form of shed design that allows them to manage the impact of climate (including orientation, insulation, open sides, curtains, high roofs) (Poultry)		
Will this practice be robust under the projected temperature conditions in the next 10, 20, 50 years?		
Controlled environment sheds Yes, but it will entail high financial costs (Poultry) "People are moving more and more towards controlled environment sheds so it doesn't matter what the temperature is" (Poultry) "A completely controlled environment is definitely the way to farm in the future, it is definitely better for the birds but it is not affordable. Climate change is not a worry except that it will increase the cost of farming" However, while the technology exists it may be too expensive for farmers to use – if temperatures increase too much then it will not be economically feasible to use this adaptation practice *Circulation fans and ventilation tunnels* Fans will be enough in some cool areas, but they will not be effective in humid areas like coastal Durban (Poultry)	**Points** 8 (Maize) 8 (Small scale) 9 (Wheat) 7 (Wheat) 10 (Poultry) 4 (Poultry) 9 (Poultry) 10 (Poultry) 10 (Poultry) 6 (Poultry)	**Median** **8.5**

Evaporative cooling wall pads Wet walls are very effective, especially in dry areas (Poultry) *Climate sensitive shed design* Yes in most areas studied, in humid areas like at the coast shed design will not be enough (Poultry) In controlled environment sheds temperature and airflow are artificially regulated and the risk of heat stress is eliminated (Poultry).		
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10, 20, 50 years?		
Increasing harvesting capacity to harvest faster To manage the threat of rainfall during harvesting, wheat farmers have increased their harvesting capacity by buying bigger combines so that they can harvest faster *Modern planter* Modern planters plant the seeds deeper allowing them to access more water. They also leave little furrows on either side of the seed, so that rainwater in funneled towards the seed. This is known as rainwater harvesting and it allows seeds to benefit from very small amounts of rain (Wheat) *Controlled environment sheds* Yes, but it will entail high financial costs (Poultry) Although it does not address water usage it will mean that current water reliant adaptations will no longer be used (Poultry) *Circulation fans and ventilation tunnels* Circulation fans and tunnel ventilation do not require water (Poultry) *Evaporative cooling wall pads* Wet walls require a constant supply of water (Poultry) *Climate sensitive shed design* Yes, shed design features do not rely on water (Poultry)	**Points** 8 (Maize) 8 (Small scale) 9 (Wheat) 9 (Wheat) 8 (Poultry) 10 (Poultry) 7 (Poultry) 9 (Poultry) 5 (Poultry) 10 (Poultry)	**Median** **8.5**

Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10, 20, 50 years?		
Mechanisation When there is heavy rain the soil gets compacted and the maize plants don't emerge. Then you need to cultivate to get the plants out. He uses a time roller to get them out, the tine roller breaks the soil over the maize and then the plants can break through the compaction. It is very risky because you have to do it at exactly the right time. Anyone can do it, most people have the equipment that is required. When there is a lot of wind erosion the wind takes fine sand and knocks maize and sunflowers (Maize) *Controlled environment sheds* Yes, but it will entail high financial costs (Poultry) *Solar reflective roof paint* Extreme weather may reduce the life of the paint (Poultry) *Climate sensitive shed design* Mostly yes, droughts and floods are not likely to affect sheds whether they are climate sensitive or not (Poultry)	**Points** 8 (Maize) 8 (Small scale) 7 (Wheat) 9 (Wheat) 8 (Poultry) 10 (Poultry) 10 (Poultry) 8 (Poultry) 7 (Poultry) 6 (Poultry)	**Median** **8**
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?		
Controlled environment sheds Requires very high energy usage (Poultry) *Circulation fans and ventilation tunnels* Fans require electricity to run, although they can be turned off when the weather is cool (Poultry) *Evaporative cooling wall pads* Wet walls require electricity and a large amount of water (Poultry) *Solar reflective roof paint* Production of the paint may have adverse impacts (Poultry)	**Points** 5 (Maize) 5 (Small scale) 8 (Wheat) 9 (Wheat) 3 (Poultry) 6 (Poultry) 7 (Poultry) 6 (Poultry) 5 (Poultry) 9 (Poultry)	**Median** **6**

Irrigating roofs A large amount of water is wasted (Poultry) *Climate sensitive shed design* The only way sheds may have negative environmental consequences is the materials they use, including concrete and insulation (Poultry)		
To what extent does the use of this adaptation by farmers have adverse social consequences within society?		
Mechanisation It is becoming more and more expensive to farm and it requires very large inputs. Francois said that they have to put R6 million in to get R2 million out. The farm is about 1400 hectares. He thinks that the minimum viable size for a farm is about 500 or 600 hectares (Wheat) *Increasing harvesting capacity to harvest faster* Harvesting faster requires bigger equipment which only wealthy farmers have access to. May increase social inequality (Wheat) *Modern planter* Modern planters are expensive and may alienate less wealthy farmers (Wheat) According to one wheat farmer, Economy of Scale is "the only way to survive in agriculture". Because you need such big equipment now you also need a big farm, or it's not worth it. Smaller farms are going out of business (Wheat) *Controlled environment sheds* Only very wealth farmers are able to afford controlled environment sheds (Poultry) *Circulation fans and ventilation tunnels* There are no adverse social consequences and most farmers can afford to install and run them circulation fans, many can afford to install tunnel ventilation (Poultry) *Evaporative cooling wall pads* Wet walls are expensive to install and run (Poultry)	**Points** 6 (Maize) 5 (Small scale) 5 (Wheat) 5 (Wheat) 3 (Poultry) 7 (Poultry) 7 (Poultry) 8 (Poultry) 7 (Poultry) 10 (Poultry)	**Median** **6.5**

Irrigating roofs May have adverse consequences for society in times of drought (Poultry) *Climate sensitive shed design* There are no adverse social consequences of climate sensitive shed design (Poultry)		
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)		
Increasing harvesting capacity to harvest faster This adaptation requires significant capital to buy new larger implements and it is not an option for less wealthy farmers (Wheat) *Controlled environment sheds* There are chicken welfare issues associated with controlled environment sheds (Poultry) Is expensive to build and run (high energy costs) *Circulation fans and ventilation tunnels* The fans make the chickens healthier, they are very easy to use and they do not change farming practices (Poultry) *Climate sensitive shed design* These measures are highly acceptable to farmers and all farmers are able to adopt some features of climate sensitive shed design (Poultry)	**Points** 8 (Maize) 9 (Small scale) 7 (Wheat) 9 (Wheat) 6 (Poultry) 10 (Poultry) 10 (Poultry) 9 (Poultry) 8 (Poultry) 10 (Poultry)	**Median** **9**
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?		
All: Highly automated/ technologically advanced farming requires farm workers are relatively well educated and trained in the use of these machines. This is not always available in South Africa where the majority of farm workers lack the necessary capacity. He said that people have stopped planting lots of the available farmland because it has become so expensive to plant. It costs about R7000 to plant 1ha of land because there is a lack of implements in the area and farmers have to hire them. People therefore do not farm the land that they have access to, they just use it for communal grazing of cattle (Small scale)	**Points** 4 (Maize) 5 (Small scale) 6 (Wheat) 6 (Wheat) 5 (Poultry) 10 (Poultry)	**Median** **6**

A big problem with maize production here is that farmers only farm about 1ha of communal land each - too small to be viable and that farmers should farm about 5ha each. If they had 5ha each they could make very successful co-ops and build communal fences etc. (Small scale) *Mechanisation* A new challenge for them is that with new technology you need more skilled labour (to read GPS's on tractors etc.). Many of his labourers have been here a long time, more than ten years, so he has been able to teach them the new equipment, but it's a big problem that labourers cannot read and write (they are mostly only educated to grade 6). His labourers are going to literacy classes in town, these classes are usually free or very cheap and then he pays for them. They also sometimes need classes in using the specific equipment, those classes are expensive but he pays for them to go (Wheat). *Increasing harvesting capacity to harvest faster* Because of the increased urgency and also because of bigger yields farmers are harvesting more tonnes per hour; a huge problem now is that the grain storage facilities cannot handle the bigger load. They have a big enough total capacity but they cannot get it into the silos fast enough. There is a limit to the intake part of the facility. Because of the increased harvest speed and the longer waits at the silos, they need to hire more transporters to take wheat away, this increases the cost of harvesting. One thing that they do to give themselves more time during harvest is to put the wheat into silo bags, this gets it off the land in time (Wheat). *Modern planter* In general the trend is towards bigger machinery or more pieces of equipment per farmer. Farmers have started to have multiple combine harvesters that harvest at the same time. Planters are bigger now and go over larger areas. Crop sprayers are also bigger and better (R3 million to buy); with no-till system a crop sprayer is the most important tool on the farm. Because no ploughing happens to break the weeds mechanically it is critical that weeds are sprayed very quickly. No- till would not be possible (at this scale) without a crop sprayer. They have always had access to herbicides, but large self-controlled (powers itself, no tractor) sprayers are new (Wheat). *Controlled environment sheds* They require the same inputs, but different technical knowledge and have high installation costs (Poultry)	7 (Poultry) 6 (Poultry) 9 (Poultry) 6 (Poultry)	

Need dedicated, knowledgeable staff as constant surveillance is required – "Controlled-environment sheds do not always work, you have to keep a close eye on the birds all the time. You need to particularly be more alert when it's hot, you need to keep an eye on the chickens ALL the time." (Poultry) Unreliable electricity supply is a problem Cost of diesel and electricity to run fans in the controlled environment sheds is constantly increasing. *Circulation fans and ventilation tunnels* Circulation fan inputs are readily available to everyone, simple household ceiling fans can be used. Tunnel ventilation typically comes from a shed design company and can be expensive (Poultry) *Evaporative cooling wall pads* Wet walls require technical knowledge, but this provided by the shed design companies (Poultry) *Solar reflective roof paint* Paint is expensive to buy, but requires no recurring costs (Poultry) *Climate sensitive shed design* All farmers have access to the required inputs for this adaptation, however it does require some knowledge (Poultry).		
To what extent does this practice change existing (or previous) levels of production and quality of output?		
Increasing harvesting capacity to harvest faster This will prevent losses from rain during harvest, but it will not actually increase yields (Wheat) *Controlled environment sheds* Both production and quality can be higher in controlled environment sheds, particularly during very hot weather. Farmers suffer fewer heat mortalities in controlled environment sheds (Poultry) *Circulation fans and ventilation fans* Quality of the output does not change, but quality is regular even during extreme heat and heat mortalities are low (Poultry)	**Points** 8 (Maize) 8 (Small scale) 7 (Wheat) 10 (Wheat) 9 (Wheat) 7 (Poultry) 8 (Poultry) 7 (Poultry)	**Median** **7.5**

Evaporative cooling wall pads Production continues during extremely hot weather (Poultry) *Solar reflective roof paint* Output may continue to be high even during hot periods, heat mortalities are reduced (Poultry) *Irrigating roofs* Yields are higher (Poultry) *Climate sensitive shed design* Output quality and quantity are higher when chickens are comfortable, heat mortalities are lower (Poultry)	6 (Poultry) 7 (Poultry)	
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)		
Controlled environment sheds These sheds will help farmers to be more competitive than they are now, but it may not be enough in the long term (because of high energy costs and low poultry prices) (Poultry) *Circulation fans and ventilation tunnels* Layer production is currently competitive using these fans, Broiler production is not competitive (Poultry) *Evaporative cooling wall pads* Layers are competitive, broilers are not (Poultry) *Irrigating roofs* Broilers are not competitive but layers are (Poultry) *Climate sensitive shed design* Layer production is competitive currently because of the market for spent hens, broiler production is not competitive even using climate sensitive shed design (Poultry)	**Points** 6 (Maize) 1 (Small scale) 7 (Wheat) 9 (Wheat) 6 (Poultry) 5 (Poultry) 5 (Poultry) 5 (Poultry) 5 (Poultry) 4 (Poultry)	**Median** **5**

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services): To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?		
All: Farmers bring soil to him [an employee of GrainSA] and he sends it to Cedara for testing, the farmers pay for the testing, but he pays for the delivery of the soil samples. It is not expensive to have the soil tested, maybe R90 per sample. All of the farmers in the GrainSA study groups to soil testing because it is very important for fertiliser recommendations. It costs R15 per year for development farmers to join a study group and commercial farmers have to pay R2 per tonne to be members of GrainSA. Study groups have between 15 and 25 members and they go on a 5-day GrainSA training from which they get a certificate. Plus there are a whole lot of other training courses that GrainSA gives. Farmers do not have to pay for these because the Maize trust, Wheat trust, Agri-seed and ARC, etc. fund them. *Mechanisation* GrainSA assists farmers in putting together the business plans that allow them to receive funding for equipment. Also helps with buying planters for development farmers GrainSA asked John Deere to loan farmers a complete package of equipment and implements to the farmers for 6 months. They will get a 50kW tractor, a ripper, a planter, a boom sprayer and a disc. The farmers will have to pay John Deere R1250 per hectare per month for the use of the equipment, which is much cheaper than it would be if they had to rent each of those implements. The farmer will use the equipment for his own land and he will contract out to other farmers. After 6 months John Deere will take back the implements. Then GrainSA will help farmers to get loans from the Land Bank to buy back all of the equipment. They will help the farmers get loans if they have done well on the 6-month trial. These loans would be at a low 4% interest and the farmers could pay them back over 6 or so years. He is in the process of choosing who the best people for the scheme are. The scheme will be profitable for John Deere and it will help the farmers (Small scale) *Controlled environment sheds* There are several companies in South Africa that sell controlled environment chicken sheds and these companies provide support to	**Points** 4 (Maize) 6 (Small scale) 4 (Wheat) 6 (Wheat) 6 (Poultry) 5 (Poultry) 8 (Poultry) 6 (Poultry) 5 (Poultry) 7 (Poultry)	**Median** **6**

their clients (Poultry) *Circulation fans and ventilation tunnels* No support from institutions is needed (Poultry) *Evaporative cooling wall pads* Shed design companies provide the technical knowledge and expertise needed (Poultry) *Solar reflective roof paint* Paint suppliers supply the solar reflective paint (Poultry) *Climate sensitive shed design* Companies that design and sell sheds give farmers all the necessary information and support with shed design, the South African Poultry Association provides training and standards (Poultry)		
Government support (extension services, policy environment, national strategies): To what extent does government support exist to enable the effective implementation of this adaptation practice?		
All: The government does not support farming at all, GrainSA applied for funding for the recapitalisation programme but they did not get it because there is a lot of corruption with the MECs. You do not get money from government (Small scale) *Mechanisation* A lack of funding is the factor that prevents farmers from acquiring implements, but there are grants and loans available from various sources including the government and the Eastern Cape Rural Development Agency (Small scale) *Controlled environment sheds* Government does not help with the acquisition of controlled environment sheds, but they do help black farmers to buy farms, some of which have these shed already (Poultry) Supply of electricity (responsibility of the government) is not constant *Circulation fans and ventilation tunnels*	**Points** 4 (Maize) 6 (Small scale) 5 (Wheat) 5 (Wheat) 3 (Poultry) 3 (Poultry) 5 (Poultry) 3 (Poultry) 5 (Poultry) 5 (Poultry)	**Median** **5**

Government support is not needed except in the provision of electricity is both prohibitively expensive and unreliably supplied (Poultry)		
Positive impact on women: What effect does this adaptation practice have on the livelihoods of women?		
Controlled environment sheds Although controlled environment sheds do not specifically impact women, there are more women involved in poultry farming than men, so advances in the poultry industry will likely be felt more by women (Poultry) *Circulation fans and ventilation tunnels* Most poultry workers are women, so any benefits help them (Poultry) *Climate sensitive shed design* Benefits are not specific to women, but women are highly involved in the poultry industry so all benefits support them (Poultry)	**Points** 7 (Maize) 6 (Small scale) -1 (Wheat) -1 (Wheat) 3 (Poultry) 5 (Poultry) 5 (Poultry) 5 (Poultry) 5 (Poultry) 5 (Poultry)	**Median** **5**
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives): Are there additional co-benefits that result from the adoption of this adaptation practice?		
	Points	**Median**

Practice: Changing densification

Changing plant population and distribution (Maize: 86)
Reducing stock density (Poultry: 89)

Proof of concept (local level, proven track record): To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?		
Changing plant population and distribution 2 maize farmers specifically stated that they had lowered the density of the crops planted while 8 maize farmers said they used narrower rows between their crops In Senekal they plant maize with a lower plant population because the soil is shallow and the rain is unreliable. They now use pesticides to kill weeds so you do not need to leave space for cultivation. Having the rows closer means that the maize plants and the soil are in the shade, which is better, when temperatures are hot (Maize) The narrow rows allow the maize to form a canopy sooner so that the sun does not dry out the soil (Maize) If you want good quality vegetables you plant them further apart, if you want lots of vegetables you plant them closer together (Small scale) *Reducing stock density* Mentioned by 4 of the 20 poultry farmers interviews (Poultry)	**Points** 7 (Maize) 6 (Poultry)	**Median** **6.5**
Will this practice be robust under the projected temperature conditions in the next 10, 20, 50 years?		
Changing plant population and distribution "Mielies don't like to be hot and they need water, so if you know there is a drought coming you can plant the mielies further apart" (Maize – small scale) *Reducing stock density*	**Points** 8 (Maize) 7 (Poultry)	**Median** **7.5**

Farmers will continue to reduce stocking density but it is unlikely to be effective enough against increased temperatures		
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10, 20, 50 years?		
Changing plant population and distribution If it is very dry they can lower the plant population so that the farm/ soil resources are shared by fewer plants (Maize)	**Points** 8 (Maize) 7 (Poultry)	**Median** **7.5**
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10, 20, 50 years?		
	Points 6 (Maize) 7 (Poultry)	**Median** **6.5**
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?		
Changing plant population and distribution The row width that they plant is getting narrower; it's now 76cm (instead of 91cm). Narrower rows make weed control easier and fewer herbicides are needed. It also leads to better water usage. It keeps the soil cool which is very important, it doesn't matter if the plants get too hot as long as the soil is kept cool (Maize) *Reducing stock density* No adverse environmental consequences	**Points** 7 (Maize) 10 (Poultry)	**Median** **8.5**
To what extent does the use of this adaptation by farmers have adverse social consequences within society?		
Changing plant population and distribution Will have a negative impact on crop yields and therefore food security	**Points** 7 (Maize) 10 (Poultry)	**Median** **8.5**
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)		
Reducing stock density Reducing stocking density means reducing the number or total chickens and therefore reducing outputs.	**Points** 7 (Maize)	**Median** **5**

	3 (Poultry)	
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?		
	Points 6 (Maize) 10 (Poultry)	**Median** **8**
To what extent does this practice change existing (or previous) levels of production and quality of output?		
Reducing stock density Quality of the output is the same, but the total output is reduced.	**Points** 8 (Maize) 3 (Poultry)	**Median** **5.5**
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)		
	Points 6 (Maize) 5 (Poultry)	**Median** **5.5**

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services): To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?		
Changing plant population and distribution They get all (not just about this particular adaptation practice) their information from GrainSA and "call them day and night" for advice. GrainSA is very accessible, unlike government (Maize – small scale) *Reducing stock density* Institutional support is not needed	**Points** 6 (Maize) 5 (Poultry)	**Median** **5.5**
Government support (extension services, policy environment, national strategies): To what extent does government support exist to enable the effective implementation of this adaptation practice?		
Reducing stock density Governmental support is not needed	**Points** 5 (Maize) 5 (Poultry)	**Median** **5**

Positive impact on women: What effect does this adaptation practice have on the livelihoods of women?		
	Points 5 (Maize) 5 (Poultry)	**Median** **5**
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives): Are there additional co-benefits that result from the adoption of this adaptation practice?		
Reducing stock density Improved animal welfare	**Points** 6 (Poultry)	**Median** **6**

Practice: Additions/ Supplements

Supplements (Poultry: 79)
Fertiliser use (Maize: 82)
Vermicost and compost use (Maize: 88/ Small scale: 4)
Liquid manure (Small scale: 4)

Proof of concept (local level, proven track record): To what extent has this practice been successfully used (i.e. to the satisfaction of the farmers) in at least one community (i.e. a group of farmers of the same commodity), or by multiple farmers of the same commodity in different communities, for at least one season?		
Supplements A few farmers mentioned this practice (Poultry) *Fertiliser use* Fertilisers are used on maize crops at both a commercial and small scale level (Maize) Fertiliser use will not directly enable farmers to adapt to climate change, but the increase in yields could help them to cope with threats from climate change. *Vermicost and compost use* Only one farmer in the study group mentioned composting (Small scale) A small group of farmers in the eastern Free State (4) have started farming worms for the production of vermicast (Maize) Since using compost/vermicast/ EM his soil health is much higher and all his plants are looking better. He believes that you need to keep adding to the pool of good bacteria. If there are lots of good bacteria they reduce the bad bacteria (Maize) He is very strong on earthworms, vermicast and the biological side. He makes compost tea (out of worm pee) and sprays it on crops. He produces vermicast himself. He said that it builds up microbes “tremendously”. To have good soil you need	**Points** 6 (Poultry) 8 (Maize) 6 (Maize) 4 (Small scale) 4 (Small scale)	**Median** **6**

earthworms, compost and microbes and your soil will see a slow and steady improvement, overall crops are healthier (GM and nitrogen make a fast improvement, but not as sustainable) (Maize) The use of compost is not widespread because although it is relatively affordable to buy, the costs associated with transporting it in a large volume make it prohibitively expensive (Small scale) He makes compost from piles of weeds, grass, maize stalks and kraal manure. It takes 3 months for the compost to be ready and he uses it every time he plants. He plants each seed/seedling with some compost (Small scale) *Liquid manure* Although this is quite a popular adaptation it is not likely to have an impact on climate change resilience (Small scale)		
Will this practice be robust under the projected temperature conditions in the next 10, 20, 50 years?		
All: If used in conjunction with other adaptation practices	**Points** 8 (Poultry) 8 (Maize) 8 (Maize)	**Median** **8**
Will this practice be robust under the projected water availability conditions (rainfall and groundwater) in the next 10, 20, 50 years?		
All: If used in conjunction with other adaptation practices	**Points** 8 (Poultry) 8 (Maize) 8 (Maize)	**Median** **8**
Will this practice be robust under the projected extreme events (droughts, floods etc.) in the next 10, 20, 50 years?		
All: If used in conjunction with other adaptation practices	**Points** 8 (Poultry) 7 (Maize) 8 (Maize)	**Median** **8**
To what extent does this practice entail adverse environmental consequences (e.g. pollution from fertiliser, disruption to biodiversity and natural resources, including soil and water)?		

Vermicost and compost use Similarly, some farmers use compost or manure instead of fertiliser. Compost is said to be better for the soil ecosystem and to result in high maize yields.	**Points** 8 (Poultry) 3 (Maize) 10 (Maize)	**Median** **8**
To what extent does the use of this adaptation by farmers have adverse social consequences within society?		
Supplements Only really used by people with access to vets and technical knowledge (Poultry)	**Points** 6 (Poultry) 7 (Maize) 8 (Maize)	**Median** **7**
Is this practice deemed socially acceptable by farmers, i.e. is this a practice that they find suitable to their culture and daily routines, does it lead to outcomes which they find desirable (e.g. quality and quantity of product that has use to them?) (all of which may be shown by how many farmers have adopted it, which is dependent on timescale)		
Vermicost and compost use The biggest factor holding farmers back is education. The process must really be easy for it to be accessible, it needs to be easy to implement. EM and vermicast could benefit African communities. He thinks that the biological approach to farming is the way to go, but it's not that easy. You need a lot of **compost** which requires money and time and increases the management pressure because it is effectively another commodity you then have to farm (Maize).	**Points** 6 (Poultry) 6 (Maize) 6 (Maize)	**Median** **6**
Are farmers able to obtain the required inputs (in terms of seeds/breeds, fertilisers, technical knowledge, etc.) to successfully engage this practice?		
Supplements Technical knowledge is missing on what to give chickens (Poultry)	**Points** 6 (Poultry) 6 (Maize) 6 (Maize)	**6**
To what extent does this practice change existing (or previous) levels of production and quality of output?		
Supplements Can strengthen chicken immune systems (Poultry) *Fertiliser use* Fertiliser increases yields and can make farming more efficient	**Points** 6 (Poultry) 8 (Maize) 9 (Maize)	**Median** **8**

Vermicost and compost use Vermicast has the potential to greatly increase yields (Maize)		
Is the product, and mode of production, regionally, nationally and internationally competitive? (i.e. will production survive without trade barriers?)		
	Points 5 (Poultry) 6 (Maize) 6 (Maize)	**Median** **6**

Enabling Environment

Support of appropriate institutions (private sector, research organisations including extension services, markets, meteorological services): To what extent is the effective implementation of this adaptation practice supported by appropriate institutions?		
Supplements There is some support from feed companies (Poultry) *Fertiliser use* The commercial farmers send their soil to laboratories throughout South Africa for testing and some send soil to international laboratories because they doubt the objectivity of the South African testers (Maize - commercial) Small scale farmers in the Mthatha region are assisted in their soil testing by GrainSA who notify them when it is required and then send the samples to appropriate South African laboratories (Maize – small scale) *Vermicost and compost use* Training on compost making and use from the CDC	**Points** 4 (Poultry) 6 (Maize) 5 (Maize)	**Median** **5**
Government support (extension services, policy environment, national strategies): To what extent does government support exist to enable the effective implementation of this adaptation practice?		
	Points 3 (Poultry)	**Median** **3**

	4 (Maize) 3 (Maize)	
Positive impact on women: What effect does this adaptation practice have on the livelihoods of women?		
	Points 5 (Poultry) 5 (Maize) 5 (Maize)	**Median** **5**
BONUS! Co-benefits (mitigation, biodiversity, multiple production objectives): Are there additional co-benefits that result from the adoption of this adaptation practice?		
	Points	**Median**