

**A CRITICAL ANALYSIS OF THE POTENTIAL FOR CEREAL  
PRODUCTION IN THE CENTRAL REGION OF MOZAMBIQUE**

**BY**

**ARMINDO TAMBO**

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**SUPERVISOR: DR. LEONORAH NYARUWATA**

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## **ABSTRACT**

The study addressed the challenges of low cereal production in the Central Region of Mozambique. There is a persistent low level cereal production as evidenced by acute hunger prevailing in the region, despite the conducive environment, example favourable climatic conditions and good fertile soil for cereal production in this region.

The study sought to close the knowledge gap left by the scarcity of research in this area. More specifically, this study investigated the main causative factors for the low production of cereals in this part of the country. The study utilized the qualitative research paradigm, and multiple technical methods were used in the investigation including interviews, field observation, document review, questionnaires and group discussion as the main method of data collection. Data were analysed and categorized for common themes and patterns. The central theme of the analysis highlights the overall cereal production of the central region of Mozambique in relation to the other regions. The findings revealed that cereal production in the central region of Mozambique is very low due to a number of different interrelated number of factors, among others lack of new or modern farming techniques such as irrigation, use of high yielding varieties of seeds and utilization of mechanical power for cultivation of cereals on a large scale.

The concluding discussion addresses the implications for improving training approaches to farmers, to help them develop valid and coherent personal-practical theories that match with production reality. It also concludes that grain production in the central region of Mozambique is low due to lack of new technologies, lack of quality seed, lack of funding for this sector by government and gross under utilization of natural resources as most of the work is done manually hence low grain production.

The researcher therefore, recommends the use of cereal production models of other countries such as, China, India and Brazil joined in 100% the green revolution (Fan, 2009) be implemented in the central region of Mozambique. The study also recommends that the region adopts some of the cereal production approaches like the use of modern agricultural technologies, improved quality seeds, the government should show commitment towards improving production by pumping more money into the agricultural sector in order to achieve sustainable food security for the population of the region in particular and in Mozambique as a whole.

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## **ABBREVIATIONS/ACRONYMS/DEFINITIONS**

CAP	Census of Agriculture (translated from Portuguese)
CIMMYT	International Centre for Maize and Wheat Multiplication
CONDES	National Council for Sustainable Development (translated from Portuguese)
CPLP	Community of Portuguese Language Countries
HRAF	Human Right to Adequate Food
RBS	Rural Development Strategy (translated from Portuguese)
FAO	United Nations Food and Agriculture
FDC	Foundation for Community Development
GEF	Global Environment Facility
IIAM	Agricultural Research Institute of Mozambique (translated from Portuguese)
IIVM	Veterinary Research Institute of Mozambique (translated from Portuguese)
INE	National Institute of Statistics
IPCC	Intergovernmental Panel on Climate Change

IUCN	The World Conservation Union (translated from Portuguese)
MA	Ministry of Agriculture
MARD	Ministry of Agriculture and Rural Development
MOA	Ministry of Agriculture
MPD	Ministry of Planning and Development
NAPA	National Programme of Action for Climate Change Adaptation
NGO	Non-Governmental Organization
OPV	Open Pollinated Varieties
PAEI	Agrarian Policy and Implementation Strategy
PAN CSD	National Action Plan to Combat Drought and Desertification
PARPA	Action Plan for the Reduction of Absolute Poverty (translated from Portuguese)
GDP	Gross Domestic Product
PNISA	Investment National Plan of Agrarian Sector (translated from Portuguese)
UCM	Catholic University of Mozambique
UNDP	United Nations Development
PROAGRI	National Programme for Agriculture Development

SEMOC	Seeds Mozambique
SETSAN	Technical Secretariat For food and Nutritional Security
TIA	Agricultural Labour Survey
UNCBD	United Convention on Biodiversity
UNCCD	United National Convention to Combat Desertification
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNFPA	Population Fund United Nations
UNICEF	The United Nation Children's Fund
WFP	World Food Programme
WHO	World Health Organization
WMO	World Meteorological Organization
ZOU	Zimbabwe Open University

## **CHAPTER 1: INTRODUCTION**

### **1. Background to the study**

Agriculture has always played and fulfilled a pivotal or important role in the creation of wealth all over the world, because of being the Staple food for an extensive group of societies, the cereals are important group of food, in terms of provision of energy in energetic terms, of most of the world-wide population, mainly in the Asian countries. The cereals contribute approximately, 80 % of the diet of humanity (Gergoletti, 2008). In spite of the advances in biotechnology and other related technologies, the world-wide production per capita of grains has been growing slowly since 1984. (Capobiano, 2006) these nourishing grains, include: corn, wheat, rice, barley, sorghum, wheat, rye, and oat. (Scolari 1997:4)” states that the most important grains are mainly rice, wheat, corn, rye, millet and sorghum. They occupy a great area for cultivation, they account for the 66 % of the amount of food produced world-wide.”

There has been an on-going debate about cereal production in Mozambique in general and in the central region in particular. The inconclusive debate about the best way to improve production has significant influence on the development of the region. As a result different views, approaches and methodologies have emerged for farmers to choose and suit their own environment. However, the methodological proposals for large scale production by peasant farmers are often implicit rather than explicit. In addition, the absence of clear guidelines about the high production of cereals particularly in situations when the environment within which the farmers work and the problems they encounter are ill-defined and deeply entangled. This then calls for critical thinking or analysis (Wohlpart, 2007).

In this case, the analysis centred on the contributing factors for low cereal production in this region of the country. The analysis or discussion focused on the reasons why the problem of acute food shortage is perennial in the area despite the presence of abundant natural resources for production. The critical analysis is with regard to the demonstration of a critical thought on production of cereals in that region of Mozambique. Production is an integral part in agriculture especially how much you produce because it determines its survival. It is therefore, not possible to talk about the agricultural process without focusing on the concept of production. This means that Agriculture and production are inseparable terms. “Production is a process that involves coordination of work, finance and business” (Santos, 2006: 2) in several ways and in several forms such as, raw materials, products already processed, equipment’s of all sorts, plants, technology, workforce, management knowledge with the objective or aim of producing agro-based products that are needed by many consumers. “The production factors are constituted by the land, labour and the capital” (Samuelson & Nordhaus, 2010:110). All these factors culminate in agricultural production of all kinds.

The agricultural production depends on the reproduction and on the natural growth of the plants and animals. The farmers can control and stimulate these processes, with a view of the production of foods and other goods for human consumption. For this productive activity, the farmers will need land, and a number of productive resources such as technical knowledge, seed, reproductive animals, labour, tools and machines. This will allow the maximization of agricultural production with a view of guaranteeing food security and the reduction of hunger. (Santos, 2006: 2-3) says that the main task of the farmer is to produce food and other products which people need to survive. Therefore, the concept of food security has been taken as the right to the food and considered as a human right (Hirai & Anjos, 2007). Reinforces that man has a

right to food and not suffer of malnutrition (Almeida, 2008). However, the reality is that hunger continues to be a world-wide calamity. In spite of the whole technological and scientific advancement that allows the abundant production of food, “There are still today 816 million people distributed in all the corners of the world under conditions of food insecurity “(Hirai & Anjos, 2007:335).

Food security presuppose constant availability of appropriate world-wide supply of basic foodstuffs to maintain a regular expansion of food consumption and to compensate the fluctuations of production and prices (Cunha, 1974), having evolved from that time. According to the FAO (2012 cited in Araújo, 2007:62) “food security is a situation that exists when people, at any moment, have physical, social and economic access to sufficient, safe and nourishing foods, which satisfy their necessities in nutritious and food preferences for an active and healthy life”. For food ingredients Brazil [FIB]( 2008:32) still defines "food security as a set of standards of production, transport and storage of foods aiming at determined characteristics chemical-physical, microbiological and sensory standardized to which the foods are adapted to consumption.”

On basis of the above definitions the question to be asked is, will it be possible to find food in sufficient quantity and quality to satisfy the needs of the ever growing population? The question may also be put in the opposite sense: since it will solve the problem of the existence of excess food, how will it excess food to be moved to areas of food insecurity. For the central region of Mozambique a noticeable reduction in the production of cereals can be seen in table 1.1 below

Table 1.1: The Production of cereal in the Central Region of Mozambique (000 tons)

Crop \ year	1996	2002	2003	2005	2006	2007	2008
Maize	1780	1156	1145	946	1469	1133	1120
Rice	115	92	113	65	103	105	88
Sorghum	215	134	170	114	210	170	126
Finger millet	31	12	21	15	23	25	15

Source: The Inquiry Agricultural Work: (Cunguara, 2011)

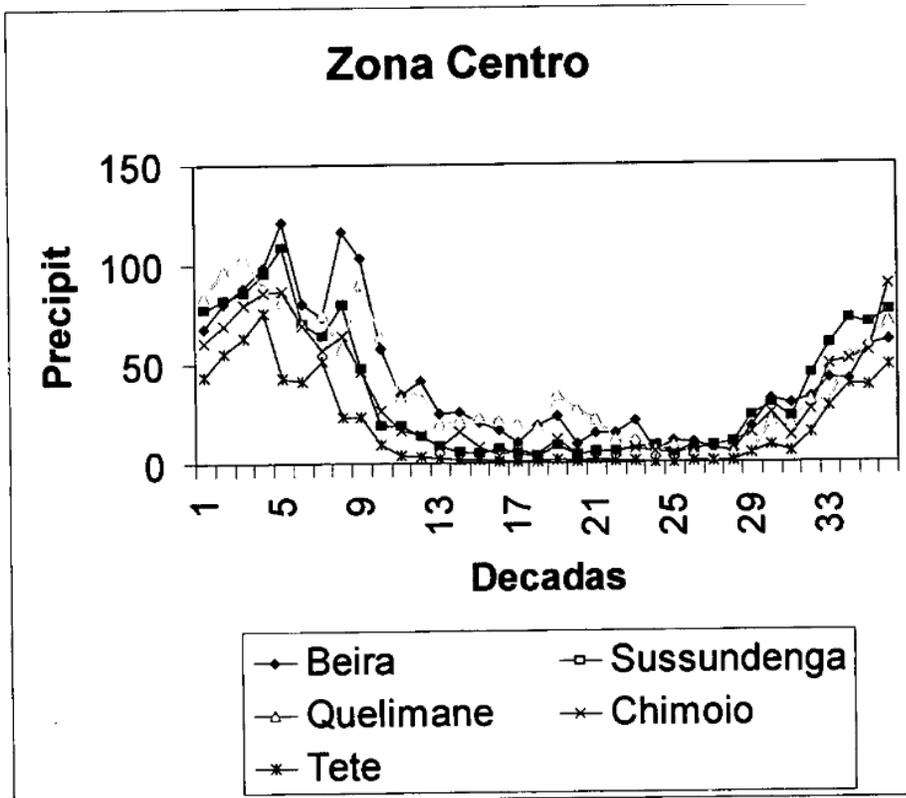
The data show an inequality in the production of cereals and gradual reduction between the years 1996 years to 2008 causing hunger and the poverty to increase to 54 % of Mozambique's population (Boom, 2011). The country, the central region of Mozambique in particular constituting Provinces of Sofala, Tete, Manica and Zambézia has more than 10 million hectares of arable lands with good soil and climate, international mozambican stud centre (CEMI, 2011).

Africa is a continent with the lowest cereal production with 1.7% according to (Cunguara, 2011). It is clearly illustrated that the most critically affected area is the southern region of Africa where Mozambique is located. Therefore, this study strives to look deeply, criticize and analyse the reasons for low cereal production in Mozambique in general and in particular in the central region of Mozambique.

Africa among the continents of the world is the hottest especially along the tropics. A third of its territory is covered by deserts and not many rivers are able to provide water for irrigation for

instance, 40% have no rivers. Many mountains are to the north of the continent and Mozambique being located to the south of the African continent has high temperatures but the rainfall pattern is quite erratic.

Figure 1.1: Rainy Season and erratic Rainfall



Source: Sawanguane, 2005

The Figure 1.1. Shows the rainy season in the center region of Mozambique which starts in the third decade of October to the third decade of November and usually finishes in the first decade of March to the third decade of April, varying the high value of precipitation between 75.7 mm (Tete) to 121.3 mm (Beira) and it frequent erratic rainfall.

As a result of this unpredictability of rainfall it becomes extremely difficult for farmers to make a plan of farming activities (farming calendar). Further, crop science agricultural experts find it

difficult to make correct estimates, for example during 2012/13 growing season, maize production was 22.8million tonnes slightly lower than the previous year's bumper yield.

The yield which Zambia lost in tones is estimated at 2.6 million (FAO, 2014). In Namibia, drought conditions resulted in a severe reduction in cereal production, except in the north eastern region compared to the year before to the extent that the government declared national year of hunger. In addition, livestock production was not spared as many animals died due to prolonged water shortage approximately 4.000 livestock deaths were recorded. (Ibid) Similarly dry spell adversely affected cereal production in Angola but recovery mechanism was put in place, particularly in the central provinces and is expected to yield positive results during this growing season. In Madagascar, rice production is expected to decline, particularly in the south western regions, due to locust infestation. A joint FAO/WFP Crop and Food Security Assessment Mission (CFSAM) are currently being conducted in the country and is expected to provide a comprehensive report in due course.

Southern African Development Community [SADC] (2012:5) reported that in Malawi, “production was expected to improve moderately over the 2012's output to 3.6 million tonnes, particularly in the southern region which experienced production shortfalls in the previous season. Lesotho and Mozambique were expected to make production gains in 2013”. In southern Mozambique, for example, flooding in early 2013 resulted in the complete loss of approximately 211.000 hectares of crop (4 percent of the national cropped area). Official estimates for Zimbabwe were not yet available; however, maize production was expected to increase from previous years. Although Botswana observed generally drier conditions, the main eastern and

southern growing regions experienced relatively good weather, and early estimates pointed to an increase in cereal production.

The Southern African Development Community [SADC] (2012) is the region recorded a drop of about 7% in cereal production from 33.81 million tonnes in 2011 to 31.47 million tonnes in 2012. However, this is still slightly up by 2% compared to the past 5 year average (2007 – 2011) cereal production. Most countries (ten out of twelve countries with data) recorded decreases in cereal production in 2012, ranging from 1% in South Africa to as high as 60% in Lesotho when compared to cereal production in 2011. Only Namibia and Tanzania had increased harvest in 2012 compared to 2011. (SADC, 2012:5-6)

Table 1.2 shows cereal production figures by country from 2007 to 2012 and a comparison of 2012 cereal production with 2011 and the past 5 year average cereal production.

Table 1.2: SADC Cereal Production by Member

	2007	2008	2009	2010	2011	5-year average harvest (2007- 2011)	2012	2012 Vs 5 year average products	2012 Vs 2011 Harvest
Angola	734	756	1.053	1.178	1.410	1.026	876	-15%	-38%
Botswana	29	37	42	55	42	41	34	-24%	-26%
Lesotho	78	88	86	137	73	92	29	-69%	-60%
Malawi	3.616	2.976	3.834	3.572	4.080	3.616	3.799	5%	-7%
Mozambique	2.168	2.284	2.526	2.641	2.935	2.511	1.439	-43%	-51%
Namibia	114	121	111	155	117	124	166	34%	42%
RSA	9.292	15.55	14.85	15.12	13.277	13.619	13.19	-3%	-1%
		0	5	2			4		
Swaziland	47	64	71	75	89	69	76	10%	-15%
Tanzania	5.448	5.622	5.265	7.095	6.787	6.043	7.558	25%	11%
Zimbabwe	1.200	660	1.561	1.534	1.652	1.321	1.120	-15%	-32%
Zambia	1.537	1.452	2.182	3.078	3.346	2.319	3.185	37%	-5%
	24.266	29.61	31.58	34.64	33.807	30.783	31.47	2%	-7%
		1	8	3			4		

Source: (SADC, 2012)

The table above illustrates that Mozambique is one of the worst countries with lower indicator-43% of cereal production on average of 5 years of production. This supports the need to develop a study on the production of cereals to understand the reasons of low cereal production causing starvation of population in Mozambique and in particular in the central region of Mozambique. The poor crop production performance in many Member States in the 2011/12 agricultural season has seen “the region experiencing a cereal deficit of about 5.55 million tonnes in the 2012/13 marketing year compared to a cereal deficit of 0.21 million tonnes in 2011/12 marketing year” (SADC, 2012:3). All Member States except Malawi, Tanzania and Zambia recorded overall cereal deficits. Zambia recorded a cereal surplus of 1.11 million tonnes followed by Malawi with 0.56 million tonnes and Tanzania with 0.19 million tonnes. The deficit of cereal production in SADC region has been echoed by authors such as FAO (2003) and SADC FANR (2003) who says that the region has experienced persistent low cereal production for the decade prior to 2002.

For the first time since 2006/07 marketing year, the region has recorded a maize deficit, assessed at 0.64 million tonnes, as regional availability of 28.86 million tonnes fall short of regional requirement of 29.49 million tonnes. The current deficit is significantly the opposite of a maize surplus of 3.41 million tonnes recorded during 2011/12 marketing year. All countries have recorded maize deficits in 2012/13 marketing year except Malawi, South Africa, Tanzania and Zambia (SADC, 2012). These four countries embarked on programmes that made them to tremendously improve production that are interesting to note. For instance, According to Government of the Republic of Tanzania Agricultural report of 2006 the government implemented a programme to boost cereal production called “Agricultural Sector Development Programme”.

Mozambique is a country on the east coast of Southern Africa which it has three geographical regions, namely northern southern and central Mozambique. To the east, the Indian Ocean stretches from the South Africa/Swaziland borders to Maputo, with many ports including Maputo, Beira, Quelimane, Nampula and Nacala (Refer to **Appendix 1**: Map of Mozambique). These ports are currently very busy, with business ranging from the transportation of cars to Agricultural products to neighbouring countries like Malawi, Tanzania or Zambia. For instance In addition, the Beira port is congested with a host of agricultural products like citrus fruits and mineral products from Zimbabwe. Thus, Mozambique has good ports which are capable of holding and processing various products in bulk. Around 80% of the Mozambican population lives primarily in areas where they can practice agriculture. Most families practice subsistence agriculture, which depends primarily on rains. Due to geographical location, the country is frequently affected by natural disasters, mainly drought, floods and cyclones. In other words Mozambique is very exposed or prone to natural disasters like Tsunami. (Siteo, 2005) In Mozambique, the agricultural sector employs more than 80 % of the population. The increase of the production after the General peace Agreement signed in 1992 is considered as one of the principal factors for poverty reduction from 69 % between 1996-1997 to about 54 % in 2002-2003 (Arndt, James and Simpler, 2006). Similarly in the last decade, “the weak performance of agriculture is due to an increase in poverty as 55% of the population live below the poverty line. “(Cunguara, 2011:1)

Critical analysis of the potential biophysical factors for the production of cereals in the central region of Mozambique will create awareness among the people as to why there is a constant decrease or an ever-decreasing production of cereals in the region. Less production of cereals affects the well-being of the people as hungry people cannot contribute positively to the

development of the country. To realize the maximum production from the land, the mentioned factors like seed quality, modern technologies and high mechanization have to be combined in order to reduce or alleviate poverty.

Currently, Mozambique is behind in relation to all the other countries of Eastern and Southern Africa in terms of maize production. “In 2004 its average maize yield was of 960kg/ha compared to 1500 kg/ha for Kenya, 1100 kg /ha for Malawi, and 2600 kg/ha for South Africa” (Uaiene, 2006:1). These low yields are a reflection of the limited use by Mozambique of irrigation technologies and inputs that increase yields such as fertilizer and improved or high yielding varieties of seeds.

All other cereal crops such as rice, maize, sorghum and corn and main are domestically produced for food in Mozambique. Thus, maize is important for the achievement of food security for the rural population as it helps to achieve food security for the livelihood of people living in rural areas the growth in production of cereals particularly. Maize through improved agricultural productivity in Mozambique stimulated growth in other economic sectors with which agriculture has strong links.

Weak agricultural technologies or almost non-existent can influence agricultural production of cereals and increased hunger taking into consideration that the central region of Mozambique is characterized by arable land or in other words Mozambique has an economy based on agriculture, a central feature of this economy is it has high risks that include the failure of production of these crops. In the last decade, the poor performance of agriculture is considered a major obstacle to the reduction of hunger and poverty incidence. The agricultural growth and in particular increased production of cereals is fundamental to the well-being of people and can be

an essential source for promoting economic growth. “The agricultural productivity in Mozambique remains low and shows a decreasing trend. Low agricultural productivity is related with several factors, such as irregular distribution and weak rain; low use of improved modern technologies; poor usage of input, precarious state of infrastructure transport; and low investment in agriculture.” (Cunguara, 2011:1)

Despite the weak development of agriculture in Mozambique, the country has a great potential to develop its agricultural capacity and to ensure sustainable economic growth in the medium and long term. Currently the development of different agro-ecological systems is frustrated by the types of mechanism used in agriculture. The fact is that the agricultural sector in Mozambique is mainly constituted by the family sector which encourages poor development as peasant farmers cannot bring a big impact to the country as a whole. The first in the rural areas of Mozambique, the family farm is composed mainly of small farms and this sector accounts for about” 99% of agricultural units and occupies more than 95% of the cultivated area of the country. The agricultural and livestock production in the country is practiced by about 3.2 million farming explorations, of which 99% are classified as small farms which mostly exploit areas with dimensions of less than two hectares. Agriculture in Mozambique is an area of activity of great importance to the economy and is the basis of food security and income for most of the Mozambican population” (Sitoe, 2010:35).

Agriculture is the basis of people's food security and especially in rural areas where farming is the only form of survival for households, cultivated crops include maize, rice, sorghum, peanuts, millet, beans and cassava. The surplus is either sold in order to purchase other commodities, mainly manufactured goods or future use in times of food scarcity or famine.

The areas to the “Central Mozambique have a high potential in agriculture as they possess sustainable water supply through rivers that flow all the year round than the south. These areas are often producers of agriculture surplus, but the development of beef cattle is difficult due to the prevalence of the tsetse flies and foot and mouth disease. However, these areas are well known for the production of pigs and goats.” (Sitoe, 2010:37)

### **1.1 Statement of the Problem**

Land for the practice of the agriculture in Mozambique is available and it has nearly 36 million hectares (Hanlon, 2011), of which, above 10 million is arable land with good soils and climate. The central region of Mozambique has 5 million hectares (Sitoe, 2005) being used for the practice of agriculture. From this, only 3.3 million hectares could be irrigated, but only 50.000 hectares is being irrigated (GPSCA, 2005), this irrigated land is equivalent to 0.13 % of the arable land (CEMO, 2011). With this data we can conclude that there is sufficient natural resource in Mozambique, in terms of farming land, for the production of cereals of importance such as, maize, rice, and sorghum. In Mozambique it is considered that the basic economic activity is agriculture, predominantly subsistence agriculture. It has been observed that 69 % of the production of cereals is from the central region of Mozambique (CEMO, 2011). Despite the above statistics, the central region of Mozambique remains the poorest region of the country with perennial food shortages due to the low rates of production of cereals, or lacks of actualization of the implicit potentiality of the region for example the gross under the utilization of the abundant natural resources available in this part of the nation. It is therefore, a curious paradox that in spite of abundant agricultural land ideal for cereal, hunger, starvation and poverty still prevail in the central region of Mozambique. Therefore, the big question that remains unanswered is that why

there is low cereal production in almost all the districts in the centre while there is vast arable land above 10 million hectares with fertile soils and favourable good climate. It is imperative to get to the bottom of this problem especially when we considering the fact that in Mozambique just like in any other country in the SADC region, agriculture is the backbone of the country's economy. The more the country produces, the more it becomes more reliant to the extent that you increase exports and reduce imports hence reduce inflation. To some degree frequent fuel hikes on the international market level (Cunguara, 2011:8) have been attributed to “poor agricultural production which reduces the purchasing power of the country as there will be shortage of foreign currency”. In addition there will be more than enough food for the general population that will provide energy to be used in various sectors of development. Furthermore, more exports mean more money for infrastructure development.

Table 1.3: Cereal Productions in Central Mozambique

<b>Years</b>	<b>Maize</b>	<b>Rice</b>	<b>Sorghum</b>
1996	1.1780.000 tonnes	115.000.000 Tonnes	126.000.000 Tonnes
2008	1.120.000Tonnes	88.000.000 Tonnes	215.000.000 Tonnes

Source: (Cunguara, 2011)

Cereal production in central Mozambique is inversely proportional to the ever increasing population, as evidence by the production of maize, rice and sorghum in 1996. This is a clear indicator that from 1996 production in cereals has been dwindling at an alarming rate which is a worrisome development and surely is the phenomenon which has triggered the current study.

## **1.2 The Purpose for the study**

The aim of this study was to critically examine the underlying factors for the low cereal production in central Mozambique in order to determine sustainable solutions to increase production and alleviate if not completely eradicate poverty in this region of the country.

## **1.3 Research Questions**

Research questions in the qualitative approach guide the focus and direction of the issue to be done. The questions help to frame the aspects or domains that the researcher is interested to explore. There is a possibility that in the process of investigating the issue under study, some pertinent questions may arise in the course of study. Hence, the “research questions may be formulated right at the outset or later on, and may be refined or reformulated in the course of field work” (Miles and Huberman,1994:23). For this study, it was worth to use research questions substituting the objectives of the research. As noted earlier research questions serve as a guide to the study undertaken, therefore the following research questions guided the researcher to explore and investigate the phenomenon under study:

1. Why is there low production of cereals in Central Region of Mozambique?
2. What factors can contribute to an increase in production?
3. What is the quality of cereal seed contributes to the rise to higher cereal production?
4. What agricultural technologies can be employed in order to increase cereal production?

#### **1.4 Research Sub Questions**

1. Why is the Central Region of Mozambique failing to produce bumper yields in cereals in spite of having favourable biophysical conditions?
2. What are the main factors that affect cereal production in Central Mozambique?
3. How do the government and other organizations fund the production of cereals in the districts of central Region of Mozambique?
4. What are the types of technologies used in the production of cereals in the district of Central Region of Mozambique?

#### **1.5 Assumptions**

Right from the onset assumed that the government officials who work with cereal farmers will give their views concerning the low production of cereals in central region of Mozambique. It is also assumed that the researcher and study participants will interact with much ease since the researcher understands the language used by the participants. It is also assumed that the researcher will find related literature about cereal production.

#### **1.6 Significance of the Study**

This research is of paramount importance to the community in terms of thinking about how they can increase cereal production in their region in order to reduce poverty. Efficient and effective cereal production will achieve high volumes of cereal yield for the farmers and surplus for sale.

In addition, the cereals consumption options and volumes will improve the central region of Mozambique as a whole and will reduce the hunger.

Findings could be used to develop training programmes for the cereal farmers. The findings could also be used by the government agricultural policy makers to formulate policies that will support the cereal farmers. The researcher will gain research skills and deepen the knowledge on cereal production around the world.

### **1.7 Delimitation**

The study was carried out in the Central region of Mozambique, specifically covering the two districts of Zambézia Province, and one district each from the provinces of Sofala, Tete and Manica. Only the cereal producers and consumers were interviewed. This problem of unwillingness by farmers to give the vital information was carefully taken care of as the researcher approached the farmers through their community leaders.

### **1.8 Limitations**

The challenge potential problems consisted of access roads from one district to another. There are regions where there is flooding due to rain and these areas become almost impossible to drive to. The researcher generated data during the period of less rain. Informants were sometimes reluctant feeling uneasy with strangers.

## **1.9 Research methodology and design**

This study was purely qualitative in nature. Observation and focus group discussions were the main data gathering instruments. The other instruments included, document review, questionnaires, and videos and photographs. These were used to examine the impact of the problem under study in the society. This section explained the research paradigm, design, instruments, procedures, population, sample and sampling procedures used in this research. Issues of trustworthiness, legal and ethical considerations, were discussed.

### **1.10 Ethical and Consideration**

To handle the relevant ethical and legal implications, the researcher applied for UCM and ZOU permission to conduct research. The researcher also applied for permission from the Ministry of Agriculture and Provincial department of Agriculture to conduct research in the cereals production. The researcher explained to the respondents the significance of the study and contributions it could make to the overall cereals production in central region of Mozambique. Participants were told that participating in the study was voluntary. Further, they were also assured that the information would be confidential and would be used for academic purposes only.

## **1.11 Definition of terms**

### **Cereals**

In this study cereals are defined as, plants, such as wheat, barley, corn, soya, sorghum, rice, whose seeds can be turned into flour, used as food for the human beings or applied like raw materials for manufactured products.

### **Production**

Production means a system of actions that are related to (factors of production) a dynamic form and that are orientated for the transformation of determined elements. In that way, the entry elements (known as factors) become the exit elements (products), as a result from a process in which their value is developed.

### **Arable land**

In this study arable lands are appropriate lands for cereal production and they should be maintained in good agricultural and environmental conditions in order to maximize the production of crops with view to reduce or alleviate hunger and poverty.

## **1.12 Conclusion**

This chapter presented the background to the study and explained what prompted the researcher to choose this area for research, highlighted the problem, purpose and importance of this research. In addition, the delimitation for the study was given; limitations and mitigations were

explained while the ethical and legal implications were stated. Finally the definitions of terms used in the study were given. The next chapter dealt with the review of related literature.

## **CHAPTER 2: REVIEW OF RELATED LITERATURE**

### **2.1 Introduction**

Chapter one (1) discussed the background to the study, statement of the problem, purpose for the study, research questions, assumptions of the study, significance, delimitation, limitations of the study and the definitions of terms. Nevertheless, this chapter sought to highlight issues related to conceptual and theoretical frameworks and works of authorities with regard to challenges of cereal production around the world. The study was based on the concepts of the production function and the theory of household food production. An attempt to define the term cereal was made, the rationale for production of cereals and the strategies for increased cereal production were highlighted. Literature on food security, farming competencies, and perceptions on emerging models of cereal farming was interrogated. Finally, the review of related literature looked at cereal production models on the Mozambican farms.

The review is discussed in six sections as follows: Theories of production; Analysis of production of cereals in the global village, in Africa, and in SADC; Technology in Cereal Production; Value Chain and Production of Cereals; Associations of Cereal Producers; and Challenges (encountered by farmers) in Cereal Production. The situation of agricultural production in the colonial phase (before independence), the post – colonial era, the present, and then analyse the cereal production prospects for Mozambique were analysed. In addition, it was also critical to understand how other formerly poor countries have reduced poverty and hunger through agriculture and find out how Mozambique, particularly the central region, may adapt similar models in order to achieve sustainable cereal production and reduce poverty and hunger.

## **2.2 Conceptual Framework**

In this section, some of the core terms were reviewed and concepts that are critical for a critical analysis of cereal production were explained.

### **2.2.1 Definition of Cereals**

Cereals are grain crops which include wheat, oats, barley, rye, maize, rice, sorghum and millet. Cereals belong to grass families that, on maturity, produce caryopses (grains) when dry (Almeida & Fernandes, 2011). During harvesting, cereal seeds are separated from the stalks through manual or mechanical threshing, with some cereals such as rice and oats retaining their husks during the threshing process. In preparing the grain for food it is customary to use the soft parts and to reject the outer coats in the process of milling. Inside the coats of the grain may be found the embryo of the future plant and the endosperm which forms its food. This endosperm consists mainly of starch, protein, fat, with an abundance of minerals throughout the grain. The germ, or embryo, of the grain is rich in vitamins and if this part of the grain is removed in the process of milling, as sometimes happens, then the people who eat the final product are deprived of an important source of vitamins in their food.

Most common cereals include wheat, rice, oats, rye and barley. Some of them, such as rice and oats, retain the bark during the threshing process, which need to be removed to produce an edible product. Grinding produces pulp or some powder made up of the fruit wall, the wall of grain, the aleuronic layer and amounts of starch obtained from the endosperm and germ, but its composition may vary according to the grinding process (Almeida & Fernandes, 2011). However, cereals that are produced by farmers are also marketed as “cereals.”

A deeper understanding of the marketed cereals (usually as breakfast food) may be drawn from the following definitions from the American Association of Cereal Chemists report, the American Whole Grain Council and the Danish Taskforce reports. According to the American Association of Cereal Chemists [AACC] (1999:39) a "full Cereal consists of caryopses intact, ground, clicked or flaked, in which the main anatomical components (endosperm, germ and bran) are present in the same proportion that exist in the intact Caryopsis." This definition does not include the fiber content. Though the pseudo cereals are included in this (cereals) group, oilseeds and pulses are not. The American Whole Grain Council [AWGC] (2006:40) expresses that: "the whole grains or foods they produced are those containing all the essential parts and all the nutrients naturally present in the seed. If the grain is processed (crushed, wrinkled, and popped, extruded or cooked) the resulting product must provide the same balance of nutrients found in the original seed". This definition includes cereals and pseudo cereals, but excludes legumes. In addition, "whole grains are those obtained when using the core, intact, dented, cracked or flaked product after the peel is removed and these include wheat, oats, rye, barley, rice, maize, millet, sorghum, and triticale. Pseudo cereals and legumes are excluded from this definition". (Almeida & Fernandes, 2011:49-50) These three approaches allow us to attain a deeper understanding about the types of cereals and difference between the benefits of certain foods, such as the importance of cereal consumption for the prevention of some diseases.

Cereals, which include wheat, rice, corn, barley sorghum, constitute the base of the human and animal food and several of these contribute significantly to the sustainability of the systems of agricultural production. States that maize belongs to the family called *Zea mays*. It is a cereal of high nutritional value and for it is widely used in the composition of animal rations and other

human foods. It is one of the grains where technologies are used in planting and harvesting. In addition, it is cosmopolitan. Its production in 2004 reached a world total of 600 million tons.

The sorghum is cultivated in areas with dry or warm climatic environment where the productivity of other cereals is uneconomic. The varieties of sorghum have been developed to be able to adapt to areas out of the tropical zone even though they perform well in tropical areas. Sorghum is cultivated mainly in areas with annual moisture content of between 375 and 625 millimetres or where irrigation is possible (Ibid). Sorghum may be consumed as food for human consumption, or animal feed, or for alcohol production, alcoholic drinks, glues and paints. In Agronomy, sorghum can be classified in 4 groups:” graniferous; foraging for ensilage; foraging for pasture, hay harvest and dead covering” (Busi, Morgado, Luciana, França & Aldi: 2011).

Rice consists of seven species and nine kinds that are (*Oryza barthii*, *Oryza glaberrima*, *Oryza latifolia*, *Oryza longistaminata*, *Oryza punctata*, *Oryza rufipogon*, *Oryza sativa*). It belongs to the grasses family. It feeds more than half the human population in the world and is the third largest cereal crop in the world, after maize and wheat (Alonço, 2005). Table 2.1 below shows types of rice according to their different characteristics, colour, taste, industrial yield, grain shape, among other features.

Table 2.1 Types of Rice Grown and their Nutritional Values

Type of rice	Calories (Kael)	Carbohydrates (g)	Proteins (g)	Fats (g)	Fibbers (g)
White	124	26.6	2.32	1.18	0.49
Integral	76	14.5	3.0	1.0	2.7
Parboilizado	123	25.6	3.2	0.6	0.63
Cateto	180	39.1	4.0	1.0	1.0
Arbóreo	175	39.2	4.16	1.17	0.50
Basmati	171	38.1	3.5	0.5	0.8
Red	173	36.4	4.9	1.0	4.2
Negro	173	36.4	4.9	1.0	4.2
Selvage	170	35.6	6.0	0.5	3.0

Source: (EMBRAPA, 2005)

This differentiation of the rice is based on their colour, flavour, industrial yield, format of the grain. It allows its differentiation and selection by people from various parts of the world. Producers are at liberty to decide on the varieties they want to produce in their regions. However, it is important to note at this point in time that this research focused on the production of maize, sorghum and rice as the main cereals for the study due to their importance in reducing hunger in Mozambique.

### **2.2.2 The Production Function**

This study is based on the concept of the production function, agriculture, cereals, cereal production and food security. It is not possible to address the agricultural process without elucidating the concept of production. The farm production is a coordinated process that brings together work, capital and entrepreneurship (Santos, 2006) in various ways and in various forms. Farm production needs raw materials, processed products, equipment of all sorts, plants, technology, workforce, and knowledge management with the aim of creating a good or, increasing agriculture produce and service that is desired by the community and the consumer. “The factors of the production comprise the land, labour and capital” (Samuelson, 2010:110). The combination of these factors culminates with the weather for effective agricultural production.

The production function is defined as the maximum amount of output that can be produced (through the use of a given production technology) with a given amount of input. These inputs are called factors of production named as the land, labour, capital (Santos, 2006) and organization. In this study the researcher is interested in understanding the production function of cereals in the central region of Mozambique by investigating the inputs and outputs given the biophysical nature and climate of the region that is very fitting for cereal production.

The cereal production area of around 1500 million hectares shows the sowing structure of the world in 2009. In this can be properly seen that growers are” producing cereals on 48% of sowing area in the world. Corn, rice and wheat have to be pointed out within cereals. Share of these three plants is 36% from entire sowing area, which is equivalent to 546 hectares”. Wheat has the largest proportion within cereals. Owing to its sowing area of 225” million hectares it

occupies 15% of area being under plant production in the world” (Kiss, 2008:115) Proportions of three main cereals are stable on average of number of years. As perms in the future significant displacement are not expected in sowing structure. Forum for agricultural research in Africa [FARA] (2009).

### **2.2.3 Definition of Agriculture**

Agriculture refers to the entire set of activities in rural areas, because they are places where the farming considerably takes place from the simplest to the most complex, almost all within farms. Agriculture is the effort to situate the plant grown in optimum conditions (climate, soil) to get the maximum performance in quantity and in quality. In other words, agriculture is artificialisation of the natural environment by man in order to make it more suitable to the development of plant and animal species (Domingos, 2004). Agriculture is the economic activity geared towards the production of food for consumption and raw materials for industry, obtained from plants and animals through biological and technological transformation. However, there are a number of agriculture types, for example, subsistence farming and commercial farming. In the case of Mozambique there is more predominant subsistence agriculture which is an agricultural production system aimed at the survival of the farmer and his family. This is characterized by the use of technically underdeveloped resources. Agricultural instruments most commonly used are: hoes, ploughs and sickles, Promotion Economic of Peasant [PROMECA](2010). In subsistence farming tractors are rarely used or other types of agricultural machinery. The production is low compared to that on large mechanized farms. Monoculture is the production or cultivation of only special agriculture whereas poly-culture is the cultivation of various agricultural products at the same time (Embrapa, 2011).

#### **2.2.4 Agriculture Production**

Agricultural production, a concept widely used in the world, understood as a set of means of production (land, labour and capital) combined with one another to ensure a crop production and/or animal, United Nations Environment Program [UNEP] (2010). Therefore, the combination of these three factors culminate with an activity, whether commercial or subsistence. Agricultural production is the art of cultivating the fields, with a view to the production of plants useful to man (Embrapa, 2012). It is an activity developed by the man who relates with the earth in a methodical and systematic way, with the aim of producing food or cereal. This research was centred on cereal production which is typical agriculture production. It is possible to observe the great importance of the sector of peasant that in 1970 produced between 70% and 75% of agricultural production and more than 90% of the production of basic food products (Walker, Pitoro, Siteo, Mahanzule, Tomo, Saliencia & Mazuze, 2006). The occupation of the land clearly reflected the productive structure and the types of producers. The following table demonstrates the concentration of land in 1970. In accordance with the work of agricultural survey, there is a diversity of food products prices; in this diversity, corn and cassava occupy dominant positions of area cultivated, being the corn grown by around 80% of the farms and the cassava by 76 %.

#### **2.2.5 Food Security**

Food security is the condition that ensures that there is food and that the food will not cause harm to the consumer when prepared and or eaten according to its intended use (Reyes, 2012). Some authors consider food security as a concept which is still under construction, either in theoretical or in the formulation of public policies (Vendramini, Oliveira & Campi, 2012) state that the

national security of a country depended on the production and supply of food. For better understanding of the term food security, was built on three parameters including availability, access and continuity (Ibid).

Food security, in view of availability, raises problems related to the volume of food production at the primary level of agriculture. Therefore for food availability, such aspects as the land question, regarding the maintenance of naturally occurring chemical and biological constituents, as well as issues related to land, the location, and the technologies employed in the production should be put into consideration (Vendramini et al, 2012). There is also need to understand the relationship between peasants or farmers, landowners, and the market requirements as well as agricultural food production in models of monoculture.

#### **2.2.5.1 Food Security Policy**

During the war years 1980 to 1992, when the country depended heavily on imported food, distribution was the key food policy with the Ministries of Commerce and Health as leading actors. Subsequently with “the revival of domestic farming, the main issue is that of reaching domestic self-sufficiency in staple foods, with the Ministry of Agriculture taking the lead role.” (Selvester & Castro, 2004:7) Currently, the main food policies emphasise increased farm output and food marketing. Most trading and storage of food is left to the private sector. Despite proposals for a public strategic reserve of grains, there are as yet no such stocks. The debate on food security centres on the production issues and above all the question of whether to focus agricultural development efforts on estates, commercial farms, and the better-resourced small farms in the most favoured areas, or whether to spread public investments for a broader coverage of smallholders. Social protection schemes are few and of very limited coverage. Mozambique is

a beneficiary of disaster relief efforts from the experience of the war years, drought, and floods. Capacity and focus, however, is on reacting to calamity, rather than mitigation. Some progress has been made in establishing the capacity to map vulnerability and to track this through the seasons. (Ibis)

#### **2.2.5.2 Food Security and Nutrition Policy Framework**

The approach to food security issues in Mozambique is a product of the historical context in the country. The Mozambican government recognized in the early 1980s that food security issues needed an inter - sectorial approach if inroads were to be made into the difficult situation caused, in large part, by the war. This was neatly illustrated in 1988 when the World Bank required the government to undertake an analysis of the food security situation and the government constituted a multi-ministerial working group. Agriculture could play in achieving food security for the population and gave much more power to the Ministry of Commerce as they were responsible for food aid management. Food security was therefore considered in terms of access to food and not only food production. The discourse was led by economists, nutritionists and social scientists and not agronomists. Debates centred on safety nets, basic social service provision and emergency planning. From this multi-disciplinary background joint information gathering exercises were organized, a department was established in the Ministry of Planning and Finance, designated the Poverty Alleviation Unit which had at its heart a food security bias and a number of initiatives were, launched that helped to cement these relationships(4). At the end of the war, the pendulum swung in the direction of the agriculture sector and the food security impetus was drawn into the agricultural field. Post-war agricultural policy has food

security as its central tenet with emphasis on improving food production and the role of the small farm sector in post war recovery was emphasised (Ibid).

Although the majority of the resources directed to improving food security now rest with the Ministry of Agriculture and Rural Development, the bedrock of multisectoralism has resisted and is reflected in policy documents and the inter-sectorial bodies now in place in the country. At the end of the war the move was towards resettlement and stability. Policies were conservative with a tendency to fall back on support for small farms in order to achieve peace and tranquillity.

Innovation was very difficult in these circumstances, as feeding the population was of paramount importance. This led to a tendency to equate food security with self-sufficiency through own production from peasant farms. The decision was pragmatic. The state was weak, the manufacturing base inexistent and there was a lack of social cohesion in the years immediately following the war. Strategies immediately post war lent themselves to uniformity and not diversity, to “kits” and packages, rather than tailored interventions.

As pointed out by (Pontara, 2002) most the large number of demobilized soldiers led to a “one size fits all” approach by the government and the donors, resulting in the indiscriminate distribution of buckets, hoes, seeds, socks and a pair of underpants, irrespective of where the demobilized soldiers were going, their professions or their livelihood options. The measures were an expensive public relations exercise and did not attempt to suit the livelihood needs of the returning soldiers. “Given ten years of stability, the generally positive growth trends, but the persistent high levels of vulnerability of households to food insecurity it is time to start looking at alternatives and more varied options that deal with the complexity of the livelihoods of both rural and urban households” (Selvester & Castro, 2004:10-11).

### **2.2.5.3 Food Insecurity Community of Portuguese Language Countries**

According to Pinto (2011) food insecurity of the population is a consequence of the non - realization of the right to food. This section aims to provide a general picture of poverty, food and nutrition insecurity and key vulnerable groups in CPLP countries as a way of framing the diagnosis. The levels of development of the community of Portuguese speaking countries (CPLP) are very disparate including countries with very high human development (Portugal), high (Brazil), medium (Cape Verde, East Timor and Sao Tome and Principe) and low (Angola, Guinea Bissau and Mozambique). (Pinto, 2011) The 2011 report on progress towards the Millennium Development Goals (MDGs) in CPLP notes that the vast majority of these countries have virtually unrecoverable delays in the four years left to 2015, affirming decisions are necessary the bolder and more robust policy foreign aid. In general, levels of poverty and food insecurity remain serious concern in most countries. According to World Food Program, (2005) in absolute terms,” the Community of Portuguese Language Countries (CPLP) has almost 28 million malnourished. In proportional terms, the most problematic countries are Angola (44 %), Mozambique (37 %), Guinea-Bissau (31 %) and East Timor (23 %). These are also the countries where child malnutrition is more pronounced. At the World Food Summit (WFS) held in Rome in November 1996 established the target of halving the number of undernourished people by 2015. This objective was subsequently incorporated into the MDGs adopted in 2001 by UN member countries. However, “despite all efforts, it appears that there is still much work to be done in most countries of the CPLP. In the case of Angola, since the end of the war in 2002 that the country has shown progress on the economic and social situation, it was recently conducted a broad diagnosis whose results indicate some improvement in the situation of hunger and poverty”, although there is still a long way to go (Pinto, 2011).

The group of food insecure households covering about 19 % of the surveyed households spread over all areas. 72 % of these have been displaced and 20 % are newly resettled over the past three years. Given the poor harvest of 2004 due to excess rainfall in the area, only these households had a normal harvest, the two have done. This group relies exclusively on farming as their main source of food and income, with alternative income options extremely limited". In addition to poultry, they do not raise animals and possession of goods is extremely low. They have almost no capacity to respond to risks. The diversity of food consumption is very low, all households eating less than three food groups (corn, tubers and grains) and take only one meal a day. "This group has the highest proportion of households receiving aid, with 35 % receiving food aid. This group is considered food insecure". World Food Program [WFP] (2005:32)

The Highly Vulnerable Households considered group 2 which corresponds to 30 % of the surveyed households is found in this group, with the highest concentration in Zone 5, where 52 % of them are considered very vulnerable. The group owns 38 % of households whose heads are females, registering 50 % in Zone 3. Approximately 22-25 % of aggregates is returned, except for Zone 1 and 7 where the ratio varies between 12-14 %. Despite its own agricultural production and fishing, these households have no other sources of income. The sale of cereals is the most common response to risk and households have some reasonable strategies to address the problem, based on "small business ". This group is also holder of a limited number of animals. The worst concentration is in Zone 1, where only 8% of households having pets. None of these have animals for farming purposes. Food intake is poor, with households consuming less than 3 food groups and nearly all of doing only one meal a day as the Group 1, based on corn, tubers and vegetables. About 37 % of the households are exposed to more than 3 risks. Food aid receives about 34 % of households. These households are considered highly vulnerable, which

means that any shock that occurs in their livelihood can result in food insecurity due to poor development of strategies to address the problem. (WFP, 2005:33)

**i) Moderately Vulnerable Households (Group 3)**

According to World Food Program (2005) around 19 % of households can be found in this group, with the highest concentration in Zone 6 where they reach 47 % of households. Up to 47 % of them are headed by female elements, with a maximum in Zone 7, which constitute 62 % of households. 18 % were resettled in the last three years. Households that make up this group have relatively good options for income diversification, in addition to their own agricultural production. Most people with permanent employment are in this group. “The majority of households in this group (73 %) is exposed to more than three risks and often use negative coping strategies to address the problem, such as changes in diet or activity that may result in environmental degradation” (WFP, 2005:33). It also happens that their strategies of tackling the problem have a negative impact on children and girls or on their productive capacity.

**ii) Aggregates Low Vulnerability (Group4)**

The proportion of households headed by persons of females is the lowest of all groups 27 % but a very high proportion was shifted 68 %. Of these returnees, 20 % returned in the last three years. Almost 33 % of households in Plateau lies this group, which is almost equally distributed in zones 3 , 4 and 6. The highest proportion is in Zone 7, at 40%. Compared with other groups, this is due to the better distribution of yield and better survival strategies.

Asset ownership is higher than in the other groups, with 31 % of households to devote himself to breeding. The highest concentration is in zones 2 and 4, over 45 % of aggregated to create animals. In Zone 4, for example, up to 25% of households own animals use in agricultural production. This group has the best diet. More than 87 % consume more than three meals groups and more than 85 % has more than one meal a day. Exposed to fewer risks, the group adopts the less negative coping strategies. WFP (2005) national reports indicate that the country has made progress in universal primary education (MDG 2), reducing child mortality (MDG 4) and maternal health (MDG 5), mainly due to notable investments in health infrastructure and education. The most recent data indicate that about 37 % of the population lives below the poverty line and about 60 % of the poor are located in rural areas (Pinto, 2011:6). In the case of Brazil, it appears that the country has fulfilled the goal of halving the number of people living in extreme poverty by 2015 (a reduction of 25.6 % in 1990 to 4.8 % in 2008). Comparing the population change with poverty reduction is perceived more clearly the scope of these advances: between 1990 and 2008, while the national population increased from 141.6 to 186.9 million, the population in extreme poverty decreased from 36.2 to 8.9 million people. Still, about 20 % of the population is below the poverty line and 13 % are at risk of getting this situation. The high political commitment and implemented various social programs have contributed to this progress (Ibid).

For the National Council for Food Security (CONSEAs) was created in April 1993 as advisory body for the Presidency. It consisted of Ministers of State and representatives of civil society, with a very innovative form of partnership in the search for solutions to the problem of hunger and poverty in the country. Certainly been an experience marked by tensions, but also with a significant number of initiatives, including the quest to make food security a priority. During the

movement that was unleashed by the Citizens Action and, with the support of CONSEAs, held the first National Conference on Food Security (CNSA) in July 1994. The CNSA resulted from a process of national social mobilization around the food issue and increase awareness of hunger in the country. It produced a policy statement and a programmatic document with the conditions and requirements for a National Food Security Policy, discussed below. The experience of CONSEAs lasted only until the end of 1994, when the new government launched the Community Partnership Program. A brief interruption of experience CONSEAs hurt your review and deepening. His successes have been limited, mainly due to the character of the transition tamar government, the zealous resistance of the policy drivers (Maluf, Meneses & Valente, 1996).

### **iii) The Community Partnership Program**

The program of the new government aims to continue the previous work and extends it to other elements, besides the food issue, which contribute to poverty and inequity. What seems like a logical move toward a more social program presents a comprehensive design risk and possible setback in dealing with food issues. By reducing the food security of the items of social action, can ratify the dominant bias restrict it to its care dimension in a context of widespread misery and impoverishment in the country. The food issue is more complex than promoting food distribution or localized initiatives to stimulate employment generation (arguably indispensable). Eliminate some of the losses of real income caused by high inflation, a stabilization plan, is not synonymous with income distribution, as well as good agricultural harvests are not confused with affordable food. The CONSEAs favored discussion of the issues cited by the core of the government and in society.

The Community Partnership Program may have difficulty incorporating them. Therefore, the recent creation, the Community Solidarity Council, a working group to monitor the development, conduction and execution of the federal budget, these items are relevant to a National Food Security Policy, as per the directives issued by the its National Conference. In parallel, established a Ministerial Technical Committee, with the participation of civil society, which will examine the government action in the area of food and nutrition security, and propose the articulation and strengthening of existing shares or new initiatives that, taken together, constitute in fact a National Food Security Policy. This Committee will collaborate in developing the Brazilian document for the World Food Summit in 1996.

Such initiatives may be a reflection of the renewed issue of food security as a strategic area of action by the Citizenship Action in combating hunger, rooting, moreover, the relations of partnership in this regard. It also cannot minimize the increased discussion of the topic worldwide over the worsening hunger and poverty and the approaching Summit 1996. Maintaining food securities in the government's policy agenda will therefore depend largely on the ability of civil society to keep this thread alive and deepen own technical discussion within the government agencies and partnership. In terms of Food Security, Development and Equity the researcher saw that the concept of food security has been used recently in Brazil and subject to various interpretations. Even with some diversity, it gained momentum in the country, the view that there is a food problem as such strongly determined by the prevailing development model which must be addressed as a strategic element to building a future of greater social equity. In my view, it is fundamental to state access to food as a right in itself. I assume here the belief that food is the right to life itself. And, therefore, supersedes any other reason to justify its

denial, whether economic or political. Denying this right is, before anything else, denying the first condition for citizenship, which is life itself. The objective of food security would combine (a) care - compensatory actions against emergency issues such as hunger , with policies to ensure structural nature ( b ) access to food without compromising substantial portion of family income , ( c ) the availability of quality food , sourced from efficient productive ways, but not exclusive , sustainable , and ( d ) disclosure of information to consumers about healthy eating practices and possible health risks , mediated food (Maluf et al, 1996).

#### **iv) Access to available food**

Access to food is at the feasibility of an economic expressions of fairness, namely center, the creation of a mass market, as demonstrated global experience. This could be a vector of economic growth, articulating government initiatives in different fields, including the core of economic policy. Moreover, the fiscal crisis and the recovery of social participation require incorporating the vision of state-society partnership, decentralizing decisions and actions. The contrast between advanced and underdeveloped countries is also quite pronounced in the food issue. For the former, her face was a critical component in shaping their patterns of development, today characterized by productive self-sufficiency.

Agric food (few equated food availability via imports) and the small scale of the problems of the population access to the same. For these countries, the issue of food security is much more geared towards stability in the supply and maintenance of strategic stocks of staple foods, than with institutional programs for the most vulnerable social segments.

An appropriation of the concept of food security appropriate to the countries of Latin America and the Caribbean, and particularly to Brazil, should emphasize the issue of access to food, both where it is irregular or insufficient, which originates hunger like those where access is costly and undertakes substantial portion of total income, making it difficult to obtain the other components necessary for a dignified life. Brazil of today boasts one of the most disturbing pictures of food insecurity around the world, where millions of people as already mentioned are hungry and significant part of its population lacks a quantitatively and qualitatively adequate feeding. The recognition that a lack of access is the main factor determining the current levels of food insecurity in Brazil , should not serve to make you underestimate the importance of policies to ensure the availability of food. It is necessary that food availability is sufficient through generating a supply capable of meeting the consumption needs of the entire population so that there is food security. Moreover, the food system must be stable and does not undergo fluctuations in supply and demand for food, over time, that threatens to adequately meet those dietary requirements. Must also feed the system has a battery life of such an order; do not unconditionally depend on imports to meet the demand for food.

These three attributes (sufficiency, stability and autonomy) seem to form themselves into trouble for food security in countries like Brazil. However, strong demand pressures on the agri - food system where there was, in the recent past, episodic recovery of purchasing power of the lower income groups, occurred, causing problems in some products (Maluf et al, 1996) supply Food Security and Sustainability.

The model of agricultural development in Brazil consolidated one of the highest rates of concentration of land use across the planet. Approximately 30 million people fled the country in the last three decades, because they have minimum conditions for survival in the face of a model that has reserved nothing for small production. It is estimated that 4.8 million families now form the number of landless, hungry and without any alternatives in order to live a dignified life (Ibid).

The technological standard based on the intensive use of chemical inputs, improved and hybrid seeds and heavy machinery, requires strong energy, proves very expensive and does not fit the requirements of small family farms. As noted, creates irreparable imbalances on ecosystems, with multiplication of pests, sterilization of soil, siltation of rivers and reservoirs, water pollution, devastation of forests, loss of biodiversity, food contamination and poisoning of farm workers (Maluf et al, 1996).

For Cabo Verde, it appears that the country is on track to achieve the MDGs by 2015. In five years about 10 % of the population is out of poverty (36.7 % in 2002 to 26.6 % in 2007) (Pinto, 2011). However, in rural areas the situation is worrisome, which is located about 72 % of the poor. In terms of food production, the main difficulties are due to drought and desertification. The country has a huge dependency on food aid for nearly a quarter of total food consumed comes from foreign aid.

Cabo Verde has an unusual situation challenges in this subject so crucial to the lives of people, not only the intrinsic characteristics of the country's food production, which has always complicated immense survival of populations, but also because it is one of countries that has

better performance in terms of food security in relation to Africa and many developing countries. Cape Verde has always taken a particular concern with the food issue and soon after independence created the EMPA public supply company with a mandate to ensure the distribution of basic food goods throughout the territory. With the evolution of the economic situation and gradual political liberalization, investment in the functioning of the market as a benchmark of the food system has come to pass , but institutionally innovating with the creation of regulatory system that would guarantee "reasonable operation of the market . "It is well established ANSA National Agency for Food Security in 2002 , with a specific mandate to ensure the supply of basic foodstuffs in the country, which has been happening with great efficiency and benefit to consumers .

However, if the macro level the country has food security levels indisputably good, locally the challenge remains. This paper characterizes not only the evolution of the country in terms of food supply and basic goods, but also presents the characterization of the interior situations in food production systems and show that as the population seeks to manage the best so your "food equation" with data that deserve our best attention and motivation for more and better research - development applied to solve local problems (Carvalho, Monteiro & Monteiro, 1992).

The Guinea-Bissau is the country with the highest proportion of “poor (over 65 %) and one of the most backward in the world in terms of human development. The country has experienced successive political and institutional crises that hinder the continued and effective implementation of public policies. The country is highly dependent on international aid. About 80 % of the budget depends on export earnings from cashew” (Pinto, 2011:7).

Mozambique is another country with huge weaknesses in terms of development. The national reports indicate that the number of poor has increased. Currently, over 55 % of the population lives in poverty. The situation of food and nutritional insecurity has had very modest improvements. The country is highly dependent on international aid, particularly in budgetary terms, although the record shows a very substantial reduction in dependence on foreign food.

The idea of access attracts, among other issues, income, logistics distribution and continuity which inevitably relate to problems with the technology and relations of production (Campi, 2012). Thus, this study attempted to understand the types of agriculture production practiced in the central region of Mozambique and establish the state of food security therein (Pinto, 2011). In Portugal the effects of the international economic and financial crisis had serious impacts. Unemployment has been rising already exceeding 10 %, which leads to the aggravation of social problems. The unemployed and precarious workers form new groups vulnerable to poverty, alongside the elderly and poorest families in rural areas and suburbs of the cities (Ibid).

For Sao Tome and Principe, national reports show that the poverty situation has worsened. Available data indicate that more than one quarter of the population is poor and about a third are at risk of poverty. The country is also highly dependent on imports, both in budgetary terms and in terms of food aid. The main difficulties the country is low agricultural production, high inflation rates, high costs of inputs, inability to generate employment, the value of the currency instability, inability to secure financial stability mechanisms, inadequate socio-economic infrastructure, exodus rural and unequal access to resources. The poverty situation in East Timor is equally serious. About 80 % of the poor live in rural areas and the levels of food and nutrition

insecurity are increasing. Despite the revenue sources of oil (97 % of total budget), the country is still highly dependent on foreign aid” (Pinto, 2011:8)

#### **2.2.5.4 Food security in Southern Africa in 2001 to 2003**

The human right to food, understood as the right to food security is an integral part of the right to development, which involves the analysis of the conditions that produce and perpetuate hunger, as a strategy of denial of access conditions for developing countries, and regions people. For the World Bank food security is the permanent access of all people to sufficient and healthy food (Rocha, 2008).

According to the Forum for Food Security (FSA, 2004) that took place from 2001 in the Southern African widespread food crisis and the response of food region to cope with this scenario because the crops declined in some countries also failed. Food prices increased considerably. The poor became unable to buy food, and so go hungry or even starve, because it began to issue statements from national and international emergencies to support those needy countries. In 1991-1992, the Southern African region still suffered a much harder blow, thus making the population more food insecure due to a combination of increased vulnerability to weather, economic and social trends. Strengthening food security is likely to be achieved through a combination of production, marketing and interventions based on consumption.

A long-term commitment to social protection for those who are unable to feed themselves, and more productive subsistence agriculture, and more markets running efficiently, not only responding to temporary starvation which may conflict effectively treat high levels of food

insecurity in the long run (Toit, 2011). Yet, for South Africa, food security is widely considered not to be a problem.

Hart et al (2009) South Africa seems to have a robust national food security but cannot be confirmed with the rural families. Therefore, it can be considered that the country is widely considered safe and can produce enough food or because of basic capacity to import food, if necessary, in order to meet the basic nutritional needs of their population. A recent poll by Statistics South Africa shows that about 20 % of South Africans have access to inadequate or severely inadequate food. The General Household Survey report indicates that in 2008 the problems of access to food were serious, where 33.5 % of households have access to inadequate supply by an estimated 40 million people in 2009, with a growth rate of 1.7 % per year. In short there are no clear statistics to ensure that food insecurity is the same at the household level (Toit, 2011).

#### **2.2.5.5 Challenges to Food Security in Africa**

The biggest challenge for food security in Africa has been the weak development of the agricultural sector which is characterized by overconfidence and area of subsistence agriculture, low fertility soils, minimal use of external inputs, agricultural, environmental degradation, loss significant food crops, both pre and post-harvest value addition of minimum and product differentiation, and inadequate storing food preservation which result in a significant price fluctuations. (Muanik, 2003) Further to ninety-five percent of the food in sub-Saharan Africa is grown under rain fed agriculture. Hence food production is vulnerable to adverse weather conditions. There is an overall decline in investment in agricultural inputs, including fertilizer, seed and technology adoption. Access to fertilizer use is limited by market liberalization and

trade policies that increase fertilizer prices relative to commodity prices, limited access to markets and infrastructure, limited development of production, inputs and credit markets, poverty and cash constraints that limit the ability of farmers to purchase fertilizers and other inputs. Soils continue to deteriorate leading to a reduction in productivity of farms. Some of the causes of the depletion of soil fertility in Africa include the limited adoption of fertilizer replacement strategies and measures to conserve soil and water, the decline in the use and duration of fallow periods (Ibid), the expansion of production agriculture in marginal and fragile areas, and removal of vegetation through overgrazing, logging, development and domestic use. Other causes include rapid population growth, limited access to agriculture -related technical assistance and lack of knowledge about management practices on fertility of soils leading to profitable growth in less favorable lands. A significant amount of the food is lost during the harvest because of the existence of pests and diseases that compete to decreased production during this process. From various authors it becomes clear that Africa has a lot more complicated agricultural system due to the existence of different systems, which is called heterogeneous.

### **2.3 Household food and food security**

Maxwell & Smith (1990), in their paper on the conceptual framework of food security, dealt with sufficiency, access, security and time. They point out that different authors defined the concept of “enough food” differently. However, for this research, the concept of enough food was referred to as that which should “supply needed food for all family members to live healthy, active and productive lives” (Maxwell & Smith, 1990:8). The individuals that make up a household are thus critical. Enough food should be that amount which is sufficient to adequately feed adults and children. It should supply calories that are adequate to nature a healthy body

irrespective of age. The individuals in the household should affirm that the food is enough and this does not include excess food that the household may wish to sell. This implies that from the household's perspective, food security means that there is enough food for the family. Food is basic human right and access to food influences the poverty level of people. Maxwell & Smith (1990:10) went further (to distinguish the poor and the "ultra-poor" using the concept of nutrition. Lipton defined the ultra-poor as "those unable to produce 80% of calorie requirements with 80% of income, the so called "80/80 rule". Lipton went on state that "the ultra -poor behave differently to the poor are at sharply greater risk due to hunger and illness" (Maxwell & Smith, 1990:10). The population of Mozambique, from general knowledge and various authors, live far below the poverty datum line. In central Mozambique many households live in shanty houses and a lot of their children do not attend school. This was one of the main motivators of this research which was centred on cereal production potential analysis. This research thus attempted to find out if household farmers in central Mozambique had the potential to produce enough food for their families as well as excess food that could ensure food security at national levels.

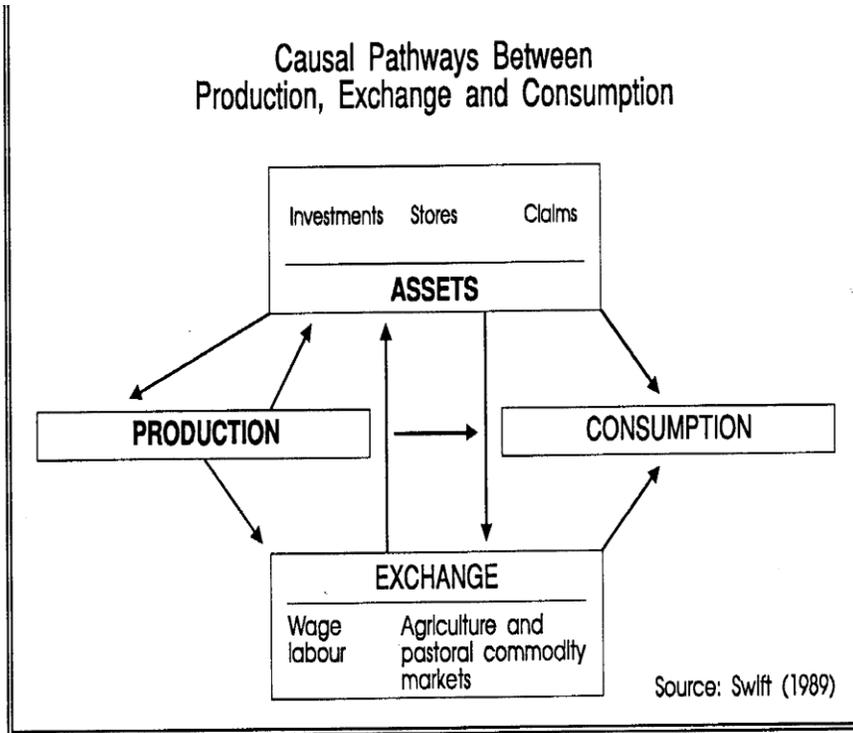
Another aspect covered by Maxwell & Smith (1990) was access. This notion is based on whether individuals and households (and nations) are able to acquire sufficient food (Maxwell & Smith: 12) Maxwell & Smith (1990) cite Clay (1983:10) who argue that "food security is a problem most often conceptualized as a macro phenomenon. ....However, as a human problem it is primarily one of the welfare vulnerability of distinct categories of people within the population....the urban poor, rural landless and small or marginal farmers". Maxwell and Smith further expressed that an individual's entitlement (ability to access) "is rooted into his/her endowment – the initial resource bundle – which is transformed via production and trade into food or commodities which can be exchanged for food". Farmers have resources some of which

are critical to agricultural production and the importance to rural farmers in Africa in general and central Mozambique in particular, was the availability of farm implements which include ox-drawn or mechanical ploughs, harrows, planters, implements used for pest control and storage. It is critical in the analysis of the potential for cereal production in central Mozambique, to examine the availability of these implements on the household farms. These resources are the agricultural production assets that the farmers own among various other assets that the farmers may possess.

In their evaluation of the access variable, Maxwell & Smith go on to quote Swift (1990) who focused on “the role of investments, stores and social claims in determining household vulnerability to famine”. They consider community support as one of the assets as it is a “buffer which people can use against entitlement failure” and they argue that the poorest farmers have the least assets. They also add that entitlement can be a result of production, marketing or inheritance.

Swift (1989:12) assumed that “when households are able to generate a surplus over and above their basic food requirements, the excess resources are diverted into ‘investments, stores and claims’ which can be drawn down when the households face a crisis. It referred to these as causal paths between production, exchange and consumption, and illustrated this in his model as shown in figure below.

Figure 2.1: Causal Paths between Production, Exchange and Consumption



Source: Swift (1989) Maxwell & Smith (1990:13)

This model was borrowed in this research and questions were drawn to verify the quantities (and qualities) of assets the household farmers of central Mozambique possessed. From this model it can be seen that there is a direct relationship between assets and production. Production can enable farmers to amass assets while assets can also facilitate and/or encourage production.

Maxwell & Smith (1990) brought out another aspect of food security which they termed “security”. They argued that “the most secure households are those which achieve adequate access to food while using only a small proportion of resources; the most food insecure, the most at risk, fail to achieve adequate access even by devoting a large proportion of available resources

to food”. This research went on to find out the level of resource utilization by household farmers in the central district of Mozambique. Effective and economic resource utilization in agricultural production should enable the farmers to achieve maximum productivity and avoid food deficiencies.

However, for agricultural production to be achieved there is need for a secure environment as well. A politically secure environment with minimal conflicts needs to be assured in agriculture. As Maxwell and Smith put it, “A food secure environment is clearly an important determinant of adequate dietary intake”. Where there are conflicts or wars this secure environment may be difficult to achieve. Where there is war for example, people may abandon their land and go to safe areas where they will be treated as ‘refugees’ or even ‘squatters’ thus losing not only their status but their ability to utilize their land. Conflicts may equally delay production or discourage agricultural production. For example, in Zimbabwe, since the land redistribution of 2002, there have been conflicts in land distribution resulting in scarcity of resources and other economic challenges which have seen the former “bread basket of Central Africa” importing maize and other food items from its neighbours, Mozambique included (The Standard, and other news items). Maxwell and Smith went on to illustrate these aspects by a table as illustrated in the following table.

Table 2.2: Risks associated with Agricultural Production

SOURCES OF RISK TO HOUSEHOLD FOOD SECURITY					
Sources of Entitlement	Types of Risk				
	Natural	State	Market	Community	Other
Productive capital(land, machinery, tools, animals, farm buildings, trees, wells, etc.)	Drought contamination (for example, of water supplies) Land degradation Fire Flooding	Land or other asset redistribution/confiscation	Changes in costs of maintenance	Appropriation and loss of access to common property resources	Loss of land as a result of conflict
Non-productive capital (jewellery, dwellings, granaries, some animals, cash savings)	Pests Animal disease	Compulsory procurement Villagisation Wealth tax	Price shocks (for example, falls in value of jewellery and livestock) Rapid inflation	Breakdown of sharing mechanisms (for example, communal granaries)	Loss of assets as a result of war Theft
Human capital (labour power, education, health)	Disease epidemics (for example AIDS) Morbidity Mortality Disability	Declining public health expenditures and/or introduction of user charges Restrictions on labour migration	Unemployment Falling real wages	Breakdown of labour reciprocity	Forced labour Conscription Mobility restrictions Destruction of schools and clinics during war
Income (crops, livestock, non-farm and non-agricultural activity)	Pests Drought and other climatic events	Cessation of extension services, subsidies on inputs or price support schemes Tax increases	Commodity price falls Food price shocks		Marketing channels disrupted by war Embargoes
Claims (loans, gifts, social contracts, social security)		Reductions in nutrition programmes (for example school feeding, supplementary feeding)	Rises in interest rates Changes in borrowing capacity	Loan recall Breakdown of reciprocity	Communities disrupted/displaced by war

Source: (Maxwell & Smith, 1990:16)

As illustrated in the above table, Mozambique is susceptible to various conflicts, most outstanding being the war between Renamo and the ruling Frelimo. War has negatively affected agricultural production, with people being displaced to neighbouring countries and losing their land rights in some cases. Thus conflicts have a negative impact on the productive sector, particularly agriculture resulting in high levels of food insecurity. Last but not least, Maxwell

and Smith (2012) looked at time as a critical component in achieving agricultural productivity which contributes to food security. ‘Time’ in this context refers to access to food at all times. (Maxwell and Smith: 15), and they go on to state that food insecurity can be divided into cyclical and temporary food insecurity. Temporary food insecurity occurs for a limited time because of unforeseen and unpredictable circumstances; cyclical or seasonal food insecurity when there is a regular pattern in the periodicity of inadequate access to food.” (Maxwell and Smith: 15). Both temporary and seasonal food insecurity may be a result of poor food storage techniques or weak infrastructural development (ibid). This research analysed cereal production potential in central Mozambique with the view of encouraging food security in Mozambique.

#### **2.4 Strategic Cereal Production and implications for food security**

Mozambique has experienced rapid economic growth over the last decade this was supported by “Gross National Product (GDP) of 8.4 percent per annum from 2003–2007 with agriculture alone being 7.4 percent (Ibid). The world recession of 2008 Mozambique experienced its share.” (Pauw, Thurlow, Uaiene & Mazunda, 2012:2) The occurrence of the 2008 drought “affected many farming households in the central region, which explains the sharp increase in poverty there despite the region’s agricultural sector being one of the better performing ones during 2002–2008.” The country also suffered the recession which affected the whole southern Africa region and the drop in world prices had a negative effect on the economy which led to a slowdown in GDP growth during 2007–2009 of 6.3 percent (ibid). Pauw et al (2012) went on to state that GDP recovered during 2009–2010. They point out that “although never an outright priority in terms of the country’s development strategy, the agricultural sector has always played an important role in the Mozambican economy.

Paul et al (2012) who supports that the during the 1990s there was strong growth in the agricultural sector, which accounted for roughly one-quarter of GDP and employed 80 percent of the adult population while contributing to the great strides made in the fight against poverty. This study aimed at revealing the cereal production potential in central Mozambique where there are vast fertile soils and abundant water resources.

In Mozambique, agriculture is still a vital income source for the majority of the population. In 2011 therefore, Mozambique launched its Strategic Plan for Agricultural Development (PEDSA) (Ministry of Agriculture 2011). The document spells out the country's vision of transforming the agricultural sector from being predominantly a subsistence farming industry to becoming a competitive and sustainable sector that would contribute to food security and raise incomes of rural households. Paul et al (2012). This was a positive step in encouraging agricultural production in the central region of Mozambique as well. Paul et al (2012) proceed to expatiate that "in parallel to PEDSA, the New Partnership for Africa's Development (NEPAD) is implementing the Comprehensive Africa Agriculture Development Program (CAADP) in partnership with various African governments, including Mozambique. CAADP supports the identification of an integrated framework of development priorities aimed at restoring agricultural growth, rural development and food security in the African region. Although the main target of CAADP is achieving six percent agricultural growth per year, Mozambique's PEDSA document sets this target at seven percent." This research on a critical analysis of the potential of cereal production in central Mozambique was in a way, a positive step in evaluating the applicability and implementation of such strategic and key developmental strategies particularly for Mozambique whose majority population still lives in dire poverty and frequently suffer from malnutrition, hunger and strife. Achieving food security is key for Mozambique.

Agriculture is an important sector for any country since agricultural produce can be consumed by the household producers, or marketed individually. Excess produce can be used for national reserves to ensure national food security or for export. This means that agricultural production not only benefits the individual households financially and for as a source of food, but it can increase a country's GDP as well. Households benefit from agricultural production through reducing hunger, starvation and malnutrition as well as contributing to their economic well-being. For typical agro-based households, agricultural produce is a source of money that they use to buy inputs, to pay for labour, to educate their children and to buy supplementary food items and clothing. Thus designing and implementing a strategic agricultural plan is of paramount importance not only for central Mozambique cereal production but for the entire country's benefit. It is through such strategic focus that government could intervene in production and marketing initiatives which would benefit the whole nation and other countries as well.

## **2.5 Farmers Competitiveness and Food Security**

The farmers' competitiveness and food security is composed of the following determinants like; of competitiveness, controllable factors by firms/farms and determinants beyond firms /farms control.

### **2.5.1 Determinants of competitiveness**

Determinants of competitiveness may be investigated with the help of an econometric regression of the scores obtained for the observations over a set of explanatory variables. This approach is standard in the efficiency and productivity literature, and has also sometimes been used to explain cost measures of competitiveness. In the case "of investigating the determinants of

technical efficiency scores calculated, the standard model used in the second-stage regression is Ordinary Least Squares (OLS). However, the bounded nature has prompted researchers to use other models that can take this into account. The literature is not, however, clear whether the efficiency distribution is censored.” (Latruffe, 2010:31)

### **2.5.2 Calculations on separate samples**

The investigation of farm competitiveness can be performed for separate groups of farms, and their competitiveness levels compared using statistical tests. For example, it is common to calculate technical efficiency for farms separately according to their specialisation (Latruffe, 2010), their technology or their legal status). In general, such separation is done on the grounds that production technologies, and therefore, efficiency frontiers, differ between the samples. In the case of farm-level data, the separation of farms according to their specialisation (Latruffe, 2010:32).

### **2.5.3 Cluster analysis**

According to Latruffe, (2010) Clustering implies grouping observations that have similar characteristics based on their relative distance from each other. In the farm productivity and efficiency literature, two methods can be found. In the first, farms are clustered on the basis of several characteristics of the farms and farmers, and then the average performance scores of each Cluster is compared using statistical tests). In the second method, the opposite is done: clustering is performed on the basis of several performance indicators, and then the average of several characteristics of the farms and farmers are compared among the clusters (Ibid)

#### **2.5.4 Determinants controllable by firms/farms**

The question of whether small farms perform better than large farms is still a topical issue in the world. The debate started with the empirical evidence of an inverse relationship between farm size and productivity. The main argument used to explain this relationship is that small farms are not affected by labour supervision and organisation problems and that family labour is highly motivated as it stands to benefit from farm profits.

However, the inverse relationship between size and performance is regularly questioned, as large farms are claimed to achieve economies of scale and to benefit from preferential access to output and input markets. Although the debate initially started for developing countries, it intensified after the fall of communism in CEECs. The co-existence of very small subsistence farms and large corporate holdings at the beginning of the transition raised the issue of which farm size would prevail after restructuring. The link between farm size and competitiveness is particularly important in assessing directions of structural change. The effect of farm size on technical efficiency, a locative efficiency or on productivity change is investigated using various indicators of size, since there is no consensus on the best measure for size in agriculture. Indicators used include: total output produced. Effect of size on other measures of farm competitiveness, in their review of several studies that have investigated the international competitiveness of agriculture using DRC ratios between 1992 and 1998, report that a few studies investigated the “relationship between international competitiveness and farm size, by calculating the DRC ratios for various farm size categories, where size is measured in hectares. Results indicate that larger farms were more internationally competitive than smaller farms within the arable sector” (Latruffe, 2010:33)

According to Latruffe, (2010) resorting to factors external to the farm is often considered as a determinant of farm technical efficiency. For this, the share of hired labour in total farm labour, the share of rented land in total land used, and the indebtedness level (measured by the level of debts or the debt to asset ratio) are used in the regression of technical efficiency. Conflicting results are found regarding the share of hired labour and rented land. Hired labour may that will imply better educated workers or workers with specific skills, but may result in supervision problems. Renting land may give farmers an incentive to be productive in order to pay rentals, but may prevent them from applying long-term improvements. An ambiguous effect also holds for the indebtedness level. Some researchers report that indebtedness has a positive impact on technical efficiency for Czech livestock farms. This suggests that farmers who are indebted need to meet their repayment obligations and, therefore, are motivated to improve their efficiency. However, highly indebted farmers might incur high credit costs and thus be less technically efficient.

Several authors have investigated the effect of farm specialization on technical efficiency. Farm specialization might be beneficial to technical efficiency since it enables farmers to concentrate their attention on a few tasks, and therefore, improves management practices. It also avoids conflicts in crop rotations, and prevents competition for the same resource, such as land.

The impact of a high degree of commercialisation (in contrast to subsistence farming) on farm technical efficiency is often “investigated for transition countries. The impact can be expected to be positive in the sense that commercialisation increases the cash proceeds and therefore, allows farmers to purchase high quality inputs” (Latruffe, 2010:35).

### **2.5.5 Determinants beyond firms /farms control**

A nation's competitiveness is largely determined by factor endowments, and by demand conditions (that is the population's tastes and preferences for products), as suggested by Porter (1990). Although not referring directly to the concept of competitiveness nor to any measures explained in Sections 2 and 3, (Peterson & Valluru, 2000) investigate the determinants of agricultural trade patterns using aggregated data for 40 countries in 1992. In a simple regression on net trade flows, the authors include as explanatory variables: four categories of the national area based on climatic differences; the national capital stocks (estimated from gross domestic investment); the number of workers in the country according to three classes (skilled, agricultural, and other workers); and national energy reserves. Results indicate that the endowment of skilled labour increases net trade flows of grain, oilseeds, cotton and fresh meat products. Only for the latter does the number of agricultural workers have a positive influence on net trade flows. By contrast, capital endowment has a negative impact on the net trade flows of grain, oilseeds and cotton, being thus a source of comparative disadvantage. "As for sugar, only the type of land significantly influences its net trade flow. For the whole agricultural net trade flow, the significant sources of comparative disadvantage are capital endowment and the number of other (i.e. unskilled, not agricultural) workers, and significant sources of comparative advantage are two categories of land" (Latruffe, 2010:37).

The strong competitive position of the Italian pasta processing sector during the period 1988-92 is due to the increasing perception by consumers that pasta are a healthy (low-fat, low-cholesterol, low-calorie) food, in other words is due to the increasing sophistication of

consumers. As Porter (1990) underlines, the presence of sophisticated and demanding buyers is important in creating and sustaining competitive advantage (ibid).

According to Latruffe (2010:40) “The policy variable used, namely the ratio of capital subsidies to total investment costs (which the authors call the rate of assistance) has a negative influence on the technical efficiency. Analysed the impact of environmental regulations on the profitability of the Mexican. In addition, they analysed the impact of the environmental regulations on the productivity growth in these sectors during 1971-94.” Their econometric regressions based on the countries’ data reveal that pollution abatement expenditures, the proxy for environmental regulations, had a negative impact on both performance indicators in Mexico, but no significant impact in the United States. Analyse the effect of trade liberalisation of five food processing industries in 34 countries (developed and developing) with annual data during 1993-2000. Using a second-stage regression with imports as explanatory variables, the authors showed that a greater exposure to trade increases productivity, a process that is faster in low productivity countries than in high productivity countries. Based on a survey of the opinion of 63 stakeholders in the food industry, conclude that regulation in the sector (which they claim is the third most regulative after the automotive and the chemical sectors is not a strong obstacle to the competitiveness of the food sector (ibis).

## **2.6 Mozambique Cereal Production Trends and Implications for Food Security**

Cereal production in Mozambique differs by regions. After studying the agricultural production trends of maize, rice and wheat, (Biacuana, 2009:2) brought out that “the north and to a lesser extent the centre are food surplus regions, while the south is a food deficit region”. The different agro – climatic conditions affect these regions differently and hence influence the agricultural

output differently. Biacuana goes further explaining that “Cereal production has shown a consistent upward trend between 1990 and 2008, except for a dip in 2001 and 2002, caused by floods.” He notes however, that the increase in cereal production was more from increased land allocated for agricultural production “as opposed to improvement in or increased use of modern.

The production techniques and technology, i.e., fertilizer, improved seeds and so forth (ibid) “this kind of growth depends on only one factor and may thus be unsustainable and this means that the upward trend cannot be relied upon by government, researchers and other organizations or institutions as being reliable “to solve the current food security problems that the country faces, unless new productivity enhancing investments is made in agriculture” (ibid).

According to Selvester & Castro (2004:6) in 2001/02 “ Mozambique experienced serious crop losses in the south of the country to drought with around one third of the expected harvest being lost in that region. In the north, however, harvests were good, so good that as much as 200kt of maize are reckoned to have been exported informally to Malawi.” This has been of little use to the south, since it is so expensive to ship grains from the north to the south because of the poor communication infrastructure. The southern districts and a few in centre-interior have seen food availability fall disastrously low in 2002. To make matters worse these are areas that were hit badly by the floods of 2000, from which households have been making a slow recovery. By early 2003, some 650,000 persons in southern and some central districts were in need of food assistance. In addition to the 53kt of food aid delivered under the UN Emergency Programmed (EMOP) 10200 by late 2002, another 31kt were needed through to March 2003. To put this in context, the numbers in need are just 3% of the population. Of the six countries in the EMOP, Mozambique is the least badly affected (ibid).

## **2.7 Farmers Knowledge as a Factor of Food Security**

According to Agea et al (2008) farmers' knowledge was directly related to high productivity and food security. Their findings included that people of the studied village in Uganda shared a lot of traditional ways of production, fertilization and pest control. Whereas the young respondents preferred modern (western) methods of these processes, the older farmers preferred to use organic manure for fertilizer, traditional pesticides, and sun drying of maize and other crops for preservation of their produce which they stored in sacks or traditional granaries (ibid).

At the launch of a four-year strategic plan, launched by the African Forum for Agricultural Advisory Services (AFAAS) at its General Assembly in Accra, Ghana, in April 2011, it was agreed that knowledge sharing was critical for the achievement of agricultural production in Africa. It stated that "agricultural advisory services should effectively and efficiently contribute to sustained productivity and profitable growth of African agriculture". This was in line with the Comprehensive African Agricultural Development Programme (CAADP) which originated from the New Partnership for Africa's Development which seeks to raise agricultural productivity by at least six per cent by 2015.

This research drew from these studies similarities that occurred in the cereal production in central Mozambique. The farmers in the districts under study were typically rural farmers and the findings were thus very relevant for increasing productivity, improving farmers' incomes and knowledge base as well as for use as strategic measure to create buffer stocks that ensure food security.

## **2.8 Disease Management in Cereals and implications for Food Security**

Plant diseases affect crop production in any country. At the present time, the threat of plant disease is particularly great in developing countries, where populations are growing fastest, poverty is endemic, the population depends on locally produced staples, and the infrastructure of extension and R & D is often poorly resourced (Strange, 2005). According to Strange (2005), plant diseases are caused by a vast number of plant pathogens from viroids of a few hundred nucleotides to higher plants. Plant diseases cause crop losses ranging from small volumes to “catastrophes in which large areas planted to food crops are destroyed. Catastrophic plant disease exacerbates the current deficit of food supply in which at least 800 million people are inadequately fed (ibid). Strange (2005) goes on to explain that “plant pathogens are difficult to control because their populations are variable in time, space, and genotype. Most insidiously, they evolve, often overcoming the resistance that may have been the hard-won achievement of the plant breeder. In order to combat the losses they cause, it is necessary to define the problem and seek remedies. At the biological level, the requirements are for the speedy and accurate identification of the causal organism, accurate estimates of the severity of disease and its effect on yield, and identification of its virulence mechanisms”(ibid).

Mechanisms of plant disease control should be a priority to all stakeholders involved in agricultural production. Diseases affect all plants irrespective of where they are grown and the seed types or varieties. Thus, to increase productivity and curb against food insecurity concerted efforts must be put in place by government and research institutions to initiate effective policies and structures that are proactive to disease control. In this research farmers in the central region

of Mozambique were asked about the mechanisms in place to combat plant disease and recommendations made accordingly.

The Climate variability and climate change, and in particular the inability to predict or respond to growing season weather, are major threats to the profitability and even the viability of farming operations. This is the case in both developed and developing countries, although in developing countries the farmer's livelihood is more affected by individual crop failures. In real-life situations, climate variability and climate change occur simultaneously, with long-term natural cycles or permanent changes being super-imposed on short-term variability. However, adaptation to climate variability and climate change involves different approaches for different stakeholders. Adaptation to climate variability requires a range of on-farm management practices to protect farmers from adverse consequences. Climate change has additional local implications such as time of planting and choice of crop type or variety, and Government policy implications regarding water availability and areas suitable for cropping. "Climate change may result in changes in the temporal distribution of meteorological variables during the crop growing season. One particular concern is that crop phenological development, which is largely determined by temperature and photoperiod, may be out of phase with rainfall and hence water availability during critical periods of grain yield determination" (Huda, Sadras, Wani, 1797:37).

The physical, economic access to food is a right for all people in all times and all over the world. For example, based on the concept of nutrition security, which involves physical and economic access to balanced diet and drinking water for all people at all times. And this organization further emphasizes the relevance and impact that water has on the world. The nutritional security is essential to give children an opportunity for the full expression of their genetic potential for

physical and mental development. In other words, to win the battle against hunger, we must fight against "hunger" for jobs. An integrated program of work, wages (that is the application of the minimum wage) and welfare measures in the fields of public health, sanitation, drinking water and education are essential for this purpose (Adrian, 2010).

To further underline the problem of economic inequality and influencing for the reduction of production of cereals in the world is increasingly reducing the biological potential of the soil, loss of biological wealth , deforestation, depletion of water resources of the soil occurs, pollution and the growing imbalance between carbon emissions and carbon absorption leading the world to the situation where the protection of ecologically-based agriculture can become the most important challenge of food security . It is clear that economic and ecological obligations must go together to achieve sustainable food and nutrition security. The Food Security Act 1985 of the United States is a good example of an integrated approach to the production, preservation and consumption. It would be advisable for all countries to adopt similar legislation, which can provide the essential legal framework for sustainable advances in both biological productivity and to eliminate chronic hunger. Since the World Bank are deeply concerned with public policy decisions necessary to stimulate greater production of 4 per small farm families based on ecologically sound and according to Adrian (2007) technologies to be the proportion of greater access to better diets quality for the rural and urban poor.

Some of the most profound and direct impacts of climate change over the coming decades will be in agricultural and food systems (Caster & Tirado, 2008). Therefore, noted that quantitative evaluations show that climate change will adversely affect to some extent in large scale food security in the world negatively affect food security. Thus, it appears that the increase in

temperature and so uncertain rains that fall into moments that have influenced producers are desperate enough in food production. These changes added a greater severity of pests and diseases are among the most drastic changes that also contribute and affect the production of cereals and not only, but also for food in general. However, the overall trends hide huge regional differences, with the poorest of greater risk, both by global climate variations and fluctuations in global commodity prices. Some of the major effects of global climate change will be felt among small farmers, especially in developing countries. It is anticipated that the probability of more heat waves, floods, droughts and other climate throughout the 21st century (2007 Parry et al). This panel was shown that in 2008, the poorest 40 countries, located predominantly in tropical Africa and Latin America, may lose 10-20 percent of their basic ability cultivation of grains due to drought. The biggest problem for food security will be provided for an increase in extreme weather conditions, which will damage crops in policies.

## **2.9 Theoretical Framework**

This section of review of related literature examined the theoretical perspectives that are pertinent to the production of cereals. It covered the economic theories of the household and household theory and models. However, from these theories, only literature related to cereal productions were discussed.

### **2.9.1 Economic Theories of the Household**

In his working paper on Economic Theories of the Household: A critical Review Wiro, (1999:1), states that “the economic theories of the household try to capture the complex structures of households and their behaviour” and went on to discuss the household economic models under

two types, the unitary model of household behaviour and, collective models of household behaviour according to Alderman et al (1995 cited in Wiro, 1999:1). However, this research borrowed from only the “Household as a producer” for discussion in this section.

According to Wiro (1999:2) views about the unitary model indicated that the model “sees the household not only as a consumer, but also as a producer”. In this regard, the household is perceived as an entity which, within a given time, “has limited resources, but also alternative uses and fixed technologies for home production” (ibid). However, a household is different from a firm (entity) in reality. The firm is established to maximize profits while a household is made up of family members whose objective is mainly social; firms employ people who are paid a wage or a salary while in a household there might be parents, children and others who interact on a daily base or frequently but without any remuneration. However, some households are actively involved in substantial agricultural production and may contribute significant volumes of grain for consumption as well as for sale.

Wiborg, (1997:137-145), states that within primary industries, the household unit has been especially important with respect to resource management and production. Due to both external and internal influences, the position of the household in relation to agricultural work has experienced a transformation. The external influences arise from economic restructuring, while the internal influences concern the gendered division of work and the management of gender identity and changes in national agricultural policy. Agricultural work is now primarily one man’s work, while housework is, at least at the symbolic level, a task where both husband and wife work together. This division of work is not only a question of finding instrumental solutions

to practical and economic challenges; it also involves cultural codifications of different tasks which vary between nationalities, communities, and cultures.

### **2.9.2 Household Production Theory and Models**

Household production theories and models discuss household behaviour in various aspects of production. Many authors focus on various aspects in their discussion of the household production theory and models. For example, Hamermesh, (2006), in his paper, focused on “Time to eat: Household Production under Increasing Income Inequity” while Huffman, (2011), focuses on demand for food and consumption time. However, in their discussions these authors bring out critical issues concerning household decisions and resource allocation in addition the demand analysis. Huffman (2011), in his paper on Household Production Theory and Models, Becker (1965 cited in Huffman, 2010) as “best known for modelling household decisions and resource allocation in a model where a household is both a producing and consuming unit.” This implies that households are not consumers only; they are actively involved in the production process. In reality however, some households can produce surplus which they can sell in the common market. In addition, households use substantial resources in the production process including but not limited to financial resources, time and labour (physical and mental effort) which require separate research to analyse.

Mendola (2007), developed three models to explain peasant farmers’ behaviour. Peasants are farm households who own a piece of land and utilize mainly household labour in farm production. She further argues that agricultural production is significantly dependent on the performance of farmers and at the same time, poverty is disproportionately concentrated among them. Ellis (1992, cited in Mendola, 2007:9-10) stated that peasant farmers are “located in a

large dominant economic and political system that could affect their production behaviour, but fundamentally they are characterized by partial engagement in markets which are imperfect or incomplete. In addition, Hunt (1991) cited in Mendola (2007) stated that who identifies peasant farmers as “both production and consumption units; a proportion of produce is sold” by these farmers.

According to Mendola (ibid), three models that explain the peasant farmer’s behaviour are the Profit-maximizing Peasant Theories, Utility Maximizing Theories, and the Risk-averse Peasant. These theories were summarized in this section for the purpose of this research.

### **2.9.2.1 The Profit-maximizing Theories**

In developing these theories, Mendola (2007) cites Schultz’s (1964) hypothesis that says farm households in developing countries are “poor but efficient”. The peasant production mode as profit-maximization behaviour where efficiency is defined in a context of perfect competition that is, where producers all apply the same prices, workers are paid according to the value of their marginal product, inefficient firms go out of business, and entrepreneurs display non-diminishing marginal utility of money income. However, this model was largely criticized for its lack of analysis of the existence of trade-offs between profit-maximization and other household goals, and the role of uncertainty and risk in farm household production decisions. This research tried to exploit the possibilities of this model in household cereal production given the resources the farmers in Central Mozambique utilize especially in view of policy makers’ interventions that would assist in increasing the output of peasant farmers; possibly by offering financial and other facilities.

### **2.9.2.2 The Utility Maximizing Theories**

Utility maximization models differ from profit-maximizing theory in that they encompass the dual character of peasant households as both families and enterprises and thereby take account of the consumption side of peasant decision-making. Mendola, (2007) in the Asian Development Review (2007). According to Mendola (2007), “the seminal work of Chayanov in the 1920s emphasized the influence of family size and structure on peasant economic behaviour ...” The author went further to explain that in the 1960’s the neoclassical farm household model became popular in explaining the behaviour of farm households in simultaneous decision-making about consumption and production. Mendola (Ibid) went further to quote Becker (1965) as revealing that this model typically incorporates the notion of full household income and conceives of the household as a production unit that converts purchased goods and services as well as its own resources into used values and utilities when consumed. In practice however, cereal production (and consumption) can be from subsistence farmers or commercial farmers. The main difference is that subsistence farmers use their limited (and usually scarce) inputs to produce and may consume part or all of their produce. Commercial farmers on the other hand, may borrow inputs and produce bulk which they sell due to the large pieces of land which they utilize. Commercial farmers use mechanized means of production which may be sophisticated while subsistence farmers produce on small pieces of land tilled either manually or simple and smaller machines. The other difference is that commercial production employs paid labourers while in subsistence farming free labour is used from the household members. In addition, subsistence farmers have to store their own produce until the next harvest or else they struggle to replenish their consumption supplies while commercial farmers usually sell all they produce and rely on the market for their consumption requirements. Thus, this model suites the subsistence farm

production since the household maximizes utility through the consumption of all available commodities subject to full income (inputs) constraints (Mendola, 2007).

### **2.9.2.3 The Risk-averse Peasant Theory**

In this research, this model was applied to the extent to which the farmers under review accessed and utilized the resources they apply in their cereal farming processes. Ellis (1992 cited in Mendola 2007) stated that peasants produce under very high levels of uncertainty induced by natural hazards (weather (floods/hurricanes), pests, diseases, natural disasters); market fluctuations, and social uncertainty (insecurity associated with control over resources such as land tenure and state interventions, and war). This concurs with what happens in practical household cereal production and thus, the farmers become risk-averse in making production decisions. This is substantiated by Lipton & Longhurst (1989) cited in Mendola, (2007) as purporting that small farmers are, of necessity, risk – averse, because they have to secure their household needs from their current production or face starvation. This research borrowed from these models in critically analyzing the potential of cereal production in Central Mozambique.

## **2.10 Cereal Production in the global Village**

This section discusses the cereal production patterns of the western world, Africa and Mozambique in general.

### **2.10.1 Production Trends**

According to Fara (2009) Africa remains one of the least contributors to global maize production. FAOSTAT shows that in 2008, North America recorded the largest production of

maize with about 38.8% of the global output. Asia (28.5%); South America (11.2%); Europe (11.1%); Africa (6.9%); Central America (3.4%); and Oceania (0.07%).” Maize production in Africa rose from approximately “31.7 million tons in 1986 to 48.9 million tons in 2006, representing a 3% annual growth rate within the 2-decade period. Annual growth averaged 3.5% between 1986 and 1996, but declined marginally to 3% per annum between 1996 and 2006. In 2006, maize production in Africa represented 5.5% of the global output”. Sub-regional analysis of maize production reveals that Southern Africa, Central Africa and West Africa are the main maize-producing sub-regions in Africa. The member States of these three sub-regions produce more than 65% of the total quantity on the continent. Maize production within the Central African sub-region was estimated at about 0.97 million tons in 2006, having increased from 0.75 million tons in 1986 at a growth rate of 6% per annum. Annual growth averaged 6.5% during 1986 – 1996, and fell by 3.9% during 1996 – 2006. Production within the Eastern African sub-region rose from 7.2 million tons in 1986 to 8.1 million tons in 1996, and subsequently declined to 7.8 million tons in 2006. Annual growth in production was quite low at 3% per annum during 1986 – 2006, representing 2.5% per annum during the 1986 – 1996 era, and rising to 4.2% per annum during the 1996 – 2006 periods.

### **2.10.2 Cereal Production World**

There has been a slowdown in the growth of world agricultural production, world cereal output stagnated and fluctuated enough in the first half of the 1990s. In 2012, cereal production, in terms of annual per capita of about 320kg, was lower than the peak of 340kg reached in the mid-80s (FAO, 2012). However, it should be noted that, in practice, progress in terms of food safety does not manifest itself as growing globally, on average (in view of the fact that the aggregate

production/consumption is increasing faster than the world population) and may progress to dwindle further even though the world average population growth stagnates or even decreases. So, in the last ten years, which have witnessed the decline in global production averages, there has not been any decline in per capita production of cereals in developing countries, while in all other products the growth has been even faster than in the previous ten years. The problem of developing countries remains the low production and per capita consumption (Ibid).

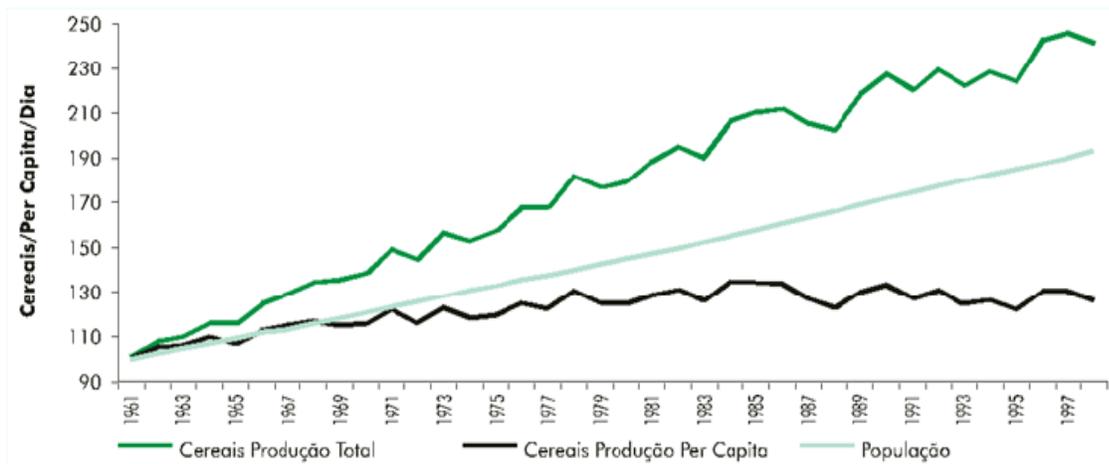
The level of World cereals constitutes the power base of various peoples and the most consumed are corn (maize), rice, wheat, barley and sorghum. The cultivation of these cereals is distributed according to favourable agro - climatic zones for the cereal cultivation. Thus, according to figures from the United Nations Food and Agriculture Organization (FAO, 2013), the total production of cereals in the world as at late September 2013, showed an increase of about 7%, compared to that of the period 2011/2012, and, this increase would create a spare capacity of global reserves and increase expectations of a more stable market for the 2013/2014 next marketing year. Furthermore cereal production is expected to reach a new record of 2,479 million tons, with wheat cultivation that individually would hit a ciphers of 704 million tons in 2013, thus representing an increase of approximately 6.8% (Ibid). This would allow the recovery in from the fall in the production of wheat in 2012 and would thus score an all-time record in the production of wheat in the world.

According to the same report (FAO, 2013), until September 2013, the world production of grains was calculated at 1,275 million tons, which would represent an increase of 9.7% from 2012 and only rice production would reach 500 million tonnes, equivalent to an increase of 1.9%. However, it has been noticed that the low-income countries with food shortage should

import 5% more cereals than in 2012, a situation which is contrary to the current rates of increase in cereal production recorded worldwide. On the other hand, countries such as Egypt, Indonesia and Nigeria should also import large amounts of grain, taking advantage of the international wheat prices, with the beginning of the harvest season in the northern hemisphere, creating in this way large reserves for years to come. However, it is important to note that the price of corn indicates a slight increase due to shortage of supply, while the price of rice remains stable and with reduction trends (FAO, 2013).

According to FAO (2013), the 8% increase in world cereal production experienced in year 2012, stems mainly from the expectation of increase of 11% in the production of secondary cereals (such as corn, barley and sorghum), which should reached 1.28 million tons. Parallel to this analysis, the United States, the largest global producer of corn, would be responsible for most of the increase, since it experienced a record harvest of 348 million tons of grain in 2013, a 27% increase over the previous period which was severely affected by a drought. Thus, the FAO forecasts for grain reserves by the end of the period 2013/2014, fell nearly 2 percent since September, where it was hoped that it would reach 559 million tons, representing 12%, that is, 62 million tons above its initial level thus becoming the highest since the 2001/02 marketing year. Forecasts project that the international trade in cereals in 2013/14 will reach 312.4 million tons, an increase of 1.6%, that is. 4.8 million tons in comparison to the past harvest, slightly above the expected indexes in September, also influencing trade in 2013/14, with benefits of a larger volume available for export of cereals, mainly secondary cereals (FAO, 1999). Figure 2.1 illustrates the changes in cereal production in the global village from 1961 to 1997.

Figure 2.2: Production of Cereals in the World (total per capita)



Source: Alexandratos, 1999

### 2.10.3 World Cereal Production Patterns

Various cereals are produced in the world. However, this section reviewed the production patterns of selected cereals.

#### 2.10.3.1 Patterns of change in maize production

According to Fara (2009) the patterns of maize production in Africa are analysed over a 20-year period (1986 – 2006) in order to identify policy options for developing the maize sub-sector. The analysis covers each of the five sub-regions of Africa whereby national data on maize production, area harvested and yield in each member state of the sub-region are aggregated into sub-regional data. Continent-wide aggregations are complemented with similar sub-regional analyses to demonstrate the diverse patterns of change in maize production in Africa. A “decomposition” method is used to analyse the absolute and relative changes in total maize production, attributable to changes in area harvested and yields. Changes in maize production

during the period 1986 – 2006 are decomposed into three effects, two primary effects involving area harvested (acreage) and yield (productivity) and one interaction effect. To isolate periods of real impact, the twenty-year period is divided into two ten-year periods, 1986 – 1996 and 1996 – 2006. The acreage effect is the change in maize production due to a change in the area harvested, holding constant the yield per hectare, while the productivity effect is the change in maize production due to a change in yield holding constant the area harvested. The interaction effect explains the change in maize production resulting from simultaneous changes in area harvested and yield. The interaction term may be positive or negative, depending on changes in the underlying variables during the period 1986 – 2006. Maize production within the Southern African sub-region rose from 13.5 million tons in 1986 to 15.9 million tons in 1996, and subsequently fell to 14.6 million tons in 2006, registering an average of 9% annual growth (Table and Figure above). “Production of maize in the West African sub-region totalled production of 11 million tons in 2006, up from 6.3 million tons in 1986. Maize production in the West African sub-region grew” (Fara, 2009:3-5).

### **2.10.3.2 Patterns of change in rice production**

According to Fara (2009) patterns of change in rice production in Africa over the last two decades (1986–2006) are analysed as a basis for identifying policy options for rice sub-sector development. The analysis covers each of the above RECs whereby national data on rice production, area harvested and yield in each member state of the REC are aggregated into sub-regional data. Continent-wide aggregations are complemented with similar sub-regional analyses to demonstrate the diverse patterns of change in rice production in Africa. A ‘de-composition’ method<sup>4</sup> is used to analyse the absolute and relative changes in total rice production, attributable

to changes in area harvested and yields. Changes in rice production during the period 1986–2006 are decomposed into three effects—two primary effects involving area harvested (acreage) and yield (productivity) and one interaction effect. To isolate periods of real impact, the twenty-year period is divided into two ten-year periods: 1986–1996 and 1996–2006. (Fara, 2009:2)

The acreage effect is the change in rice production due to a change in the area harvested, holding constant the yield per hectare, while the productivity effect is the change in rice production due to a change in yield, holding constant the area harvested. The interaction effect describes the change in rice production resulting from simultaneous changes in area harvested and yield. The interaction term may be positive or negative, depending on changes in the underlying variables during the period 1986–2006. Using (FAO, 2009) statistics, absolute and relative shares of each effect in the total change are calculated and used to compare, across sub-regions, the impact, and therefore the contribution, of each factor to changes in rice production in Africa. The analysis highlights the importance and magnitude of each factor and therefore underscores the need for policy options to address each of them.

### **2.10.3.3 Patterns of change in sorghum production**

According to Plessis, (1994:1) patterns of change in sorghum production in the recent years, there has been a shift in sorghum production from the drier western production areas to the wetter eastern areas. This change has resulted in the identification and development of cultivars which are more tolerant to lower temperatures. Sorghum belongs to the grass family, Graminea. It is essential that producers know the crop they are cultivating in order to develop the most effective production practices. The production of sorghum in South Africa varies from 100. 000 ton (13.000 ha) to 180.000 ton (150.000ha) per annum. The Free State and Mpumalanga

Provinces are the largest contributors to the area planted to sorghum and sorghum production. The roots of the sorghum plant can be divided into a primary and secondary system. The primary roots are those which appear first from the germinating seed. The primary roots provide the seedling with water and nutrients from the soil. Primary roots have a limited growth and their functions are soon taken over by the secondary roots. Secondary roots develop from nodes below the soil surface. The permanent root system branches freely, both laterally and downwards into the soil. If no soil impediments occur, roots can reach a lateral distribution of 1 m and a depth of up to 2 m early in the life of the plant. The roots are finer and branch approximately twice as much as roots from maize plants (ibid).

#### **2.9.3.4 World Production of Barley**

According to (EMBRAPA, 2013) is a cereal originating in the Middle East and is the fifth most important grain in the world after rice, corn, wheat and soybeans, with average annual production of approximately 140 million tons. The production of barley is concentrated in temperate regions of Europe, Asia and North America.

According to the same report, the harvested area of barley in the world significantly reduced over the past four decades, from 84 million hectares (1979/1980 campaign), to a current area of 50.4 million hectares (2010/2011 campaign). The decades of 1970 and 1980 presented the highest values of harvested area of barley in the world. The maintenance of harvested area and the increase in revenue resulted in upward growth of world production until the beginning of the decade to 1990. However, the highest amount was registered in the period 1990/1991, when 179.5 million tons were harvested. From the year 1990, the quantity produced showed a decline, mainly due to the reduction of sown area of this product.

One of the largest amounts of barley lies in food, in the form of malt used in the manufacture of alcoholic beverages, medicines, flour or flakes for the composition of infant feeding products, bakery and dietetic food. On the other hand, barley is used in the form of green foliage, hay, silage and grain when manufacturing animal feed, which constitutes the greatest worldwide use. According to data of the Agricultural Census (2009), in Brazil for example, producers of barley, consist of over 1,294 properties, of which 65.1% of these properties have a total estimated area of 10 to 100 hectares and 42.7% cultivate barley in areas less than 10 hectares. However, 58.3% of the production of this grain originated from properties with a total area of 100 to 1,000 hectares totalling 27.3% of total registered agricultural enterprises that produce barley. Still according to the same census, only 2.8% of the total area where barley was harvested was conducted with the use of irrigation, 87.5% with use of certified seed and there was use of chemical fertilizer in 95.5% of the harvested area. Regarding the fate of 56.3%, produce was marketed to cooperatives and 30.5% directly to industries. In Brazil, unlike other countries which find the alternative of producing animal feed more advantageous, the most economic application of this cereal is the use of barley for malt production. On average, 75% of the volume of barley produced annually in the country of South America is used in the manufacture to an average annual production capacity of 425 thousand tons of malt, which corresponds to approximately 38.20% of the national demand.

#### **2.10.3.5 Global Maize Production**

According to Fara, (2009) the maize, also called corn, is one of the most crucial and strategic cereal crops in Africa and the developing world in general. It is produced in different parts of the continent under diverse climatic and ecological conditions. Due to its increasing importance,

maize has become a major staple and cash crop for smallholder farmers. Maize is a preferred staple for about 900 million poor consumers and about one third of all malnourished children. It is estimated that by 2050, the demand for maize in developing countries will double by 2025 maize will have become the crop with the greatest production globally and in developing countries. Maize is also one of the most important commodities used for food aid. Since maize is cheaper than other cereals such as rice and wheat, it is more affordable to the vast majority of the population, and therefore occupies a prominent position in the agricultural development agenda of several countries in Africa. During the December 2006 Abuja Summit on Food Security in Africa, African Heads of State and Government identified maize, among other crops<sup>1</sup>, as a strategic commodity for achieving food security and poverty reduction and called on African This brief therefore analyses the changing patterns of maize production in African sub-regions, in response to the need for regional policies and initiatives that complement and countries (Fara, 2009:1), regional economic communities (RECs), the African Union Commission (AUC) and the New Partnership for Africa's Development (NEPAD) to promote maize production on the continent to achieve self-sufficiency by 2015 (Fara, 2009).

In order to ensure this it is important to understand the changing patterns in maize production on the continent. An analysis of the various forces that influence and shape the patterns of change in sub-regional maize production is important so that policies supporting increased maize production and marketing leverage national maize development efforts. It adopts compositional approach to analyze the aggregated trends in production; area harvested and yields in maize production in five sub-regions (Central Africa, Eastern Africa, North Africa, Southern Africa and West Africa). Individual country data for the countries of each sub-region are aggregated into sub regional data to establish trends in production, acreage, and yields. Changes in these

parameters are used to (i) determine the magnitude of effects attributable to each and analysed region (Fara, 2009).

According to (FAO, 2013) maize (*zea mays*), is a very cultivated cereal in much of the world and extensively used as human food or animal feed, due to its nutritional qualities. All the scientific evidence suggests that it is a plant of Mexican origin, since their domestication began 12,000 to 7,500 years ago in the central region of America. Corn/maize is one of the most nutritious foods in the world, containing almost all the essential amino acids with the exception of lysine and tryptophan.

According to (FAO, 2013) corn was planted by Native Americans in hills, using a complex system that varied from species to species and planted according to their use. With the evolution of production technology, the method of planting according to differentiation by species has been replaced by single species plantations. With the process of migration of people to search for new areas for housing and an ally to the great navigations of the 16th century and beginning of the process of colonization of America, the maize crop has expanded to other parts of the world, and is now cultivated and consumed in all continents, positioning itself in third place after wheat and rice.

The same FAO report (2013) goes on to express that corn has a high productive potential and responds positively to the use of diverse technology, both for the genetic improvement as well as for its mechanization of cultivation. Generally, agriculture is carried out mechanically. In 2009, world production was 817 million tons more than that of rice (678 million tons) and wheat (682 million tons). However, more than 332 million tons are produced annually in the United States,

which is the world's largest producer of rice (ibid). Table 2.3 below illustrates the world producers of corn.

Table 2.3: World Producers of maize.

Countries	corn	2002	2003	2004	2005	2006
United Nations		227.767.000	256.278.000	299.914.000	282.311.000	267.598.000
China		121.500.000	116.001.000	130.438.000	139.502.000	145.625.000
Brazil		35.933.000	48.327.000	41.788.000	35.113.000	42.632.000
Mexico		19.298.000	20.701.000	21.670.000	18.012.000	21.765.000
Índia		11.150.000	11.152.000	14.984.000	14.172.000	14.710.000
Argentina		14.712.000	15.045.000	14.951.000	20.483.000	14.446.000
France		16.440.000	11.991.000	16.372.000	13.688.000	12.902.000
Indonesia		9.654.000	10.886.000	11.225.000	12.524.000	11.611.000
Italy		10.554.000	8.702.000	11.368.000	10.428.000	9.671.000
Canada		8.999.000	9.587.000	8.836.000	9.460.000	9.268.000

Source: (FAO, 2013)

According to the table above, the United States of America leads the list of the 10 most corn producers in the world, with USA 267,598, China 145,625 and Brazil annuals 42,632 million tons respectively.

## **2.11 Implications for maize policy development and effects in maize production**

According to Fara, (2009:6) generally, “the overall positive productivity effects observed in the sub-regions have implications for national and regional maize policy development in Africa. It is evident from the de-composition analysis that sub-regions need to support their members States to increase productivity rather than acreage cultivated if they are to respond to the challenges being faced by maize growers. “Among the strategies that national and regional authorities should use to address constraints are the development of improved technologies, and facilitation of access to and use of the technologies. Here the use of safe biotechnology to develop high yielding and improved maize varieties, with high good quality characteristics and resistant / tolerant to important biotic and abiotic stresses may hold some promise. The technologies will close the yield gap that exists between Africa and the rest of the world and thereby improve production.

Strengthening partnerships at national, regional and global levels is very important for a successful regional maize policy implementation in Africa. Within the framework of the integrated agricultural research for development, collaborative initiatives, coalitions, and platforms that engage actors from across public, private and civil society stakeholders are needed to mobilize the necessary technical, human and financial resources for up-scaling and out-scaling national maize development initiatives. Good examples include the drought tolerant Maize for Africa initiative, which aims to generate maize varieties with 100% superior drought tolerance, increase productivity under smallholder farmer conditions by 20-30% and reach 30-40 million people in SSA; the Swiss Agency for Development Cooperation sponsored, which aims to stimulate the development and delivery of improved maize varieties to farmers in SSA; the Bill

and Mellinda Gates, CIMMYT, Foundation Monsanto and Water Efficient Maize for Africa (WEMA) aims to develop drought tolerant and royalty free maize varieties for Africa; and the CIMMYT Foundation Insect Resistant Maize for Africa (IRMA) Project, which aims to increase maize production and food security through the development of insect resistant maize. One of the crucial steps to be taken in order to rapidly double the productivity of maize and dramatically increase the sustainability and resilience of maize-based farming systems on essentially the same land area is to utilize regional or continental platforms to facilitate and coordinate maize development initiatives (Fara, 2009).

The regional platforms will strive to bring together and package the best maize technologies developed by the CGIAR Centres and National Agricultural Research Systems, facilitate linkages and promote partnerships between research and extension on the one hand, and maize farmers, their organizations and the private sector on the other. This will enhance dissemination and adoption of improved maize technologies. To be successful, significant support from regional economic communities and national governments is required to promote breeding, capacity building and seed production initiatives in order to provide smallholder farmers in Africa with seed of drought tolerant varieties. National governments and Regional Economic Communities need to build on successes achieved by CIMMYT, IITA and national agricultural research systems in maize technology development and FARA in establishing region-wide initiatives for technology dissemination and adoption. This will need to be linked through country and regional processes. (Fara, 2009)

The de-composition analysis reveals that total maize production in Africa increased by 17.2 million tons between 1986 and 2006. The acreage, productivity and interaction effects were all

positive. The increase in production attributed to the area harvested (acreage effect) was 8.6 million tons compared to 6.7 million tons due to the increase in yields (productivity effect). The estimated increase in production due to simultaneous (interaction effect) changes in area harvested and yield was 1.9 million tons. Regarding the increase in total production between the two decades, about 50% (8.6 million tons) of the total increase in production (17.2 million tons) occurred during the first decade between 1986 and 1996, while the second decade 1996 and 2006, accounted for approximately 39% (6.62 million tons) of the total increase. All the three effects – acreage, productivity and interaction - were positive for both periods. In relative terms, the increase in area harvested accounted for 50% of the total increase in maize production during the period 1986 and 2006. The productivity and interaction effects accounted. National, sub-regional and regional policies should however extend focus beyond increasing yields to include improving the scope of knowledge-based innovation along the entire maize value chain, from production to consumption. Providing maize farmers with better and more equitable access to sub-regional inputs and output markets in Africa through the provision of information on market prices and opportunities is critical for successful maize development policy in Africa. Of crucial importance also is the need for increased investments in maize research and extension as a matter of priority. Such investment should focus on developing improved, stress resistant varieties; developing new methods and techniques for preventing post-harvest losses; and detailed characterization of maize genetic resources. Investments in extension efforts should also focus on dissemination of improved germ, hybrids and stress-resistant varieties. In non-rain fed areas, priority should be given to increased investments in irrigation schemes including the relevant infrastructure.

## 2.12 World Production of Wheat

According to FAO (2013), wheat, is a cereal grass originating in Mesopotamia and America. It is the second most cultivated cereal in the world, followed by corn. Data indicate that some species considered to be the ancestor of wheat were cultivated in Syria, Jordan, Turkey and Iraq for 8,000 years (Ibid). However, wheat has had great importance in Egyptian and Mesopotamian civilizations. In the world, agriculture of wheat occupies 20% of cultivated area, resulting in production at around 500 million tons per year with the largest producers being China, India, Russia, United States, France and Canada. In Brazil, due to special climatic demands in terms of temperatures for the development, the production concentrates on the States of the South and Southeast of the country (Ibid).

World economy role of wheat production is significance both in terms of cultivated land and food supply, feeding and commerce. In my opinion this significance has to be tried to make clear as well as it is worth to examine the role and importance of Hungary in it. Hungary has 4.5 million hectares of arable land. Shares of cereals' sowing area from Hungarian arable land fluctuated between 68.4% and 69.9% in period of 2004 and 2008 (Kiss, 2009). The difference between different years is negligible. The significance of wheat and corn is nearly the same within cereals. Both plants meet with approximately rate of 28% in comparison to entire arable land. KSH (2009 cites Kiss, 2009).

According to Kiss (2009) in connection with international trade of Hungarian wheat production our country has to cope with considerable competitive disadvantages. Since it has to cope with logistics handicap, the reason of it is that due to geographical situation of Hungary in many cases we are not able to transit our agricultural products at a competitive price. Other countries, such as

the United States, with maritime transport, by much more logistics costs, stay easier competitive at international markets. In spite of this, Hungary as regards exported wheat quantity is placed of the world in 2008, the available statistics. It was performed statistical evaluation on this data and in terms of some change, tendencies they did logical argumentation. Aim of the study is to prove significance of wheat production in world economy and introduction, revelation of Hungary's role in wheat production of the world deemed it necessary to introduce and analyse the sowing structure in the world. The ranking of top 10 countries on the basis of yield quantity of wheat, cultivated land, imported and exported quantity. According to the meaning different countries are included in each rank. In ranks beside top 10, Hungary also appears with its own rank and value representing the basis of ranking.

### **2.13 World Production of Sorghum**

According to Sani (2013) the coefficient of determination was 64.0%. This means that 64.0% of the variation in output of sorghum production was determined by the explanatory variables included in the model. The coefficients for labour, herbicides, fertilizer, all have positive signs. This implies that an increase in units of the same inputs will result in increase in output but in the case of implements, it was found not to be significant. Amongst all the variables used, seed is the only variable with a negative coefficient which disagrees with that of rice production as reported by Abakar (2003) in Bauchi Local Government Area of Bauchi State with seed having a positive sign. This implied that it has reached its third stage in the production process (diminishing returns) and any increase in its unit will lead to decrease in the total output to about -0.4083kg. Among the constraints identified, high cost of inputs, inadequate credit facilities, low prices of produce and untimely disbursement were found to greater capacity thereby affecting the production of sorghum in the study area.

The high cost of inputs (98.3%) and low prices of produce (98.3%) were identified as the major constraints to sorghum production. Other factors such as lack of adequate storage (66%), disbursement of loans (83.3%) and inadequate provision of credit (87.7%) limits the acquisition of capital items identified as major problems impeding expansion. Also, untimely delivery of inputs (75%), incidence of striges (75%), small farm size (21.7%) and poor extension services in the study area (Sani, 2013).

Sorghum ranks among the top three important grains in the country while its industrial demand is increasing particularly in the food, beverage, and livestock feed industries. Significant efforts have gone into research and development of improved sorghum varieties and production practices by both the public and private sectors. In spite of this, the producers-mainly smallholder farmers-are yet to achieve a significant increase in their incomes due to high cost and adulteration of inputs, lack of credit, inadequate extension services and poorly developed market linkages (USAID, 2008). An average farm income of N14, 400 per hectare was realized with an average of N 1.79 return on every (Haruna, 2013) naira invested which was quite profitable though opportunities exist for increased profit through resource readjustment.

#### **2.14 World Production of Rice vs. Temperature of Rice**

FAO (2013) states that rice is grown on every continent, highlighting first Asian, with an output equivalent to 90% of world production, followed by the Americas, with 6%, Africa with 4%, and 0.6% for Europe and Oceania, while Australia, Melanesia and Micronesia add up to a production of 287 thousand tons. The world production of rice in 2009 amounted to 685 million tons harvested in an area of 158 million hectares, with an average productivity of 4.3 tons per hectare, being second to wheat in the production and extension of cultivated area (Ibid). This

contributes to 27.5% of world production of cereals, which are consumed by the populations in all quarters of the globe. FAO (2013) goes further to state that China contributes a world production equivalent to 29% (32% of Asian production), followed by India with 20% which 22% of Asian production is. In the customs union and free trade area Venezuela, Argentina, Brazil, Paraguay, and Uruguay commonly referred to as MERCOSUR, the highlight is for Brazil, which occupies the 1st place in harvested area and production of rice, followed by Uruguay, Argentina and Paraguay.

Table 2.4: The World Production of Rice and Mercosur (2000 to 2009)

Agricultural.	World	Product	Productivity	Mercosur	Production	Productivity
Year	(1.000 ha)	(1.000t)	(Kg/ha)	Area (1.000ha)	(1.000t)	(kg/ha)
2000	154.169	598.880	3.885	4.060	13.304	3.277
2001	151.838	597.904	3.938	3.474	12.180	3.506
2002	147.607	568.993	3.855	3.457	12.215	3.533
2003	148.137	584.183	3.944	3.496	12.064	3.451
2004	150.186	607.318	4.044	4.119	15.725	3.818
2005	154.475	631.509	4.088	4.296	15.537	3.617
2006	154.324	634.606	4.112	3.376	14.125	4.184
2007	155.060	656.503	4.234	3.243	13.417	4.137
2008	157.739	689.140	4.369	3.237	14.787	4.568

2009	158.300	685.240	4.329	3.286	15.493	4.714
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Source: (FAO, 2009)

In 2009, the rice area in the southern corn countries amounted to 3.3 million hectares, with an output of 15.5 million tonnes, which corresponded to 1% and 3% of world production, respectively, and a productivity of 4.7 tons per hectare (Thessalonik, 2011). The growth of the rice production in Mercosur during the period from 2000 to 2009 contributed to the supply of global demand. The table 2.4 below illustrates the year on year production of rice in Mercosur compared to world production from 2000 till 2009 (FAO, 2009).

According to Tran (1997:58) about 146.5 million hectares of rice were harvested in 107 countries, producing about 534.7 million tons of rice, which is 1.16 times the amount produced in 1984. In fact this time the world rice production reached high levels apparently because the same production was not accompanied with the high level of growing population in the world. It was envisaged therefore that rice production was due to hit in 2010 about 690 million tons or 27.6. Tran (1997 cites FAO, 1993). Therefore, despite this prediction refers that in recent times the reduction in rice production was reduced which in turn between the years 1984 to 1994 the production was seen to fall in the order of 1.5 %. Due to the hot and humid climate of the Asian continent finds it the largest consumer in this area in the world and obviously this continent and where more is produced rice. For the African continent, interest in rice product has been gradually increasing in the last two decades. This demand for the product of rice in Africa is due to constant changes in eating habits of Africans, particularly those living in African cities, leaving eating cassava, maize, sorghum passing for rice and wheat. To elucidate the level of consumption, according to Tran, (1997:58) the per capita consumption of rice increased in the

order of 14.8 kg to 16.3 kg per year per year between the years 1980 to 1992. For example, in Latin America and the Caribbean, rice production increased by 32 percent in the last decade (1983-1993). The climatic differences clearly states in the production of rice, alias and this type of culture that demands the very best environment for production. For example, for most Japan rice production is due to low temperature and water availability is dependent factors. Because of these factors or inexistency competes in big way for the same production and soon gets affected the germination and planting rice.

For example in southern California, southern Italy has insufficient water impended the successful production of rice, despite these countries offer a favorable climate than the northern part of the same countries. Therefore, some developed countries create policies of subsidies to ensure rice production regions in the seasons, because this production involves very high costs. On the basis of this, the developing countries, particularly Mozambique, should also follow suit, creating policies for subsidies in rice production to reduce hunger and food insecurity affecting this African continent and specifically Mozambique.

### **2.15 Challenge for Rice Research and Production**

The extensive adoption of modern and improved cereal production technology was accelerated through favourable government policy, expansion of irrigated areas, accessibility to agricultural credit, intensive extension services and the availability of agro-chemicals, especially fertilizers and herbicides. The Green Revolution in the 70s and 80s has maintained rice production well ahead of the population growth in many developing countries. Concern has increased about mining the soil for plant nutrients, changes in the status of rice pests from minor to major

economic importance, a negative impact on the environment and losses of natural resources and biodiversity. Tran (1997 cites Shastry et al, 1996:59).

The main issues on the production of rice in the world can be listed below: low temperature. Low temperature has been crucial for greater higher production. With this becomes biggest concern for rice producers in temperate regions. Although farmers tried to deploy varieties with tolerance to low temperature and recommended cultural practices such as planting date and water depth during the development of the panicle rice crops still suffer from poor parenting and high grain sterility, due to changing weather each year. In 1993, the average night temperature dropped to about 11 ° C in summer, causing heavy losses in Italy, and particularly in Japan and the Republics of Korea. Japan had a posterior rice shortage and had to import about 2 million tons of milled rice in 1994-95 Tran (1997:60). It is good to know that Japan is, to some extent tolerant to cold. However, if it is less productive grown under very low temperature, the critical temperature of rice is about 15 ° C, depending on the varieties. The rice producing countries in temperate regions devote their important resource for varietal improvement in this respect. Recent work has focused on breeding cold tolerance, increasing the vigor of seedlings and reducing floret sterility in rice. Planting date, early-maturing cultivar, and retain the depth of high water during the panicle development could help the rice fields to escape the cold. Farmers, however, still need other varieties with increased tolerance to cold. According to (Tran, 1997) says that the most strategic research is still needed in this field. The biotechnological approach should be implemented to identify.

### **a) Water Efficiency**

Water is a critical and most important factor in rice production. About 55 percent of the cultivated rice area is under irrigation. It is known that, in irrigation systems, more than 4-5.000 liters of water are used for producing 1 kg of rice in many areas. Assessment of field suggests a water efficiency of 50 percent and can reach 80 percent, if the drainage water could be recycled and used Tran (1997 cites Giar, 1996:60). Development costs of new areas under irrigation and rehabilitation of irrigation systems on a large scale are high. Therefore, it is important to improve efficiency of water use in rice production systems through the use of techniques of water control and management of the appropriate culture, with emphasis on irrigation technologies combined with genetic improvement. The improved efficiency of water use has attracted little attention from the creators of rice.

### **b) Availability of water**

Although the water in Southeast Asia is generally considered abundant, especially in the rainy monsoon season, it is anticipated that many Asian countries will suffer from water shortages by 2025, as the rate of population growth and urbanization is increasing rapidly. According to Pingali, (1996:60 cited in Feder and Tran 1997). “The availability of water per capita fell by 40-60 per cent during the period 1955-1990. The competition related to the demand for water between agriculture and other sectors such as industry, environment, has become acute. Alternative agricultural genetic improvement, appropriate cultural techniques and efficient irrigation systems must be developed to solve this problem (Tran, 1997:60).”

### **c) The quality of water**

Poor drainage is the main factor linked to water issues, including water logging, salinity, toxicity and water pollution. This situation of poor drainage is mainly due to the inadequate development of irrigation systems and passive reaction of farmers to the operational organization of systems and their economic conditions. “Salinity is caused by the intrusion of saline water from the sea in coastal regions and the upward movement of salt water through capillary action in soil and salt accumulation on the soil surface due to rapid evaporation. About 24 percent of irrigated lands are affected by salinity problems “Tran (1997 cites Postel 1989:61).

In Asia during the Green Revolution, the rapid expansion of modern varieties of rice sold favorable lands. In 2025, 53 percent of people in Asia will live in urban areas compared to 30 percent in 1990, Tran (1997 cites Hossain & IRRI, 1995:61). “Rapid urbanization, industrialization and population pressure have encouraged farmers to exploit marginal lands to increase rice production to meet the demands of their families. Therefore, acidic soils, tidal lands, forest lands “were recovered and placed under cultivation, thereby limiting crop yield potential. Production in intensive irrigated rice systems, the major soil problems include change in soil characteristics, soil affects mining and soil pollution. (Tran, 1997,) The characteristics of the soil Long term soil drenching and drying lead to the formation of rigid containers 5-15 cm below the surface. The hard pan, which has a density, with fewer medium and large pores, reduces the permeability of the soil and the ability of roots to extract nutrients from the subsoil and increases the formation of soil toxicity due to long- flooding condition, making it difficult thus, the growth appeared after dry land rice. The widespread modern rice also encourages increased use of machinery in rice farming, especially rice farmers in developed countries, which

in turn leads to soil compaction. Permanent water logging and monoculture of rice have commonly caused trace element deficiencies, especially zinc and sulfur, and toxicities, particularly iron. The symptom of Zn deficiency has been increasingly reported in India, Bangladesh, Pakistan, Philippines, Thailand and the United States. In Asia, the increased use of low - concentrated fertilizer S intensive and high cutting rice caused deficiency of (Ponnamperuma & Deturck , 1993). The sulfur deficiency has been reported from Bangladesh, Indonesia, Nigeria and Brazil. Iron toxicity is commonly found in continuously flooded soils. Other toxicities, such as boron, salinity in irrigation have been reported of poor quality (Tran, 1997) effects of mining and fertility change.

Modern varieties of rice Fertility escape more quickly than traditional varieties of the soil. Modern rice crops under intensive cultivation (Tran, 1997). Farmers tend to offset these nutritional losses, especially macro elements with chemical fertilizers, neglecting some essential micro - elements. In the long term, micro - elements become deficient and cause an imbalance in soil nutrition increase the demand for phosphorus and potassium and nitrogen cause inefficiency, affecting the production of end grain. Therefore, the nutritional status of the soil requires regular monitoring, especially for intensive cropping systems.

The environmental problems, in the field of rice has a high potential for methane production, while the potential of upland rice for methane production is not significant since upland rice is never flooded for a long period of time. The hydromorphic rice produces methane emissions when soils are flooded and no methane under the condition of dry soil. The rice can cause problems of flooding, soil water depletion, salinity and alkalinity. Upland rice can increase deforestation and soil erosion, the fallow period is short (ibid).

Application of fertilizers (especially N), can contribute to the emission of greenhouse gases, due to the applied potential, such as nitrous oxide nitrogen losses. The impact of nitrous oxide to global warming is large in relation to carbon dioxide with a proportion of 180-300/1. (Tran, 1997) Excessive use of fertilizers and pesticides in rice production can cause water pollution and health risks through the water drained.

The problems mentioned above lands could contribute to the low productivity of rice. Some phenomena, such as mining soil depletion, exploitation of marginal lands, unbalanced soil nutrition and intensive cultivation systems, deserve more consideration to avoid declining productivity. However, under population pressure, farmers are encouraged to increase crop yields by means of intensity on less land, for example, high land productivity in order to produce enough food for mankind. Thus, intensive production systems have to be conducted by small farmers, who are less than skill, unviable agricultural and environmental consequences of investments unconscious.

The skills of farmers and technical knowledge should be improved through training and frequent field visits. Some delivery services such as outreach, provision of credit, the supply of appropriate input, farmer organizations, cooperatives and marketing should be provided to farmers to support the intensive rearing systems. These conditions are further disability in developing countries. Apparently holistic approaches are needed to ensure and maintain high productivity and output in the long run (Tran, 1997).

In the humid tropics, the introduction of semi dwarf varieties height and great use of nitrogenous fertilizers and insecticides have changed the status of pests and down related to the economic importance in rice production. It is reported that the incidence of some serious bugs like brown

plant hoppers, stem borers, leaf folders, etc., and diseases such as blast, bacterial blight, sheath rot ... The short term growth of modern rice varieties modified existing cutting patterns and increased intensity monoculture farming to double or triple cultures, thus inducing a favorable environment for insect pests and multiplication of the pathogen. In temperate regions, diseases and insect pests are less problematic than in the humid tropics, due to its favorable climate (dry climate and relatively low night temperature in summer) and the cultivation of rice per year only. However, some diseases such as blast, sheath rot and local and large insects, such as rice water weevils are commonly reported in this climate. Improvement efforts and agronomic management are explored to help minimize these problems (Tran, 1997).

Rice producers are particularly attentive to weed control. In temperate regions, the main weeds including barnyard grass. The red rice in rice production systems using continuous direct seeding as a method of crop establishment is commonly reported. Various methods of weed control, such as agronomic practices (good sources of seed, high rates of seed and water depth), herbicides, mycoherbicide, selection of allelopathy and genetic engineering have been explored. According to Tran (1997 cites Hill et al , 1994), the use of herbicides will be reduced in the future as a result of water pollution , effects on adjacent sensitive crops , expensive water systems and weed resistance . Integrated weed management, together with better information on weed control strategies are suggested for weed problems in temperate regions (Tran, 1997:62), “considerable research efforts are still needed to solve the above problems. However, some intractable biotic and abiotic constraints such as low temperature, drought, flood, explosion, bacterial leaf blight, yellow stem borer, weed resistance”. They need a more upstream research, particularly in physiology and biotechnology to understand and solve problems.

#### **d) Improving the productivity of rice**

Rice yield not only vary from one country to another, but also within the same country based on different agro - ecological zones and production systems used. “The difference between the yields obtained by farmers and research stations is still great, although some reduction has been recently reported. This indicates the various limiting factors that affect rice productivity and production, ranging from land development, production and marketing” (Tran, 1997:62).

#### **e) Yield gap**

In rice, the average yield of farmers is about 4-8 t / ha, compared to 7-13 t / ha obtained by the research stations. Note that the average yield of California and Australia is higher than in the EU “30-40 percent. In fact, it was reported that rice production in the state of California was 8.500 lb / acre on 485.000 hectares in 1994. In Australia, the average yield of 8.5 t / ha in 1995.” FAO (1995b cites Tran, 1997, p.63). It is possible that rice production in the EU to achieve the level of income above the state and country under the Mediterranean. Closing these gaps is not an easy task, and productivity gaps still exist in all rice producing countries. It requires a concerted effort from rice policies of governments to ensure proper leveling of the land, the efficient control of water, appropriate inputs (improved seeds, fertilizers, pesticides) supplies, lending , and effective institutional support (research, extension, marketing, price of rice incentive ) . If one of these is absent or inadequate, the difference in performance cannot be effectively closed.

Consequently, understanding the various components of grain yield of rice and how to improve them will help improve the skills of human resources and capacity increase rice production by

increasing the level of current income. According to Tran (1997 cites Lacy, 1984, p.63), the 'Rice check' method in Australia, which was developed for wheat in 1984 and subsequently applied to rice in 1986, has played an important role in increasing the yield of rice in the last 5 years. The 'Rice check' is the objective of integrated management package, which provides the template for achieving the target of 10 t / ha, through discussion groups and with the participation of producers of rice in field activities: observation, measurement, recording, interpretation and performance.

#### **f) Yield plateau**

The yield potential of modern rice varieties reached the plateau. Maximum yields are about 13 t / ha in tropical environments and 15 t / ha in temperate regions. The highest yield of the latter is due to more favorable weather conditions, such as the length of the long day, sunlight, high and low temperature overnight. In the tropical climate, the yield per season 8 IR has also been advocated, while production per day increased the development of modern varieties of rice early maturing. (Tran, 1997:63) Genetic resistance and tolerance to adverse environments together with the improvement of agricultural techniques from the beginning of the rice planting to post harvest could increase the current income country. The current technology of hybrid rice increases the potential for rice production by 15-20 percent. IRRI has developed a new type of rice plant, aiming to increase the yield potential by 50 percent. More discussions on hybrid rice and super rice will be done next.

### **g) Yield decline**

According to (Tran, 1997), declining productivity of rice was found in several experimental farms IRRI and in some research sites in the Philippines. In the sixties, rice production reached 8-9 t / ha at IRRI farm, but recently did not exceed 6-7 t / ha in the dry season and 5-6 t / ha in the wet season, while the rate of fertilizer remained constant. In three places in the Philippines, rice production fell 0.1 to 0.3 t / ha per year over a 20 year period (Datta, 1989). Experiments of long-term fertility of IRRI in two or three crops of rice per year over the last 25 years indicate some decline in income in many of its local search “Tran (1997 cites Cassman & Pingali, 1994:63) the causes of yield decline phenomenon in research stations are under investigation. It has not yet been determined whether such phenomena decline in productivity are restricted to a few farms or research are common in all farms of research, independently of the degree of intensification in rice cultivation . In farmers' fields, a factor of decline of farmers who cultivate modern varieties noted." It is well known that modern technologies are very sensitive to different levels of crop management. In Chiang Mai Valley of Thailand, the yield fell from 7 to 4 t / ha under normal management culture for unknown reasons Tran (1997 cites Gypmantasiri et al, 1980:64). In Africa, various development schemes of rice generally achieved the highest yields in the early years, but later , the yield began to decline, possibly as a result of inadequate farming , including the use of poor seed sources, the entrusted input (fertilizer ) supplies, poor crop protection , poor water management and soil nutrition depletion. A decline in productivity was also found in the production of rice -wheat, which accounts for more than 11 million hectares of intensive food production system in South Asia. The decline in income from farmers' fields has not been well studied and documented. Note “that the farmers are now used more numbers and higher levels of entries than before to maintain the yield of rice (Tran, 1997:64).”

#### **h) Decline in investments to increase rice production**

According to Tran, (1997:64) water control was the main factor necessary to increase production and productivity of rice in Asia during the Green Revolution, but a decline in investment for the development of irrigation infrastructure in many developing countries occurred, affecting the growth of rice production and productivity. In Asia, investment in irrigation has declined about 60 percent since 1960 Pingali (1996 cites Tran, 1997, p.64). The amount borrowed for the development of irrigation decreased from \$ 630 million in 1977-79 to \$ 202 million in 1986-87 (Rosegrant and Pingali, 1993). Similarly, the growth rate of spending on research in Asia fell from 7.4 percent in 1961 to about 4.6 percent in the 1980s Tran (1997, cites Rosegrant & Pingali, 1993:64).

#### **i) The high cost of rice production**

High labour costs, mechanization, use of chemical inputs and the slow increase in grain yield contributed to the high cost of rice production in irrigated rice, especially in developed countries. The cost of rice production was about U.S. \$ 400/ton in Tran (1997 cites France Cambon, 1995) and U.S. \$ 166/ tonne in the U.S. Tran (1997 cites Sanint & Zeigler 1990, p.64). Grant became national policy in many countries. It is known that an increase in the production of rice can substantially offset the high cost of production but increases slowly and cannot catch up with it. Furthermore, the potential yield reached the plateau and the rice price is not high enough to provide an incentive to farmers to increase the increased imports of rice from China, Indonesia, Philippines, etc., and the occurrence of floods and droughts in these countries (Tran, 1997).

#### **j) Emerging new technologies to increase productivity of rice hybrid rice**

According to FAO Tran (1997 cites FAO, 1997a), the recently hybrid rice is the only emerging technology available to increase the maximum potential rice yield by 15-20 percent. Hybrid rice, which is grown on 17 million hectares and accounts for over 50 percent of the total rice area in China, has helped the country to produce over 300 million tons of rice since 1976 and has saved more than 2 million hectares for agricultural diversification. This was accomplished due to the fact that the yield of hybrid rice is more than 20 per cent (or 1 to 2 t / ha) higher than that of conventional varieties (Yuan and Fu, 1995). This technology is very essential to highly populated areas where arable land is limited. Moreover, this practice to increase production of rice involves lower investment than the earth and irrigation development, however, this method of producing hybrid seed (three lines) is still laborious and expensive. The new method of deployment of hybrid rice in two genetic lines using sterile males sensitive to the environment (temperature and photoperiod) lines looks promising for future widespread adoption of hybrid rice in other countries besides China, India and Vietnam.

According to (Tran, 1997:65) the method of a form or apomixes rice is under intense investigation in China, the U.S. and IRRI in the Philippines, but without success in this field has not yet been reported. At CIMMYT, Mexico, Savidan and his team are working on the development of apodictic maize exploring combined conventional breeding techniques, DNA markers and other advanced science (CGIAR, 1996b). Once an apodictic maize gene is identified could be transferred to other crops like rice. As apodictic seed reproduces asexuality, farmers do not need to renew their seeds, especially hybrid rice seeds.

FAO has assisted several countries in Asia (India , Vietnam , Bangladesh and Myanmar ) and Latin America (Brazil and Colombia) in strengthening their national capacity for the development and use of hybrid rice , by the FAO Regular Programme, funding ( and Vietnam Myanmar) and the UNDP (India). India recently launched four varieties of hybrid rice and Indian farmers have, for the first time, grown from 6.000 ha of hybrid rice in 1994, followed by about 80.000 ha in 1995. Vietnam grew from 11.000 ha of hybrid rice in 1992 to about 100.000 ha in 1995/ 96, especially with the Chinese seed imported through border trade. Under the current population pressure and limited arable land, an increase in rice yield by the method of hybrid rice, will contribute to world food security. It should be noted also that the FAO have jointly established the International “Task Force on Hybrid Rice (INTAFOHR) in 1995, with the participation of 12 member countries, aimed at accelerating the development and use of hybrid rice outside China. His coordination center is located in the Philippines” (Tran, 1997:65).

## **2.16 Cereal Production in Selected Countries**

This section examines cereal production in Portugal and Africa with the view to draw out the relevance or similarities of these areas with the central region of Mozambique. Portugal has been selected due to the role it played in introducing agriculture and farming methods to Mozambique since Mozambique was colonized by Portugal.

## **2.17 Production of Cereals in Portugal**

The importance of agriculture in the Portuguese economy has declined over the years, as in all industrialized countries, but is still large compared with the average values in the European Union. European Commission [EC]( 2002). As in other member states of the European Union,

agriculture and primary employment based on natural resources have become less important, down from 21% of the workforce in 1988-90, to 10 %. (EC, 2002:5) The relationship between agricultural employment and total GDP has been negative since the decrease of GDP has been accompanied by a slowing rate of decline of labour- agricultural work force.

According to European Commission [EC] (2013) in Portugal the contribution of agriculture represents less than 1 % of gross total fixed capital, following a long-term downward trend. The importance of food consumption in final consumption has also slowed down and was about 22.5 % in the period 1999-2001 (EC, 2013).

The inflation is greatly influenced by the price of food products, as demonstrated in 2000, the year in which unfavourable weather conditions had a negative effect on the supply of fresh food in Portugal and other European countries. Agricultural trade has been growing, but less rapidly than the global trend. From 1988-1990, the share of agricultural trade in total trade was 7.8 %, with a decline to around 6 % from 2000-2002 (Ibid). Ross (2013) says that the Portuguese food industry in 2001 was responsible for 5 % of GDP and gave employment to 2.3 % of the active population. These percentages are slightly lower than those of 1996 which were 5.8% and 2.5 %, respectively. (EC, 2013) However, the ratio between these two indicators changed slightly, indicating a stable level of labour productivity, labour in the food industry (Ibid).

In Portugal, 40 % of the total population is from predominantly rural areas. Maintaining or increasing the competitiveness of rural areas thus assumes crucial importance of agriculture and agric-food industry play an important role in this regard. The differences in the importance of agriculture in different regions are very sharp. In terms of employment, agriculture is especially important in the central region, while in terms of value added, the highest percentage is in the

Alentejo region, where this value is greater than 10 % (Ibid). More productive agriculture in Portugal is however concentrated in the lower region of Lisbon and the Tagus Valley, where there are concentrated orchards and vineyards (EC, 2013).

(Almeida, 2010) asserts that cereals were always in a prominent place in the diet of the general Portuguese population. Wheat is the most representative cereal (38%), followed by maize (27%) and the remainder of less relevance such as oats and rice. Alentejo region contributes 80 % of the total production area in the country, with more than half of the area used for cereals that include wheat, barley, and oats, among others. This research borrowed from this literature, the crucial role played by rural cereal production in alleviating cereal consumption stocks.

## **2.18 Sowing of Cereals**

This section discusses how cereals are grown in Portugal, a European country where technology is highly utilized in production. It explains details of cereal production that is essentially done in Portugal so as to draw lessons for the production of cereals in Mozambique. These production mechanisms are therefore critical for this research since they highlight the relationship between production mechanisms and yield notwithstanding the differences in the developing stage of Mozambique.

Some cereals like wheat and barley require a period of low temperatures for floral induction followed by exposure to long days to allow complete reproductive development. In the case of cultivars obtained at low latitudes (for example Mexico, India, Australia) they do not require long days for initiation of reproductive development. Increasing the photoperiod (long days) translates not only in promoting reproductive development but all phases of plant growth,

implying that when sowing dates have been made in different heights it widely separates the grain ripening time which is reached within a few weeks or even days apart (FAO, 1992). This is done at the expense of a smaller number of leaves per stem. Fertilization will be based on the extraction of culture and expected production depends on the availability of soil and leaching losses.

In most soil and climatic constraints, nitrogen acts as the main factor limiting the expression of the yield potential of wheat crop. Thus it is particularly important to determine, with any degree of certainty, the optimum amount of nitrogen to be applied. This is not always easy for a whole host of reasons. Nitrogen is an element that is characterized by its high mobility in the soil and being very subject to a set of transformations that alter very easily to their availability in the soil Klem (1966 cites FAO, 2002). An increase in the supply of nitrogen promotes shoot development in relation to the root. This increases the ratio of dry weights of the shoot and the root is greater when put in terms of the length of shoot and root. This is unfavourable to the acquisition of water and nutrients from the soil in the final development of the plant, so it is a desirable characteristic particularly in dry land farming systems practiced in soils with low usable capacity (FAO, 2002).

At the level of the shoot, an increase in the supply of nitrogen leads to an increase in the length, width and leaf area at the same time that the leaf thickness decreases. In cereals, the effects of increased supply of nitrogen at the level of elongation/extension of the stem may become a limiting factor of production since it promotes eyespot. The new varieties selected to obtain high yields of grain stalks present (stem) small "straw low", a characteristic that also can be induced by application of growth retardants such as chlormequate chloride, which acts as compensating

for the negative effect of excessive supply of nitrogen (FAO, 2002). The increase in production obtained with the application of these substances is the result of the reduction that occurs in terms of the eyespot. Thus, while the application of either potassium or phosphorus shall be always in the background, and particularly in the case of the latter, preferably located in bands or rows when planting, as in regard to the application of nitrogen that should be carried out fractional applying one third of the total nitrogen required when sowing and the rest in coverage. This application may be made in one or two fertilizations coverage depending on the course of the agricultural year. In rainy years during the winter period it is prudent to opt for the application of two fertilizations cover but being aware that washing losses increase with the increase of precipitation, depending on the amount of nitrogen to be applied and soil texture (Ibid). For the situation of the Portuguese territory existing results indicate losses of 40-70 kg N / ha / year (when low doses of nitrogen are applied) or 40-90 kg N / ha / an O when higher doses of nitrogen are applied, also depending on the winter precipitation (CIA, 2004). Where the winter is more "dry" the amount of precipitation is lower and consequently, the losses will also be smaller. As the application of nitrogen does not take place at once, the nitrogen is applied in the background, part spread. The application of nitrogen background assumes that winter is (will be) dry (loss of 40 kg N / ha / year per wash) and fertilization background is a third of overall fertilization admitting losses by washing in the order of 40 kg N / ha (Ibid). If this indeed happens and winter run "dry" wash then a single cover can be applied to the remaining 2/3. However, if the winter is wet, washing losses will be higher and more nitrogen is applied (30 or 50 kg/ha) depending on soil type (Pollok, 2004).

## **2.19 Maize Production**

Maize is, in the agricultural context, the most important field crop, and is notably the one that most farms engage in with an estimated production on over 80.000 productive units and occupying approximately 170.000 hectares of cultivated area in the North and South Portugal (Jones, 2011). In Portugal, maize is produced mainly by irrigation, taking advantage of the fertile soil and conducive climate, but also because the geographic location of the arable lands makes watering an indispensable contribution to the vegetative growing (Embrapa, 2002).

## **2.20 Cereal Production in Africa**

According to statistics of the International Centre for maize and Wheat Improvement [CIMMYT] (2002), in Africa and in the world, the demand for wheat increases faster than that of other crops and in this context, researchers are studying the possibility of converting the production of wheat to Africa, the largest importer in the world. It is estimated that spending on the purchase of cereals for the year 2010 stood at US\$ 12 billion, with the acquisition of wheat amounting to 40 million tons of wheat (Ibid). Higher production and fewer imports could ensure greater food security in sub-Saharan Africa, said the researchers at the Conference on wheat for food security, organized by CIMMYT, in Addis Ababa, Ethiopia in 2013. Farmers who depend on the rainfall have special opportunities to expand cereal production and they will spend less on food imports thus ensuring food security.

The report presented at the Conference of Addis Ababa by, Mr. Said Adejumobi (2013), focused on Angola, Burundi, Ethiopia, Kenya, Madagascar, Mozambique, the Democratic Republic of the Congo, Rwanda, Tanzania, Uganda, Zambia and Zimbabwe, where wheat is produced in the

traditional manner, although there is sufficient rainfall for the production of wheat. The same study showed that in these countries, between 20% and 100% of productive land are conducive to profitable wheat production (CIMMYI, 2002). According to the Department for International Development of Agriculture, food and resource economics at the University of Michigan, there are several factors that increase the demand for wheat. Predominantly, the high consumption levels of bread and pasta, apart from the fact that wheat is the second staple food after corn and an important source of protein in African countries. Mason (2010 cited by CIMMYT, 2002) showed that urban consumers tend to spend more on wheat than their rural counterparts, so the rapid urbanization of Africa increases the consumption of wheat.

The lifestyle change of women on the African continent also has a significant impact on demand for wheat, because "to the extent that more women work outside the home, have less time to prepare food and seek convenient and easy ways to prepare foods, such as bread and pasta" (ibid). Mason goes further to contend that as urbanization is one of the important factors of the increase in demand, it is necessary to investigate alternatives to cope with the population growth of 300% predicted for Africa over the next 40 years. In addition to farmers' production increase of 10% and 25%, this activity will be recognized as a profitable activity, since Africa is able to produce many cereal crops and a very strong market for the absorption of all future production (Hoffmann, 2013). However, it is necessary to invest in seed and technology for Africa to become a sustainable wheat producer and cease from being an importer. In addition, with good management of water, hydroelectric plants for conservation and irrigation of fields and use of fertilizers, Africa can become the breadbasket of the world for many cereals, not just wheat (Brown, 2003).

Based on Braun (2012 cites CIMMYT, 2002), it is necessary to change these obstacles that have much to do with political issues, because the production of other crops is also extremely low. Several African countries were producing wheat on a large scale until the decade to 1980. However, the large amount of donated food at the time substantially reduced international prices and small farmers of sub-Saharan countries are responsible for the bulk of production. Technically and frequently there is improvement in production and productivity. Best varieties are required and access to seed for which production is truly viable. With high cereal yields, poverty reduction can be checked in the long term, as this is one of the positive consequences of the transformation of wheat production by small farmers. Mozambique is one of the largest exporters of grain in Southern Africa especially corn, despite registering a chronic food deficit in certain regions of the country according to a study by the Ministry of agriculture (FAO, 2012) In the evaluation report of the food and nutritional security situation, the Technical Secretariat for Food Security and Nutrition (SETSAN, 2012) indicates that Mozambique leads the list of informal exports of corn, with 54 per cent of regional exports to Malawi (11.887 tons), Zambia (943) and Zimbabwe (a ton), with a total of about 14,000 tons from April to June 2012.

The report goes further to state that through 2012, Mozambican producers informally sold 33 thousand tons of maize to neighboring countries, compared to 20 thousand from Malawi and 10 thousand from Zambia respectively. However, central and northern Mozambique are the two regions where more informal cross-border trade of corn is realized, due to the difficulties of access to the internal market. The normal source of agricultural produce sold in Mozambique comes from the most productive Northern and Central regions. Consumers are the Southern regions and neighboring countries through informal border trade. The report also points to an

increase in cereal production in the order of 3.9 percent to 2.9 million tons of grain, in 2011, of which 2.2 million tons are from corn and 282 thousand tons from rice (SETSAN, 2012).

### **2.20.1 Maize production in Africa**

Globally, Africa is perceived as a minor producer of maize, accounting for only 7% of global production. An average annual production is estimated at 49 million tons during the period 2005-2007; increasing from 32 million tons during the period 1985-1987. Maize yields in Africa are quite low by world standards and average 1.7 tons/ha in 2006 compared to the global average of about 5 tons/ha. The yields have increased only marginally over the last two decades. Most of the increase in production has come from expansion in the area harvested rather than from increases in yield. The area harvested increased from 131 million hectares in 1986 to 152 million hectares in 2006. This represents about one fifth of the global area harvested. Most of the maize produced and consumed in Africa comes from smallholder rural farms. Production takes place under difficult conditions characterized inter alia, by poor soils, low-yielding varieties; inadequate access to yield-enhancing inputs such as fertilizers and improved seeds; inadequate access to finance by producers, suppliers and buyers; and variable climatic and environmental conditions. “There are also heavy post-harvest losses due to poor storage and processing facilities and technologies. The entire maize value chain, from input supply through production to marketing and consumption, suffers from constraints that could be removed if known technologies and policy and marketing innovations could be harnessed effectively and efficiently” (Fara, 2009:2).

### **2.20.2 Cereal production in the Southern Africa Development Community (SADC)**

According (Ngwawi, 2013), the SADC envisages increased production of cereals, although there are changes in rainfall patterns. These resulted in relatively higher yields of grain and other crops during the 2012/13 season despite disruptions caused by irregular rains and floods. Statistics released by the Early Warning System Network (FEWSNET) (Food, 2013) hunger show that global production of cereals in the region is projected at 33.7 tonnes for the 2012/13 season, slightly up from 32.6 million tonnes recorded in the previous year (Food, 2013). These levels were projected despite a decline of two percent in the production of cereals by the world's largest producer of the region, South Africa, which was expected to reap 14.2 million tons in 2013, compared to 14.6 million tons in 2011/12. In the same period, cereal production in other SADC member states could have an increase of eight percent, reaching the 19.5 million tons, due to the significant increase in expected production in Mozambique. However, these numbers exclude estimates for the Democratic Republic of the Congo and Madagascar. In terms of production of corn, which is cultivated in most SADC countries, the major crop in the region will be achieved in South Africa, where estimates indicate a commercial corn output of 11.4 million tons, a fall of three percent of the 11.8 million tons recorded during the season 2011/12, according to the report. An additional 675 thousand tons were expected to come from the subsistence sector, bringing total supply of corn from South Africa to 12.12 million tons (FAO, 2013) “and the remaining amount of the corn in the region could be from Malawi, Mozambique and the United Republic of Tanzania”(Ngunawi, 2013:6).

According to the SADC Report (2013), cereal production is affected by erratic rainfall patterns, crop failure, poor agricultural practices and pest outbreak which erupted in the first half of the

season, where various crops have been affected in several countries, including Botswana, Lesotho, Malawi, South Africa, Tanzania, Zambia and Zimbabwe, although the infestation was controlled in most areas (SADC, 2013). The SADC countries that are potential barns (countries or regions of great cereal production) include Angola, Mozambique, the Democratic Republic of the Congo and Zambia. These countries are characterized by plenty of water and highly productive soils. However, there is need to invest in economic investment in order to develop the necessary infrastructure. Countries with less water security but are economically well-diversified include South Africa, Botswana, and Namibia (ibis).

Maize is the dominant staple food throughout southern Africa, equalling that of rice and wheat in Asia. Although rice and wheat are also consumed, increases in supply are usually from imports. Most maize in southern Africa is produced on medium to high potential agricultural land and more densely populated areas and areas with better infrastructure (FAO, 1999). Maize is the main food with Malawi supplying about two thirds of the daily food calories intake. Maize production in Malawi between 1990 and 1999 averaged 1.3million tons per annum from 1.2million hectares of land, whereas domestic consumption averaged 1.4 million tons per annum. Malawi was accordingly a net importer of maize during those years. “Malawi is blessed with an agro-ecological environment, which is highly suited for maize cropping. Maize is mainly produced in the central and southern parts of the country and about 90% of households in the country cultivate maize” FAO (1999 cites, Smale & Heisoy 1997, P.11).

South Africa, Tanzania and Zimbabwe are the main maize producers in the SADC region producing approximately 70% of the total maize output. Table 2.3 below shows the area, yield, production and consumption of maize in SADC.

Table 2.5: SADC Cereal Production

	<b>Area</b>	<b>Yield</b>	<b>Production</b>	<b>Consumption</b>
	(000 Hects)	(Ton/Hects)	(000 T)	(000 T)
Malawi	1400	1.77	2478	2057
Mozambique	1152	1.08	1244	1356
South Africa	3230	2.08	6718	7658
Tanzania	1764	1.39	2452	2643
Zambia	598	1.43	855	1460
Zimbabwe	1446	1.05	1518	2018
Rest of SADC	214	1.14	244	824
SADC	9804	1.42	13922	18016

(Source: FAO, 1999)

## 2.21 Technological Production in the World

Recent patterns of global production point to a slowdown in revenue growth in rice and wheat, leading to calls for greater investment in order to reverse this trend and rejuvenate growth rates of cereal yields (FAO, 2009). In effect, China, India and Brazil seek increased production using different paths during processing (Fan, 2004) through technological innovation.

China has chosen an “attack from below ” and started its reform with the agriculture sector, advancing to the manufacturing and services (Fan, Gulati & Dalafi, 2008). Through a gradual reform that was mainly based on trial and error, China initiated institutional reforms and economic liberalization, including the decentralization of agricultural production systems and the liberalization of prices and marketing (Ibid). The transformation of both agriculture and industry has created a highly favourable environment to encourage agriculture, leading to an increase in agricultural productivity, incomes and growth in the non-sector agriculture.

India, where after an unprecedented leap in agricultural productivity during the Green Revolution through technologies used such as the intensive use of chemical fertilizers, pesticides and irrigation soon after began to slowly check the growth Hazell (2000 cites Gulati & Fan, 2000). For example, India in the 90s, agricultural reforms and the building of rural infrastructure, especially irrigation, were crucial for agricultural modernization.

Brazil adopted as relevant a strategy for the use of technology in the production process consisting of technological innovation that happened in the seventies, especially with the modernization of mechanized Country Park in particular mechanization of the main crops (Scolari, 2004) contributing significantly to improved productivity.

Despite their different paths to follow directions with regard to aspects related to the production of cereals and not only on economic growth. One of the main common denominators between these three economies is its rapid growth and rapid integration into the world economy. Through the use of technologies, China and India are the largest producers of wheat and rice in the whole world and, along with Brazil, are among the six largest wheat producers. The major contribution of China and India into the global production of staple foods in conjunct with a large percentage

of them that it is chronically hungry people in the developing world, who require that these emerging countries have an active role in promoting improvements in production and productivity of agricultural produce.

A major difference between the growth strategies of India and China was that China gave priority to agriculture, directly, through the introduction of institutions and policies that improved agricultural productivity and, indirectly, through the transformation of the manufacturing sector, that was fuelled by the aggressive policies of China to reduce its trade barriers and to attract foreign direct investment. India, on the other hand, implemented policies, to the early 90s, which often distorted agricultural incentives, resulting in inefficient allocation of inputs and low productivity in the agricultural sector (Pratt, Yu & Fan, 2009). Agricultural and rural spending have contributed substantially to agricultural productivity, rural household income, rural household consumption and the reduction of rural poverty through various channels (Fan, Mogues & Benin, 2009). For example, data from developing countries have shown a strong relationship between investment in agricultural research and infrastructure with the growth in agricultural productivity. This study sought to understand the role played by technology and research in cereal production in Mozambique.

## **2. 22 Evolution of Cereal Production in Mozambique**

The Mozambican inputs the cereal production evolved over time response to different factors in its history. This evolution can be traced with using the literature from the colonial phase to the current.

### **2.22.1 The Colonial Period**

Considering that the colonial economy was never consistently being turned exclusively to meeting the needs of the bourgeoisie in the accumulation of capital, this helps in a way that would provide a consistent economy not to Mozambique and developed to meet the needs of capital accumulation of Portuguese bourgeoisie. Please note that two major regions, including South and Central and North, by which his small southern agriculture marketing was transformed into a reserve of manpower to meet the mining capital of South Africa and the development of ports and roads iron. For critical analysis of this study concerns make further study of the central region of Mozambique (Appendix 2).

The central region of Mozambique has good potential and agricultural watersheds with flow regime and dominant feature of the economic structure characterized by large agricultural holdings constituted from the Companies and majestic, more remote from the "crown deadlines" Mosca (1996 cites Serra 1978 and 1980:10). These companies are mainly engaged in the production of export commodities, notably sugar, tea, sisal, copra and cotton. These productions were performed with the labour-intensive technologies and companies defined their areas for the recruitment of labour-work that was carried out with the support of the colonial administration and the "Gentile authorities."

With the growing needs of skilled manpower in these fields and in South African mines, the colonial government, under pressure from companies of central Mozambique, had to delimit areas where recruitment was allowed to South Africa. Mosca (1996 cites ECA, 1980a). The competition in the recruitment of labour, work force companies to pay salaries comparable to those in the mines.

The agreements between the Portuguese government and the "Companies majestic" as a way directly associated with colonization ceased their functions at different times. The last, the Mozambique Company, became extinct in the early 40. All airlines have resulted in companies with economic objectives. The peasantry was the central of Mozambique, in the process, transformed into a semi agricultural proletariat. Mosca (1996 cites Head, 1980 and Wuyts, 1981). Much of the work was temporary and linking the peasant agricultural production stood by the family not emigrated, which facilitated the practical aspect of low wages due to the contribution of food production in the plantation workers. Nevertheless, the large concentration of workers in companies required the supply of large quantities of food that were obtained in different ways: by producing food in their own companies (mainly plantations with extensive breeding of cattle), and on through marketing surplus of peasant production performed by the network of rural commerce or by the company itself. In central Mozambique, the Mozambican peasantry is thus specialized in the production of commodities, mainly corn, becoming the largest producer of food products marketable.

The Portuguese were allocated large chunks of land for Mozambican leaders soon were related to the settlers when they arrived soon. The land was intended for various activities and among them, the production of cereals. Native families who would occupy the land they already owned the settler was required to pay taxes in the form of product or work. These were mostly small farmers who practice subsistence agriculture and the use of indigenous knowledge, such as shifting cultivation and to preserve soil fertility and select appropriate seeds for planting. The main objective of this phase by the Portuguese was the production of cereals and increase the supply of raw materials Kizito (2011 cites Mosca, 1996) for Portugal and that this government has done much to achieve this investment objective Mlay (2003 cites Mosca, 1996).

### **2.22.2 The Immediate Post Independence and Civil war Period**

Soon after independence in 1975, Mozambique's seed, seed distribution company at the time to ensure the production of cereals successfully. This company was established by the Government to distribute seed variety and quality as part of the seed assistance program Kizito (2011 cites Mosca, 1996). This was the way the government has found to provide seed producers to increase cereal production soon after independence. Form of Production Soon after independence were held the first nationalizations in Mozambique and all that matters for this study are ways and means by which it is possible to carry out agricultural production in the central region of Mozambique. In this context is the land. So the land was declared state property. Within production in central Mozambique had more than 80% of the private sector and agrarian been abandoned, operated upon and transformed into public corporations. There was a "ranking" of public enterprises, which translated in different prioritizations. The allocation of resources companies producing products for export and agro-industrial complexes were mostly considered most important (part of the county of ministers). The public companies in 1985 contributed approximately 50% of total agricultural production commercialized. Export crops accounted for about 38% of the production of these companies and vegetables and cereals approximately 23.3% and 19.3% respectively (Mosca, 1996).

Some companies abandoned led to the formation of production cooperatives, based on common ownership of land and collective work. Many cooperatives were formed with expectations important aid administration, which in most cases did not. In fact, the cooperatives were never prioritized in the allocation of resources. Politically, the cooperatives were regarded as a form of

transient production within the socialist model, because only public undertakings constituted a "property of the whole people" and therefore a "higher form of production."

However, the highlights are exceptions, especially some cases of cooperatives, receiving public assistance and / or with irrigation, productive and economic results achieved positive and yields superior to those obtained by cooperative family farms. These cooperatives generally produce cash crops for the market, thereby complementing the income earned on family farms where they basically produced food. A combination of factors public support - irrigation - production of cash crops - and market, introduced elements of complementarity in economy and family farms that facilitated the success of these initiatives. (Mosca, 1996:10) The rapid passage of family farming to a larger scale and forms management business type significantly affected the productive results. Deficiencies in management and organization, economic results and negative forms of retribution poorly defined cooperative, were some of the factors that hindered the growth of this sector. In fact, the cooperative of family farms were always prioritized in relation to the distribution of working time allocation and household incomes. The cooperatives were, in most cases, a way to achieve greater accessibility to possible support from administration (land, machinery, financing, allocation of inputs, credit,), and they may or may not be used on the farm family across the agrarian economy, cooperatives not exceeding 2% of the value of agricultural production (Mosca, 1996). If they are not considered cooperatives located in irrigation and producing cash crops (usually vegetables) the weight of this sector in agrarian economy would be lower. The vegetables in 1985 represented approximately 63.2% of the value of agricultural production cooperatives Mosca (1996 cites CNP, 1989).

The civil war period between the years 1977 and 1992 coincided with diversity of natural disasters , such as the two Limpopo and Incomati rivers in 1977 and another the Zambezi River in 1978 completely flooded , thus adversely affecting the most fertile soils and grain production more down in central Mozambique . Moreover , in 1980 , the central Mozambique in particular and the region in general parents turned into civil war between the years 1977 and 1992 coincided with a series of natural disaster. Two rivers namely the Limpopo and Incomati (flooded) in 1977 and another the Zambezi River in 1978, affecting some of the most fertile soils of Mozambique. Then the central region of Mozambique was hit by two severe droughts in 1986-1987 and 1991-1992 Parents leaving entirely dependent on external donors for food aid, including agricultural inputs. The combination of all these factors, such as war and natural disasters determined at low cereal production Kizito (2011 cites Mosca, 1996).

## **2.23 Policies for the Production of Cereals**

Various countries apply different policies to promote or discourage production of certain grains or foods depending on their national requirements and international expectations. National production of cereals may be encouraged for various reasons as well and these may include the political inclination of the ruling government or import/export requirements, for other reasons. This section looked into the policies that are used to promote cereal production in Pakistan, Ethiopia (for wheat production) and in Mozambique.

### **2.23.1 Input and Output Policies for Cereals Production**

In his discussion paper (Salani, 2012), Salam highlights that cereal production in Pakistan has declined in the ten year period 1990/91 to 2009/10. Pakistan produces wheat, rice, maize, millets,

sorghum and barley, crops that are produced in Mozambique as well. In addition, just like Mozambique, Pakistan considers cereal production as having far reaching implications for combating rural poverty and improving food security prospects in the country (Ibid). Hence, the input and output policies for Pakistan cereal production were found to be relevant for Mozambique.

### **2.23.2 Institutional Setup in the Seed Sector**

In order to promote quality cereal production, one of the major input considerations is centred on the quality of seed available for planting. Salam (2012:8) highlights that “prior to 1961 Pakistan did not have its own independent seed production and marketing systems; farmers relied on their own seed or purchased from other farmers. Following recommendations of the Food and Agriculture Commission, the West Pakistan Agricultural Development Corporation (WPADC) was established in 1961 for the procurement and distribution of improved seeds of various crops” but it was abolished in 1972 when provincial governments were given the mandate “for seed production, multiplication, procurement and distribution functions” (ibid). Salam goes further to point out that as a result of recommendations from the World Bank commission, the government of Pakistan “initiated the Seed Industry Development Project to operate under the Seed Act of 1976, which established institutions for quality seed regulation including the National Seed Council (NSC) and provincial councils. NSC advises government on policy measures to regulate the provincial seed industry approves the seed standards and regulates the interprovincial movement and import of seed”. (ibid) In 1997 the Federal Seed Certification and Registration Department (FSC & RD) was formed so as to ensure quality control mechanisms in seed and law enforcement by public and private companies dealing with seed as well as multinational seed

companies. This research will borrow such insights as to how cereal production policies encourage Mozambique cereal producers.

### **2.23.3 Policies in the Fertilizer Sector**

Salam (2012:9) points out that the Pakistan fertilizer sector “has experienced policy shifts and changes in the management of its production, import, and distribution system.” According to Salam (2012), the government of Pakistan formerly controlled fertilizer retail prices and was directly or indirectly engaged in fertilizer production, import and distribution. After reforms that were concluded in 1995, “subsidies on sales prices of fertilizers were eliminated; the reforms disbanded provincial distribution organizations and the Fertilizer Imports Directorate (FID) in the Ministry of Food and Agriculture (MINFA)”(ibid). This resulted in the privatization of the public sector production units and government involvement became limited to policy planning and analysis. Thus, deregulation of the fertilizer sector and the elimination of subsidies, coupled with the rising prices of energy used in fertilizer production, has seen an increase in fertilizer prices in Pakistan. These policy decisions had detrimental implications on cereal production especially for the rural cereal producers whose incomes are usually lower than commercial producers due to the small surplus which they usually sell. This research seeks to draw similarities of these policies in view of cereal production in Mozambique.

### **2.23.4 Farm Mechanization Policies**

According to Salam (2012:11),” traditionally manual mechanisms were used in Pakistan in “land preparation and tillage, weeding and intercultural, spraying, harvesting, threshing and hauling produce from farms; with tillage done by bullocks, male buffalo, and camels while horses and

mules provided the muscle power to transport goods and produce for storage”. Since the 1960’s, mechanization has improved in cereal production with government engaging commercial banks in advancing farm credit for the purchase of tractor – powered equipment and machines, and water pumping equipment.

Though mechanization was criticized for reducing farm employment, eviction of tenants and other social concerns, the use of deep tillage implements, cultivators, planters, ridges, seed drills and boom sprayers has improved the quality of tillage operations and land preparation and resulted in higher yields (ibid). In addition, to make these implements and machines accessible to household farmers, a market for the rental of farm machines, tractors, and tube wells was developed. “To encourage mechanization, urban and rural manufacturers of farm equipment produced and marketed these equipment which opened up employment opportunities for skilled, semiskilled and unskilled labour as well.”

Availability of water is critical in agriculture. Irrigation in Pakistan is built around the Indus River and its tributaries and is based on gravitational flow. According to Salam (2012:16), “storage reservoirs and canals were added to the system under the Indus Waters Treaty, brokered by the World Bank to resolve the 1960 water conflict between India and Pakistan. Irrigation from the canal system is the lifeblood of Pakistan’s agriculture.” Thus well water complements the canal water in Pakistan agriculture.

Mechanization has thus facilitated adoption of other yield – increasing inputs, including fertilizers, improved seed, plant protection, precision land levelling and other inputs” (ibid:16). In addition to improving incomes for farmers through improved and increased agricultural production, mechanization made cereal production much easier and enjoyable for the farmers.

This research attempted to find out the role of mechanization and irrigation in cereal production in Central Region of Mozambique as well.

To fully utilize mechanized production methods, a specialized bank, the Zarai Taraqiati Bank Limited (ZTBI) formerly the Agricultural Development Bank of Pakistan, has served agricultural credit needs since its inception in the 1960s. Its short-term loans (production loans), repayable after crop harvest, are for seasonal cash needs for buying seed, fertilizers, and pesticides while development loans are for long-term investment and payable over 5 – 10 years. The bank has established regional offices and branches to serve the agricultural sector. (Salam, 2012) However, the input policies would not be complete without examining the role of research in agriculture. Salam (2012:19) argues that “modern agriculture requires the support of a first-rate agricultural education, research, and extension system to train workers and address emerging technological, socioeconomic, and institutional challenges.” There are six research institutions at federal level and fifteen provincial research institutions and in addition, thirteen agricultural and veterinary sciences university's (faculties) augment the government research efforts. However, research efforts have declined (by 2010) due to inadequacy of funding, lack of financial and administrative authority, poor accountability and centralized authority (ibid). This research examined the role of research in cereal production as well.

## **2.24 Output Policies Agriculture**

The output policies include agricultural pricing policies and policies for the procurement, stocking, and distribution of food grains.

### **2.24.1 Pricing Policies**

According to Salam (2012 cites Niaz, 1995:22), the” government of Pakistan controls, reviews and modifies all grain prices since the country’s independence in 1947. The government has a policy of monopoly procurement of wheat and rice so as to provide cheap food to the urban population and industrial workers.” (ibid) This practice adversely affected both production and producer incentives. However, this policy was reviewed during the third five – year plan (1965) and policy focus shifted to providing incentives to farmers in terms of limited price support and price stabilization operations, with the prices of wheat and rice being periodically reviewed to reflect the changing domestic demand and supply situation. (Salam, 2012) In 1981 the Agricultural Prices Commission (APCOM), an autonomous organization affiliated to the Ministry of Food, Agriculture and Cooperatives (MFAC), for advising on pricing policy of wheat, rice, maize, and other crops Salam (2012 cites Niaz, 1995:22).

### **2.24.2 Procurement, Stocking, and Distribution of Cereals**

Cereal procurement, stocking and distribution in Pakistan is currently not government controlled except for wheat, the country’s staple food. (Salam 2012). “The federal-level Pakistan Agricultural Storage and Services Corporation (PASSCO) and provincial food departments intervene in the wheat market, buying the crop at the support price fixed by government at harvest time”(Salam 2012:28). The wheat so purchased would be issued to flour mills at subsidized prices and, during grain shortage wheat movements are restricted (ibid). In Central Mozambique, this research sought to establish the existence of policy in procurement, stocking and distribution of cereals.

## **2.25 Policies for Wheat Production**

From the Monitoring African Food and Agriculture Policies (MAFAP) Policy Brief 9, Ethiopia, is the second largest wheat producer in sub-Saharan Africa after South Africa though Ethiopia is one of the largest recipients of food aid in Africa. The MAFAP report shows that production of higher wheat yields in Ethiopia is curtailed by government policies which aim at keeping the wheat prices low for consumers while there are no policies to mitigate the impact of these low prices on producers. In addition to this, grain marketing in Ethiopia is characterized by weak institutional support, inadequate infrastructure and weak trade associations, who have limited capacity to regulate themselves, establish and enforce standards. Production of cereals in Ethiopia has also been discouraged by the government role. The government of Ethiopia has overvalued its currency and controlled exchange rates thus discouraging impacts on cereal producers. The report further elucidates that high transport costs and poor infrastructure all add up to discouraging cereal production by farmers, most of who reside far away from the markets and input suppliers. Similarly for Mozambique, there are currency value fluctuations, poor infrastructure and absence inputs suppliers close to the farmers. This research then found out implications for these in relation to cereal production.

## **2.26 Mozambique Government Policies for Production of Cereals**

Most governments' main strategic lines are based on the recognition that adequate food is a basic necessity. Production, processing, distribution and consumption of food play a key role in the economy in general and ensuring food and nutritional security are among the central objectives that should guide the public economic and social policies. According to Economic Commission for Africa (2012), the elaboration of such a strategy should take into account the deep changes

that have occurred in management of the economy and the normalization of the economic environment of the country level as well as the commitment of Mozambique at the World Food Summit of 1996, to reduce the number of undernourished people to 50% by the year 2015. However, this goal may not be achieved if the various assumptions that guide the implementation of these devices are not observed.

According to NEPAD (2001), to achieve food security, allocation of resources to the recipients, stabilizing the economy, maintaining the political and social environment of the country and the region in general, as well as the monitoring of compliance with the decisions taken is thus key elements of this strategy. The Food Security Strategy (ESA) or recognizes:

1. The political and legal framework of economic regulators as important factors for a rapid increase in production and efficiency of food economy;
2. The valuation of women, given their responsibility in ensuring household food security;
3. The considerations for demographic dynamics;
4. The importance of cities and rural areas & imbalances;
5. Improved utilization of foods and nutrients (NEPAD, 2001).

In this context, the Food Security Strategy aims to promote the development of human capital, rehabilitation of production infrastructures and marketing, the restoration of agricultural production and the creation of an environment favourable to the development of private initiative.

Mozambique was once self-sufficient in rice production with specific regions considered barns of the country due to their high productivity especially areas such as Lioma, administrative post of Gurué and Chimoio, and the Centre of the country respectively. Several efforts to revive agricultural production in the country with a focus to the production of rice, are underway as highlighted in the approval and implementation of the program of agriculture (PROAGRI, 1998-2011), the action plan for food production (PAPA, 2008-2011), the Strategic Plan of Development of Agrarian Sector (PEDSA, 2011-2020).

Funding for rice production in Mozambique has largely been drawn from government efforts to work with other countries; for example, funding for rice production in the District of Maganja da Costa is from a Triangular program between Mozambique, Japan and Vietnam while the re-launch of rice production in the delta of the river Limpopo in Chókwe district is a program of the cooperation between Mozambique and Japan, and that in the Low-Limpopo region of Chicumbane, Gaza Province, operated by under an area of 20,000 hectares is from a group of Chinese businessmen (MINAG, 2012). From these agreements, rice production in Mozambique has drastically improved.

Article 100 of the Constitution of the Republic (No.1 and 2), postulates that (1) "the Republic of Mozambique takes agriculture as the basis of national development, and, (2) the State ensures and promotes rural development for increasing satisfaction and multiform of the needs of the people and the economic and social progress of the country". In addition to these government initiatives, the smallholder farmers continue to have greater attention from government in promoting technical assistance. Family agriculture in Mozambique is dominant and dependent on

the weather, factors that are outside the control of man. However, the problem of rice deficit still prevails which contributes to the constant price rises of this cereal in the domestic market.

MINAG (2012), in its bulletin on Agricultural Market Information Systems (SIMA), state that the change in the price of rice has its peak at the time of the beginning of the agricultural season because, at that time the population no longer has sufficient stocks of rice produced locally, using the imports, with direct reflection on price rises. In parallel with the production of other cereals such as maize, sorghum and wheat, government policies rely on production from smallholders, and hence assume the responsibility to produce and market the surplus from maize and sorghum. However, there are few Government initiatives relating to the production of rice, a crop that was once in surplus for the country.

## **2.27 Research System for Cereal Production**

The high productivity levels achieved for agriculture in developed countries are a result of a clear fusion of science, technology and practice. However, such a merger has not appeared in a simple and easy manner since the decade to 1970. Researchers' concern is thus focused on questioning the new approach of technological development for agriculture. The paradigm of research on agricultural systems has developed rapidly since the 1980s both in the literature about agricultural development as an organization of agrarian research and extension systems. Since then, agricultural research, combined with its practical application through extension services, has been taken as one of the pillars of agricultural development in recent times, which has translated to increased productivity. There is therefore a need to look at the agrarian research as one of the pillars for the development of sustainable agriculture in Mozambique. An approach of Adaptive Agrarian Research that is sensitive to biological, economic and social factors that

have influence on the management of production systems is fundamental, Statistical National Institute [INE] (2004). Thus, sustainable development of agriculture embodied in increased production and productivity and adoption of new technologies is supported on research and analysis, which is one of the main pillars of agrarian development.

Currently in developed countries, agricultural development has been associated with a strong investment in research, where each agro-ecological zone has special attention in terms of their productive potential. In Mozambique, the formal research in the field of Agriculture began to be developed in the middle of the last century (1940) through natural resource surveys, botanists and veterinary studies, followed by targeted research for commercial purposes (IIAM, 2012). However, the real emergence of systematic research on the agricultural industry in Mozambique only began in 1965 with the formal establishment of the Agronomic Research Institute of Mozambique (IIAM), followed by the creation of the Veterinary Research Institute of Mozambique. This research seeks to understand the impact of research in cereal production in Central region of Mozambique.

## **2.28 Value Chain and the Production of Cereals**

The value chain approach eliminates the artificial separation between sectors and focuses on the interrelation between activities and processes regardless of sectors, whose main concern is to increase the added value and generate more and better benefits (Development Planning Minister – MPD- 2010). For example, in a value chain approach methodologically is counterproductive to define whether agriculture or the industry is the leading sector of development in a given economy. The most important thing is that the priority should be the combination of activities

and processes in such an efficient way as to significantly reduce the costs in every link and increase the benefits.

The central issue is that the activity and agrarian processes depend on reciprocal processes and industrial activities, services and others. On the other hand, the technological and scientific development makes it very clear that the division in sectors is inadequate, because it becomes difficult to classify certain activities across sectors and primary or secondary processes, for example, the production of software for industry or services. The modern production of agricultural products and livestock now uses biotechnology in agriculture as well as in industry. In the case of promoting the revival of economic activities in products and agrarian production subsectors, the leadership of the value chain is in the private sector. This is to create a favourable environment and encourage the activity of the productive sector to exploit opportunities created by market and by existing resources.

The State must intervene strongly in establishing strategic value chains, mainly acting in key factors that leverage the entire chain. The State has a very active role in the initial phase of the establishment of a value chain, which reduces as the private sector is consolidating and taking ownership of the ruler's own chain (MPD, 2011). However, any analysis that aims to increase the quantity and quality of agricultural production has to analyze the production and producers as part of a more comprehensive system that affects, and is affected by elements/activities outside of its own. The agrarian production should be framed within the historical and socio-political context where all possible opportunities and constraints are taken into account.

The challenge lies in the conceptualization of a methodology of analysis that allows the researcher to capture all main elements of a coherent and rigorous way. This conceptualization of

the value chain, used to organize and evaluate the macroeconomic and micro-level activities, shows that there is a link and interrelation between chain components that form a cohesive and integrated system in which every link chain precedent supports and feeds the next link, and each influences the other (s). The coexistence of the links is to ensure the survival of its components and the formation and breakage of chain is influenced by different historical, social and political factors. So a more adequate conceptualization must take into account the multifaceted nature of actors in different processes and activities that constitute the chain (MPD, 2011). This study seeks to understand the extent of value chain in cereal production in the central region of Mozambique.

## **2.28 Conclusion**

Cereals are an important since they are consumed as staple food by a large population in the world. According to Pimentel & Pimentel (2006), grains contribute about 80 % of the human diet. The global per capita grain production has grown slowly since 1984. Secondly, the definition of the World Resources Institute (WRI, 2003) considers food grains, such as corn, wheat, rice, ceveda, sorghum, wheat, rye, oats as commonly consumed by people of different nationalities. As for Dante (1997), the most important grains are mainly rice, wheat, corn, rye, sorghum, ceveda, millet and triticale, occupying a large area of crops, and largely produced in several countries since the earliest times.

This chapter thus looked into the conceptual, theoretical and empirical evidence of cereal production in the world, in SADC, and in other countries with the view of drawing lessons for Central Mozambique. It examined the input and output side of cereal production policies as well

as elaborated the importance of technology in cereal production. The change of agricultural technologies is urgent in Mozambique if the country is to achieve the goals of poverty reduction. Technological change can help reduce poverty directly by raising the welfare of the poor farmers who adopt technological innovation. Last but not least, the chapter looked into the role of research and value chain in cereal production. In each case, the importance of literature review to this research was shown. Chapter three will reveal the research methodology that this research adopted to be able to conduct a “critical analysis of cereal production potential in Central Mozambique.”

## **CHAPTER 3: RESEARCH METHODOLOGY**

### **3 Introduction**

This chapter looks into the methodology and methods of research that took place in the central region of Mozambique. The qualitative approach made it possible for the researcher to generate data on the “Critical Analysis of the Potential for Cereal Production in the Central Region of Mozambique”. This chapter presents the research paradigm, research design, research process, data generation instruments and procedures, data presentation, analysis and interpretation procedures. The chapter also discusses triangulation, credibility, trustworthiness, dependability and the ethical issues addressed.

#### **3.1. Research Paradigm**

A research paradigm is defined as “...a network of coherent ideas about the nature of the world and the functions of researchers which, adhered to by a group of researchers, conditions their thinking and underpins their research actions” (Bassegy 1990:8). Guba (1990:17) defines a research paradigm as an interpretative framework that is guided by "a set of beliefs and feelings about the world and how it should be understood and studied" while Morrison (2000: 9) defines a research design as simply ‘a basis for comprehension, for interpreting social reality’. A research paradigm thus has some influence on perceptions, conceptualization and understanding of researchers. Research paradigms are thus frameworks of thought or beliefs through which one’s world or reality is interpreted; or, commonly held beliefs among a group of people; and, these can be qualitative or quantitative.

McNabb (2004:97) illustrates that research paradigm can be divided into positivist (quantitative approaches) paradigm (methodology) and post phenomenological (qualitative) paradigm (methodology). Anti-positivism emphasizes that social reality is viewed and interpreted by the individual him/herself according to the ideological positions he/she possesses. Therefore, knowledge is personally experienced rather than acquired or imposed from outside. The anti-positivists believe that reality is multi-layered and complex (Cohen et al, 2000 as cited by Dash, 2005) and a single phenomenon has multiple interpretations. They emphasize that the verification of a phenomenon is adopted when the level of understanding of a phenomenon is such that the concern is to probe into the various unexplored dimensions of a phenomenon rather than establishing specific relationship among the components, as it happens in the case of positivism Dash, (2005). Thus, research paradigm can be quantitative or qualitative depending on the problem to be studied and the choice of the researcher.

A paradigm is essentially a worldview, a whole framework of beliefs, values and methods within which research takes place. According to Cresswell, (1994:15) “a qualitative study is defined as an inquiry process of understanding a social or human problem, based on building a complex, holistic picture, formed with words, reporting detailed views of informants, and conducted in a natural setting.” Alternatively a quantitative study, consistent with the quantitative paradigm, is an inquiry into a social or human problem, based on testing a theory composed of variables, measured with numbers, and analyzed with statistical procedures, in order to determine whether the predictive generalizations of the theory hold true. In challenging the assumptions underlying positivism, Lincoln and Guba, (2000) also identified two categories that distinguish different paradigms, that is, causality and axiology. The hypothesis of causation affirms the position of nature and possibility of causal relationship while axiology deals with questions about value

(Ibid). Specific assumptions about this research include the role of value in research, how value influences research, and how best to use research products.

Quantitative research requires the use of exploratory, descriptive and causal designs while qualitative research utilizes exploratory, interpretive and critical designs (McNabb, 2004). Most authors argue that in quantitative research the researcher must state a null and alternative hypothesis while in qualitative research method, the researcher must clearly state the research questions to be answered by the research. Another difference in these two research methods is that quantitative research utilizes quantitative data collection methods and interpretation with tables, graphs, charts while qualitative research makes use of focus groups, interviews, observation, desk research (document review) in data generation while the interpretation is largely narrative. Furthermore, qualitative research methods are flexible, subjective, and speculative and grounded while quantitative research methods are fixed, objective, and abstract and test hypothesis (Silverman, 2006).

Many differences between quantitative and qualitative research paradigms abound including that quantitative research employs a reductive data analysis, high levels of measurement and a deductive approach while qualitative research employs an explicative data analysis, low levels of measurement and an indicative approach. From a general perspective, it is easier for researchers to generalize and replicate results from quantitative research than from qualitative research due to the large sample size and deductive aspects of quantitative research. In qualitative research, due to the need to study participants in their own setting, the sample may be very small, “even a single phenomenon”, and thus the results cannot be generalized and replication may give different results from the initial research.

This research was therefore based on the post positivist or anti-positivism paradigm, the qualitative research approach, which utilizes biographic, phenomenological, ethnographical and case study research methods (McNabb, 2004). Thus, qualitative research was used for this research as it is a form of inquiry that analyzes information conveyed through language and behaviour in natural settings. It is used to capture expressive information not conveyed in quantitative data about beliefs, values, feelings, and motivations that underlie behaviours of cereal production.

Qualitative research was used in this study because it comprises a set of different interpretive techniques aiming at describing and unfolding components of a complex system of meanings. It aims at translating and expressing the sense of the phenomena of the social world, thus reducing the distance between the indicator and the indicated, or between theory and data or between context and action (Denzin & Lincoln, 1994 cites Maanen, 1979).

According to Hammersley (1992) qualitative researchers share a set of preferences which are:

- A preference for naturally occurring data, that is, observation rather than experiment, unstructured versus structured interviews.

- “A preference for meanings rather than behaviour, that is, attempting to document the world from the point of view of the people studied” (Hammersley, 1992:165). A preference for inductive hypothesis that is, generating research rather than hypothesis testing.

Therefore, a qualitative method was used for this research since the research was based on the way people experience social phenomena of cereal production in the real world in which they live, with particular focus on how they produce cereals. Thus, qualitative research enabled the

researcher to come up with a “deeper” understanding of social phenomena than would not be obtained from quantitative data. Though qualitative research downplays or avoids the use of quantitative instruments, numbers and other phenomenon that arise in research need to be measured thus quantitative instruments had to be used in this research.

The method used in this study qualitatively resembles the interpretation of phenomena that are used every day, which have the same kind of data that the researcher employed in this research. Godoy (1995:58) explains some key characteristics of a qualitative study. He asserts that qualitative research "considers the environment as a direct source of data, and the researcher, as a key instrument having a descriptive character; the process is the main focus of approach and not the result or a product; where data analysis is performed intuitively and inductively by the researcher". Thus, according to Godoy (1995:58) “qualitative research does not attempt to enumerate and/or measure the events studied, nor employ instrumental statistical data analysis; ” it involves obtaining descriptive data about people, places and interactive processes by direct contact with the researcher who studies the situation, trying to understand the phenomena from the perspective of the participants, that is, the situation of the participants in the study’s.

It has been observed that qualitative research paradigm framework is made up of:

- a) **Philosophy** - the rational investigation of the truths and principles of being, knowledge, or conduct; or the investigation of the nature, causes, or principles of reality, knowledge, or values, based on logical reasoning rather than empirical methods.
- b) **Ontology** - is the study or concern about what kinds of things exist.
- c) **Epistemology** - a branch of philosophy that investigates the origins, natures, methods and limitations of the human knowledge.

- d) Methodology** - a body of methods, rules, and postulates employed by a discipline: a particular procedure or set of procedures; or, the analysis of the principles or procedures of inquiry in a particular field.
- e) Ontology** is “concerned with being”; it answers the question “How do you look at reality”. It is the starting point of all research, after which one’s epistemological and methodical positions logically follow, that is, it is the image of social reality upon which theory is based. Blackie (2000:8) offers a fuller definition suggesting that ontology claims are “claims of social reality, claims about what exists, what it looks like, what units make it up and how these units interact with each other. In short, ontological assumptions are concerned with what we believe constitutes social reality”. This component was thus effective in assisting the researcher in this case study.
- f) Epistemology**, on the other hand, is the branch of philosophy that is concerned with the origin, nature, methods and limits of knowledge, especially in regard to its methods, validation and “the possible ways of gaining knowledge of social reality”. Derived from the Greek words “episteme” (knowledge) and “logos” (reason), epistemology focuses on a knowledge-gathering process and is concerned with developing new models or theories that are better than competing models or theories (University of Sheffield, year). However, since knowledge, and the ways of discovering it, is an ever-changing process (not static), assumptions and objectives of each research become critical in research. To carry out authentic research on “a critical analysis of cereal production”, the researcher applied ontology and epistemology approaches. Interviewees were interviewed in such a way that it was possible to draw out if they had cereal production knowledge through using different age groups in every province.

In addition, since this research was on “Critical Analysis of the Potential for Cereal Production in Central Mozambique. It fits into social science because weak production of cereals presents social problems including but not limited to hunger/starvation, lack of or low finance, and other social ills hence qualitative research was appropriate for the research. (Bogdan & Taylor, (1975 cited in Westbrook 1994). The qualitative method was used for this research since the research was based on the way people experience social phenomena in the real world in which they live. The focus of inquiry in this research was how the participants produce cereals. Thus, qualitative research enabled the researcher to come up with a “deeper” understanding of social phenomena of cereal production than would be obtained from quantitative data.

### **3.2 Research Method**

A research design is an architectural blueprint; a plan for assembling, organizing, and integrating information (data), and its results in a specific end product (research findings). A case study is characterized by profound and exhaustive study of one or a few objects, in order to allow broad and detailed knowledge of the same. A case study allows for greater understanding of complex and systemic problems by studying the dynamics and interaction of multiple factors, from a few specific situations (Boyd et al & Mattar, 1989 and 1994:7 cited in Revillion 2000). However, in some case studies, generalization of the observations may not be possible especially where the case may not represent the mean of a population. A case study examines a phenomenon in its natural environment by applying various methods of data generation in order to obtain information from one or more entities. In addition, the study's results depend heavily on the integrative power of the researcher, of his skill in site selection and methods of data generation, as well as the researcher's ability to make changes in the method of research in a timely manner.

According to Yin (1994:2) “case study proposes to investigate a contemporary phenomenon, where the boundaries between the phenomenon and its context are not clearly perceived. Its utility is to assist in the development or improvement of theories. Empirical evidence should generate feedback to the unknown and enable analytical generalization where possible.”

In this research therefore, individual farmers, and government officials were interviewed through the use of various instruments to draw out deep meanings of the current and future cereal production prospects in central region of Mozambique.

Robson (1993:40) defines case a study as the development of detailed, intensive knowledge about a single “case”, or a small number of related “cases.” The case study approach also has considerable ability to generate answers to the questions, ‘Why?’ ‘What?’ and ‘How?’ (Robson, 1993:44) and these were common questions in this research on why certain production methods were preferred, what was produced and how the cereals were produced.

Low cereal production poses a social problem of hunger, which culminates into poverty that plagues the central region of Mozambique. Hence some ways to increase cereal production in the central region would undoubtedly benefit the people of this area. This research’s goal was to make a thorough investigation on the perception of the farmers or their associations for the reasons why there is low cereal production while biophysical conditions are suitable for more quantities of cereals to be produced in the central region of Mozambique. The next section describes the process followed to generate the data for this study.

### **3.2.1 Target population**

The target population for this study included the peasants or small, medium and large agricultural peasants of central region of Mozambique, officials from the Ministry of Agriculture, cereal traders and elders living in the research areas. In addition, the target population included economic agents, district officers from the government departments, agricultural associations, non-governmental organizations, transporters and the general public who are the consumers of the cereals. These constitute the key stakeholders in the production of cereals. In this region, different cereals such as maize, sorghum, millet and rice are produced and distributed through various categories of grain merchants, while the consumers who benefit from this process are mainly the general public. It is critical to note that there is always food crisis in those regions which are very close to the central region of Mozambique. For this research, data were generated from a heterogeneous population that represents the country's population that is practising agriculture in this region.

### **3.2.2 Sample and Sampling Procedure**

The central region of Mozambique has four major provinces namely, Zambezia, Sofala, Manica and Tete. One district experiencing low cereal production in each province with agricultural potential was purposively selected. Thus, for Zambezia province Namacura district was selected, Gorongosa district was selected in Sofala province, Gondola District for Manica province and from Tete province Angonia district was selected. Cereal producers and consumers were then selected using the simple random sampling method due to the fact that the participants reside in clustered homesteads and to save time, the researcher preferred this sampling method. The sample comprised groups of peasant farmers and agricultural associations to form designated

focus groups for discussion. For the focus groups, guided unstructured interviews were carried out. This allowed the researcher to understand the profound reasons for the low production of cereals.

The population was divided into subpopulation (stratum). The researcher grouped members of the population into homogeneous subgroups before sampling through stratification. The researcher then used a convenience sampling method within each stratum on the participants on the basis of their accessibility and convenience to the researcher. The main assumption for using convenience sampling method is that each stratum is homogeneous (Ross, 2006). The sample size of 32 was used for this research.

### **3.2.3 Sampling Procedure**

Stratified random sampling was used for this research. For group discussion in each district, 6 people of the producer group were selected. Within this group there were producers of sorghum, maize and rice and other cereals. The 7 participants were the principal farmers in each district who are the presidents of the associations. For each district, the director or the district director of agriculture was interviewed, totalising 8 participants per district. The following table (Table 3.1) shows the sampling and stratification method used for this research.

Table 3.1: Sampling per Stratum

<b>Target Participants</b>	<b>Strata</b>	<b>Number</b>
Growers of sorghum	People with at least 1 ha and local leaders	1
Growers of maize	People with at least 1 ha and local leaders	1
Growers of rice	People with at least 1 ha and local leaders	1
Farmers of other cereal (specified)	People with at least 1 ha and local leaders	2
Mixed cereal growers	People with at least 1 ha and local leaders	2
Government Officials	Administrators in each district	1

Source: Author, 2013. Please note that this gave a sample of 8 persons per district and 32 persons in total. This was a representative sample since it covered as many people involved in cereal production as possible.

### **3.3. Data Generation Instruments and Procedures**

This section discusses data generation instruments and the procedures used to generate data for this research.

### **3.3.1 Research Instruments**

This research included interactive interviews in the form of one-on-one interviews, focus group discussions, document analysis and observations. Primary data on demographic characteristics, for example agricultural crop type, crop quantity, quality of seed, uses of incomes, markets, agricultural technologies, agricultural policies and soils used for agriculture were collected.

#### **3.3.1.1 Observation**

Observation was used to gather information in a systematic way through direct contact with specific processes, people and situations. A qualitative observation is fundamentally a naturalistic practice in the context of occurrence among those involved in the interaction and naturally follows the normal process of everyday life (Adler, 1994). The qualitative observers are not restricted by the categories of measurement or responses; they are free to search for concepts and categories that appear to be significant to the participant. The qualitative observation is not from a rigid research project and its greater virtuosity lies in its flexibility and openness (Ibid).

Glues (1992b) identified four steps of observation: the first step is selection of scenarios which involves the initial ideal scenario and that to which the researcher has an easier access, establishes a good relationship with the participants and offers information directly related to the fundamental issues for research. The second step is collection of information through field notes, that is, records of textual dialogues with the actors observed and interviewed with the informants. The third step involves theoretical reflection on the observed aspects. Last, but not least is the observation of formulation of connections between the various dimensions of reality. These steps were useful in assisting the researcher and research assistants in this research. From the

interaction between these steps it was possible to make assumptions and relationships that led to the formulation of more conclusions applicable to this research.

During the field research, it was observed that each district has its reality and totally different culture. For example, in district C, it is normal to find farmers who use fire as a way to prepare the land for the cultivation of cereals such as maize and sorghum. For the district D, it was observed that farmers belonging to a particular association do not have the financial capacity. The other common observation in all districts, is that farmers and smallholders cereals are still comfortable to use the short-handled hoe and machete as a safe means in cereal production and to manage time, for example, for the District B in each hectare production is normal to find every family grows and then pass on farm to farming knowledge to another member of the family. All this and other information were noted on observation checklists.

### **3.3.1.2 Interviews**

The interview is one of the most common and important tool in the study and understanding of the human being. It adopts a wide variety of uses and a great variety of forms ranging from more common (the individual spoken interview). The group interview, or even the mass-media campaigns with interviews by mail, telephone or computer. It can be used for commercial, political, therapeutic or scientific purposes and its duration can be from a few minutes to long days, as in the case of the interview in the stories of life. Eight randomly selected participants from about five families in five neighbourhoods of the four districts were used for this study, namely from Namacura, Gondola, Gorongosa and Angonia.

It was important for the researcher to complete the open ended questions as interviewees responded due to the low literacy level in the rural areas. One-on-one interviews also gave interviewers the opportunity to see facial expressions and gestures of participants and other group members. Interviews ranged from guided to unguided depending on the situation, for example, when interviewing the educated administrators open questions were administered while for focus groups, audio recording was used. The participants were interviewed individually before the focus group discussions.

The interviews were thus the main method of data generation and were based more on the interaction between interviewers and interviewees. In some cases, non-structured interviews were carried out in which case the questions were not defined beforehand and, therefore, were emerging in the course of the interaction between the two parties (interviewer and interviewee). This type of interview is applied predominantly in the studies of a qualitative nature and its basic objective is to gather and deepen the information on dynamic events, detected or not detected conceptions, during the observation.

### **3.3.1.3 Focus Group Discussion**

The focus group discussion is a technique for gathering information. It is normally used by qualitative researchers. The focus group discussions were based on open-ended questions that were answered through the conclusions of the discussions that were held or recordings from those who did not know how to read and/or write. Focus groups were composed of people ranging from 18 to 40 years. The groups were heterogeneous. Therefore, the groups consisted of six members made up of three men and three women and they participated in farming different cereals such as sorghum, maize, rice and other. In each group there was a moderator to ensure

that there was communication and discussion during the recording or the completing of open-ended questions. To ensure productive discussions, the moderator had to be in conversant with Portuguese and the local language and was a motivator of the group in each case.

The focus group discussion practices adapt themselves to the metalinguistic function of language, because they facilitate the production of particular and controlled discourses, which in turn refer to other general and social discourses. This social dimension of speech is theoretically supported by ideas of Bakhtin (1995) who states that the true reality of language is that of social verbal interaction that is fulfilled in statements made by the concerned interviewees. In the speech, what one says or what someone says in certain conditions of enunciation articulates itself with the social order and subjectivity (Kind; 2004 cites Peinado, 1995). The group thus acts as a “reticule that fixes and orders, according to criteria of relevance, social meaning corresponding to the concrete semantic field in which the proposal of the prescriber is written”. More detail on how the group discussions transpired were elaborated in chapter 4 of this research.

What the researcher collects through this technique needs to be captured, validated and reproduced. The data were thus gathered from the perspectives of different people, views, groups, ideas and cultures. Various discussion techniques were adopted during group discussion and groups adjusted themselves to the questions during the entire research process. The techniques were designed to make it possible for the participants to freely express themselves while others could agree, or make more elaborations to some expressed views within the groups.

#### **3.3.1.4 Document Analysis**

In this study document analysis was critical because it enabled the researcher to dig into the archives of the country's repositories in search of documented evidence about cereal production in Mozambique. Considering that qualitative approach, as a research method, is not presented as rigidly structured, it allows the imagination and creativity to lead researchers to propose studies that explore new approaches. In this sense the documentary research represents a form that can be of an innovative nature, bringing important contributions in the study of some of the themes.

In addition, documents were also used to reveal the impact of inadequate cereal production in Mozambique and to find out if improved cereal production could substantially reduce hunger and poverty in the country. Therefore, document analysis enabled the researcher to discover, decipher, and interpolate cereal production processes with the hope of revealing gaps and suggesting strategies or models that could be successfully adapted to improve cereal production in the central region of Mozambique. Some of the documents sought and read were the annual agricultural reports from the Ministry of Agricultural, from Non-Governmental Organisations (NGO) and agricultural associations including some of the strategic plans.

#### **3.4 Data generation procedures**

Data were generated primarily by fieldwork through participative observations, in-depth interviews and focus group discussions which is appropriate for generating data on naturally occurring behaviours in their usual contexts. Methods of data collection through observation used in this study were written descriptions, photographs and documentation.

Community leaders and all parties involved in the study were informed and visited. A team of research assistants made up of final year students in Management at Catholic University of Mozambique was engaged. This team was provided with technical data generation instruments. A support team, including the researcher, was involved in the development of the research instruments. Table 3.2 below, illustrates phases of the data generation process that was applied to this research.

Table 3.2: Phases in the Data Generation Process for this study

<b>Qualitative Data Generation</b>	<b>Phases in the Process of Research</b>
Purposeful sampling strategies  Small number of participants  and sites	Sampling
From individuals providing access to sites  Institutional review boards  Individuals	Permissions
Open-ended interviews  Open-ended observations  Documents  Audiovisual materials	Data sources

Interview protocols	
Observational protocols	Recording the data (using cell phone, digital camera, pictures/photographs for example)
Attending to field issues	Administering data collection generation
Attending to ethical issues	

Source: Creswell (1998)

Researcher with the help of research assistants gathered people into focus groups and went through the open ended questions, recording both verbal and non-verbal responses. In some areas households and individuals were randomly selected for interviewing, with each household or individual being interviewed for a maximum of thirty (30) minutes. Some interviews were videotaped or voice taped on cell phones, with the researcher and research assistants setting aside time to download the tapes and upload on the researcher's laptop.

In addition to these interviews, observations were made by both the researcher and research assistants on various issues studied in this research including land size, implements and tools used in agriculture, types of soils, land preparation, the types of cereals grown, and storage of produce by the farmers. In addition, researchers gathered other physical issues that affect cereal production in central region of Mozambique.

### **3.5 Data Presentation, Analysis and Interpretation Procedures**

As MacNabb (2004) puts it, one outstanding advantage of qualitative research methods is the richness of information gained. “Richness refers to the large number of topics (areas) that may surface in an interview” MacNabb (2004:145). In addition to this, the researcher who uses the qualitative paradigm usually gets immersed in the natural setting in which the research is carried out and may find it difficult to bring out the human element in such a way as would separate what is relevant from the irrelevant in order to clearly address the set research question and sub question of the research. With this in mind, data were presented (in Chapter 4) mostly through description and explanation with photographs and pictures from other sources, with tables, minimized to illustrative designs.

Likewise, data were critically analyzed through explanations with reference to illustrations where appropriate. Gaskell (2000:53) brings it out, “The broad aim of (all qualitative data) analysis is to look for meanings and understanding of what is said in the data, but the researcher must interpret (all of) this”. From the generated data in the field, the researcher demonstrated (in chapter 4) the themes and sub themes that were used to draw meaning to the analysis of cereal production in central region of Mozambique. The data were generated through interviews with farmers and focus group discussion with district officers.

Deep interpretation and analysis of data enabled the researcher to draw answers to the research questions that addressed the “Critical Analysis of the Potential for Cereal Production in Central Region of Mozambique”

### **3.6 Triangulation, trustworthiness, credibility and dependability Issues**

This section examines issues relating to triangulation, trustworthiness and illustrates how the researcher effectively drew out authentic data that would make this research credible. Evidence was drawn from literature and strategies used to put these issues under control were given.

#### **3.6.1 Triangulation**

In qualitative research, researchers should generate data through interview, observation and open ended questions instruments. This desire to use multiple sources of data is referred to as triangulation as suggested by Mills (2003). It involves mixing of data generation methods (multiple techniques) so that diverse viewpoints cast light upon a topic.

Jick (1979) hinted that researchers can improve the accuracy of their judgments by collecting different kinds of data bearing on the same phenomenon. Qualitative research uses triangulation to increase the credibility of research findings. It is largely a vehicle for cross validation when two or more distinct methods are found to be congruent and yield comparable data. This would involve the use of multiple methods to examine the same dimension of a research problem. In this regard, this study used document analysis, interviews, observation, focused-group discussion and semi-structured questions with open-ended questions to get information from the sampled participants.

A triangulation of qualitative and quantitative methods was then used in data collection as this chapter elaborated. This is supported by Silverman (2005) who argues that there is no reason why qualitative researchers should not use quantitative measures to collect and analyse data where appropriate. Thus, in this research, some quantitative instruments were used to gather

data and interpret the data hence the researcher used numerical values to quantify measurements as well as to analyse some data where appropriate.

An example of such measurements included the numbers of people with certain farming implements, or the number of households who produced certain quantities of cereals. This enabled the researcher to clearly demonstrate some findings in this research. In the researcher's view, simple counting techniques that are theoretically designed and ideally based on participants' own categories can offer a means to survey the whole corpus of data ordinarily lost in intensive, qualitative research Hammersley (1992:163). Argues that: the level of precision is appropriate in relation to what is being studied and any particular claim should depend on the nature of what the research is trying to describe, on the likely accuracy of descriptions, on purposes, and the resources available to the researcher, not on methodological paradigm.

### **3.6.2 Trustworthiness, Credibility and Dependability**

Guba (1994) developed a well-developed model which has been effectively used in qualitative research in the medical field. Guba's model is based on the identification of four aspects of trustworthiness that are relevant to both quantitative and qualitative studies: (a) truth value, (b) applicability, (c) consistency, and (d) neutrality. Based on the philosophical differences between qualitative and quantitative approaches, the model defines different strategies of assessing these criteria in each type of research. This section will thus summarize what is relevant for assessing qualitative research as drawn from Guba's model.

### **3.6.2.1 Truth Value**

Truth value asks whether the researcher has established confidence in the truth of the findings for the informants and the context in which the study was undertaken (Lincoln & Guba, 1985). It establishes how confident the researcher is with the truth of the findings based on the research design, informants, and context. In qualitative research, truth value is usually obtained from the discovery of human experiences as they are lived and perceived by informants. Truth value is subject-oriented, not defined a priori by the researcher.

Lincoln & Guba, (1985) termed this credibility; they argued that internal validity is based on the assumption that there is a single tangible reality to be measured. In this research, the researcher's job became one of representing those multiple realities revealed by informants as adequately as possible and one way through which this was achieved was through testing the findings against various groups within the same district or across the districts.

In some cases, observation also helped in authenticating truthfulness, for example, a field with a bumper harvest would show evidence through the bulk of stalks which are usually not cleared until preparations for the next season are under way. Sandelowski (ibid) suggested that a qualitative study is credible when it presents such accurate descriptions or interpretation of human experience that people who also share that experience would immediately recognize the descriptions. Truth value is perhaps the most important criterion for the assessment of qualitative research.

### **3.6.2.2 Applicability**

Applicability refers to the degree to which the findings can be applied to other contexts and settings or with other groups; it is the ability to generalize from the findings to larger populations. The ability to generalize from the study sample to the larger population and noted the importance of sampling technique in its establishment.

Two perspectives to applicability are appropriate for qualitative research. The first perspective suggests that the ability to generalize is not relevant in many qualitative research projects. Strength of the qualitative method is that it is conducted in naturalistic settings with few controlling variables. Each situation is defined as unique and thus is less amenable to generalization. Consequently, explained, generalization becomes difficult in all qualitative research because every research situation is made up of a particular researcher in a particular interaction with particular informants, cereal producers and other stakeholders in this case. In this context, applicability is not seen as relevant to qualitative research because its purpose is to describe a particular phenomenon or experience, not to generalize to others.

However, Guba (1994) presents the second perspective on applicability in qualitative research by referring to fittingness, or transferability, as the criterion against which applicability of qualitative data is assessed and, research meets this criterion when the findings fit into contexts outside the study situation that are determined by the degree of similarity or goodness of fit between the two contexts.

Lincoln & Guba (1985) note that transferability is more the responsibility of the person who wants to transfer the findings to another situation or population than that of the researcher of the

original study. They argued that as long as the original researcher presents sufficient descriptive data to allow comparison, he or she has addressed the problem of applicability.

This research, although carried out in the central region of Mozambique, could be applicable to more districts in the country since most regions share the same ecological conditions and the people of Mozambique generally practice similar cultivation cultures.

### **3.6.2.3 Consistency**

The third criterion of trustworthiness considers the consistency of the data, that is, whether the findings would be consistent if the inquiry were replicated with the same participants or in a similar context. Unlike the relatively controlled experimental environment prevailing in qualitative research which would make this criterion easy to measure, the qualitative field setting may be complicated by extraneous and unexpected variables. The structure of the experimental design is the antithesis of the unstructured and often spontaneous strategies of qualitative research. The key to qualitative work is to learn from the informants rather than control for them. Moreover, instruments that are assessed for consistency in qualitative research are the researcher and the informants, both of whom vary greatly within the research project.

Qualitative research emphasizes the uniqueness of the human situation, so that variation in experience rather than identical repetition is sought. Thus, variability is expected in qualitative research, and consistency is defined in terms of dependability. Guba (1994) developed a concept of dependability implying tractable variability, that is, variability that can be ascribed to the identified sources. Explainable sources of variability might include increasing insight on the part of the researcher, informant fatigue, or changes in the informant's life situation. Another source

of variability stems from the fact that qualitative research looks at the range of experience rather than the average experience, so that atypical or non-normative situations are important to include in the findings.

To ensure that consistency was achieved in this research, participants were given as much time as possible to express themselves and the researcher ensured as free an atmosphere as possible during interviews. In addition, elderly participants were included to give more insight into traditional and other practices and trends of cereal production in the four district of Central Mozambique.

#### **3.6.2.4 Neutrality**

The fourth criterion of trustworthiness is neutrality, the freedom from bias in the research procedures and results. Neutrality refers to the degree to which the findings are a function solely of the informants and conditions of the research panel not of other biases, motivations, and perspectives (Guba 1994). Qualitative researchers try to increase the worth of the findings by decreasing the distance between the researcher and the informants, for example, by prolonged contact with informants or lengthy periods of observation as occurred with participants in Gorongosa in particular, who tended to sometimes dwell on security issues instead.

Lincoln & Guba (1985) shifted the emphasis of neutrality in qualitative research from the researcher to the data, so that rather than looking at the neutrality of the investigator, the neutrality of the data were considered. They suggested that conformability be the criterion of neutrality. This is achieved when truth value and applicability are established. To ensure neutrality therefore, triangulation was applied during data generation and four districts were

covered. This resulted in minimizing the possibility of the researcher establishing personal relationships with respondents. Use of observations, document analysis and focus groups were particularly effective in ensuring neutrality.

### **3.7 Ethical and Legal Issues**

When most people think of ethics (or morals), they think of rules for distinguishing between right and wrong; norms for conduct that distinguish between acceptable and unacceptable behavior. Resnik (2011) say that ethical norms also serve the aims or goals of research and apply to people who conduct scientific research or other scholarly or creative activities. Most societies also have legal rules that govern behavior, but ethical norms tend to be broader and more informal than laws.

There are several reasons why it is important to adhere to ethical norms in research. One of the reasons why ethics is important in research is that norms promote the aims of research, such as knowledge, truth, and avoidance of error. For example, prohibitions against fabricating, falsifying, or misrepresenting research data promote the truth and avoid error. Secondly, since research often involves a great deal of cooperation and coordination among many different people in different disciplines and institutions, ethical standards promote the values that are essential to collaborative work, such as trust, accountability, mutual respect, and fairness. For example, many ethical norms in research, such as guidelines for authorship, copyright and patenting policies, data sharing policies, and confidentiality rules in peer review, are designed to protect intellectual property interests while encouraging collaboration (Resnik, 2011).

Most researchers want to receive credit for their contributions and do not want to have their ideas stolen or disclosed prematurely. Thirdly, many of the ethical norms help to ensure that researchers can be held accountable to the public. For instance, in many countries, government policies on research misconduct, conflicts of interest, the human subjects' protections, and animal care and use are necessary in order to make sure that researchers who are funded by public money can be held accountable to the public. Fourthly, ethical norms in research also help to build public support for research. People and organizations are more likely to fund research projects if they can trust the quality and integrity of the research. Finally, many of the norms of research promote a variety of other important moral and social values, such as social responsibility, human rights, and animal welfare, compliance with the law, and health and safety (Ibid). Ethical lapses in research can significantly harm human and animal subjects, students, and the public. For example, a researcher who fabricates data in a clinical trial may harm or even kill patients and a researcher who fails to abide by regulations and guidelines relating to radiation or biological safety may jeopardize his health and safety or the health and safety of staff and students.

In this particular research, fabrication or falsifying of results may mislead other researchers or give a false impression about Central Mozambique's cereal production potential which has downside effects on all stakeholders who may read this research or the published articles.

To handle the relevant ethical and legal implications, the researcher applied for UCM and ZOU permission to conduct research, in addition to applying to the Ministry of Agriculture and Provincial Direction of Agriculture for a permission to conduct research in cereal production in the central region of Mozambique. A prior visit was then made to the selected districts showing

them the authorization from UCM, ZOU, local authorities, and the Ministry, in each case explaining to the possible participants the significance of the study and contributions it would make to the overall cereal production process in the central region of Mozambique, highlighting its importance in poverty alleviation as well as bringing out the importance of the research to the whole country.

### **3.8 Conclusion**

This chapter has demonstrated that in carrying out research, it is critical to select appropriate research methodologies and techniques in order to gather as much data as possible. Research methodology, method and data generation's techniques and instruments were explained and elaborated. This chapter therefore, explained the research paradigm, method, instruments, procedures, population, sample and sampling techniques used in this research. Issues of trustworthiness, legal and ethical considerations, were discussed. In addition, the actual courses of action carried out by the researcher in each case were clearly spelt out. The next chapter will deal with data presentation analysis, interpretation and discussion.

## **CHAPTER 4: DATA PRESENTATION, ANALYSIS AND INTERPRETATION**

### **4.1 Introduction**

This chapter looks at data presentation, analysis and interpretation. The data were presented on the basis of the themes that emanated from the data generated from the field. This chapter thus presents analyses and interprets the data generated from the districts of Namacurra in Zambezia province, Gondola in Manica province, Gorongosa in Sofala province and Angónia in Tete province. For a better understanding the chapter began with analyzing demographic data after which the profiles of the central region of Mozambique districts studied were elaborated. The chapter was then structured into themes that were developed from the responses of the participants in the research and observations by the researcher and research assistants. The themes were presented into organized sections as the analysis indicated.

For ease reference, the districts were codified using the alphabet with A being Namacurra district in Zambezia province, B being Angonia district in Tete province, C being Gondola district in Manica province and D being Gorongosa in Sofala district. These codes were applied throughout the analysis of data in this chapter. It was from content analysis that codes and categories which later led to themes that formed the sections were produced. Theories were then derived from the data. The following were the themes that emanated from the data generated:

- Cereal Production in Mozambique;
- The Input Sector;
- The Output Sector.

The Role of Research in Cereal Production in Central region of Mozambique include the following:

- Food Security Technology and Human Resources;
- Technical Assistance and Cereal Production;
- Policy Considerations in Cereal Production in Central Region of Mozambique.

## **4.2 Demographic Data**

This section presented and discussed data distribution based on gender and age, research groupings, farming experience, and farming qualifications. The section also looked into the participants' stratification model used for data collection for this research.

### **4.2.1 Distribution by gender and age**

Education in Mozambique is not compulsory. Children can drop out and start school later. As a result most children below 18 years of age can be employed to work on fields or in homes.

The total number of participants was 32 including farmers and representatives of associations, and government officials residing or working in the area of cereal production in Namacurra, Gorongosa, Gondola and Angónia districts.

There were significantly more men than women available in the age group 29-38 years old. The participants generally agreed that young men (aged 18 -28 years) tended to be hesitant to go into towns without assurance of a job elsewhere; or they were married and were working on their

pieces of land; or were home because they could easily attain land from their parents or from the village heads.

#### **4.2.2 Distribution of Participants by Farm Experience**

From the observation, most of the farmers led a nomadic life where they settled in an area for a number of seasons then changed to another place in search of more fertile land and for other reasons. This was evidenced by the lack of durable home structures, with the participants living in pole and dagga or grass built structures in most areas. In addition, fresh cut trees were seen as evidence of land preparation for constructing the “homesteads” or for farming.

From the table 4.1 below, Gorongosa district has farmers who are most experienced in farming (up to 7 years), with the district of Angónia having some of the least experienced farmers (2 years). On average, the farmers’ experience varied from 2 to 6 years, with the exception of the oldest participant interviewed in Gorongosa who expressed that he had more than 15 years of farming experience. Farming experience is critical in cereal production as it means that the farmer would employ informed decisions on the choice of seeds to plant, how to prepare land, when and how to manage the crop until harvesting and how to store and market the produce.

Table 4.1: Distribution of Participants by Farming Experience

<b>Number of Participants</b>	<b>Classification</b>	<b>Period of experience</b>
01	Official Government of cereals production in Namacurra District	06 Years
02	Officials Governments of cereals production in Angónia and Gorongosa district	03 years
01	Officials Governments of cereals production in Gondola district	02 years
01	Representatives of associations of cereal production	06 years
01	Representatives of associations of cereal production	04 years
01	Representatives of associations of cereal production	03 years
1st group of 6 people	Small farmers and buyers in Gorongosa district	4-7 years
2nd group of 6	Small farmers and buyers in Namacurra district	3-5 years
3rd group of 6	Small farmers and buyers in Angónia district	2-4 years
4th group of 6	Small farmers and buyers in Gondola district	4-6 years
Other 01	Elderly persons above 50 years	15+ years

Source: Researcher's initiative, 2013

From the above table, it was interesting to note the lack of experience in the government officials with Gondola being manned by a person with only 2 years' experience while some farmers in the same district have farming experience of up to 6 years. This mismatch usually results in the government officials encountering resistance from the more experienced farmers especially regarding new farming methods and use of modern input varieties. While the young officials viewed the older farmers as backward and resistant to change, the older farmers viewed the young officials as arrogant and inexperienced. This resulted in non-compliance by the experienced farmers which might explain the low cereal production levels observed in this research.

#### **4.2.3 Distribution of participants by farming qualifications**

Most of the farmers interviewed were illiterate, with only four having attained a Primary School certificate. However, the four district officials all have a Bachelor's degree in Agriculture. This, the government officers said, posed the challenge of dissemination of information. The farmers can only understand when the officers literary explain issues to them. Table 4.4 below illustrates the distribution of participants by farming qualifications.

Table 4.2: Distribution of participants by farming qualifications

<b>Qualification in agriculture</b>	<b>Number of participants</b>
Primary Certificate	04
Secondary Certificate	00
BA Certificate	04
Master certificate	00
PhD certificate	00
No level of qualification	24

Source: Researcher's initiative, 2013

Due to problems of accessibility and dilapidated infrastructure that exists in rural areas of Mozambique in general; illiteracy posed a great challenge to crop management and hence affected the levels of cereal output.

### **4.3 Agro-climatic Zones of Mozambique**

According to the report of Muleza (2012) agro ecological areas are zones with natural characteristics that make them specific and particular to the development of certain economic activities agro-livestock. They are used as a means for the definition of policies and strategies for the development of agro-livestock sector of the country and other rural development programs. The Climate, rainfall and temperature play important roles in defining the areas agro - ecological.

The Climate most varied in Mozambique is the component of the environment that greater influence in the distribution of crops by country. There were two types of agro-ecological study: Based on Carvalho (1993 cited in Mulenza, 2012) “**Traditional Agriculture of Mozambique 1970**” he defines Agri - Areas in which established Ecological maps of distribution of traditional cultures and defined a number of agricultural regions that makes the close relationship between the distribution and the climate, defining the concept of field’s climatic conditions typical of climates of each of traditional cultures. Furthermore, the lack of adaptation would mean too often years of famine. Example: Cassava, Rice, Beans, Corn, Cotton and Cashew Nuts it has concluded that the peasant over the years adapted to their crops to local conditions, especially climate, so that with few crops capable of constituting the basis for development.

#### **4.3.1 Characterisation**

Climatically Mozambique varies from arid areas to dry and wet lands or where receive a lot of rain. The semi-arid Zones are favourable for agriculture rain fed conditions, and this aspect has numerous relations with the selection of cultures and patterns of cultivation. The altitude varies from 0 to 6562 meters above mean sea level. While it is estimated that 94% of the area is below 1.000 meters. In the region south of the Save river, 90% of the area is at an altitude below 200 meters. Approximately 40% of the area in the provinces of Cabo Delgado and Zambezia and 60% in the provinces of Manica and Sofala are, also, at an altitude lower than 200 meters.

The regions of low altitude (200 meters) are covered in sandy soils and poor, in alluvial soils (provinces of Zambezia, Manica, Sofala and some coastal areas), of black soil (Cabo Delgado province) and dark brown soils and derived from basalt (region of Libombos, province of Maputo).

The altitude between 200 to 500 meters occurs mainly in the northern region of Mozambique. The soils are very variable in texture, and may find it very heavy and light soils. The altitude between 500 to 1000 m occupies about 25% of the area and the large proportion occurs in the northern region of Mozambique. (Mulenga, 2012:2) The altitudes above 3.280 ft are scattered throughout the country (plateaus of Angonia, in Tete, Gurué, in Zambezia, and Mossurize and Sierra Choa, in Manica) (ibid).

According to Selvester & Castro (2004) the general situation in the agriculture sector is characterised by low productivity, low mechanisation and levels of inputs (only 7 per cent of farmers use animal or mechanical traction and only 2 per cent use fertilizers or pesticides) (Fauvert, 2002). Some of the traditional risk factors are reflected in the statistics, e.g., war displaced have higher levels of food insecurity when compared to non-migrants (perhaps emphasizing once again that the demobilization package was largely ineffective in economic terms). However, Selvester & Castro (2004 cites INS, 1997:11), shows that female headed households are not at greater risk of food insecurity. One reason for this is due to the migratory labour patterns in much of Mozambique where males left for work in South Africa, Zimbabwe or the cities and regularly sent remittances home to the rural areas. This system was disrupted during the war and has been further undermined with the political and economic changes in neighbouring countries. Rural relationships and livelihoods are varied and it would be a mistake to believe that subsistence farming on family plots will guarantee food security for all in a country as diverse as Mozambique.

For example, the 2002/3 food crisis appears at first glance to be closely related to food production capacity. With most severely affected areas by the drought in the food deficit areas

This analysis does not take into account the chronic nature of food deficit in these areas and the importance of other food sources at household level (Selvester & Castro, 2004:7), such as remittances and other income sources, even in good agricultural years. The easy conclusion is that policy makers should concentrate on increasing food production in these areas as they are clearly the most vulnerable to chronic and acute food insecurity. This thinking is reflected in practice with irrigation schemes, drought resistant crops being encouraged in these areas. Maybe it is time to open possibilities for alternative food sources that will in fact lessen the food deficit through increased purchasing power and alternative (to agriculture) livelihood options (ibis).

Information regarding the rural job market in Mozambique is scarce and scattered. Formal off farm employment opportunities are few and limited to seasonal jobs on commercial farms during weeding and harvesting time. Demand for labour in the rural areas is higher in northern region and less in the south, but even those opportunities are scarce. Data indicates that only 11% of male adults as Selvester & Castro (2004:26) in rural areas have some sort of formal employment, most of the time they are paid with a combination of cash and food and non-food goods. Daily labour on farms in the family sector is the principle source of income for the majority of the poor households and is an integral part of the livelihood strategies Selvester & Castro (2004) cites MoH (1996-2000:26). Statistics about daily labour are not available. There are some government initiatives to promote wage labour as part of a drought mitigation programme with the intention of carefully monitoring the impact of wage labour on vulnerable food insecure households. Data from the monitoring system should provide insights into the functioning of the cash-starved rural economies. In some areas large agricultural companies control commercialization by allowing employees to withdraw goods from company shops and the value of the goods are deducted from wages at the end of each month. Other sources of income for rural communities include charcoal

and wood sales, sale of traditional beverages and sale of traditional crafts. Remittances from migrant labour are also an important source of income in many of the rural areas. As all of these activities are not part of the formal domain there are no reliable figures to represent the weight of each of the activities in rural livelihoods. The high cost of investment and inappropriate policies has meant that food processing plants in the rural areas are under developed. The cashew industry has been decimated by the policy to allow the export of raw cashew causing the loss of hundreds of seasonal jobs (mainly female labour). There are only a few labour intensive plants still open. The commercialization policy for domestic cotton (selling above international prices) has also jeopardised the textile industry causing the closing of many of the factories. In order to fully understand rural livelihoods more research is necessary on actual off-farm income opportunities and future perspectives for investment in non-agricultural employment in the rural areas, Central Region of Mozambique District Profiles.

Mozambique is located on the east coast of southern Africa between 10 ° 27 ' and 26 ° 57' Latitudes South and 30 ° 12 ' and 40 ° 51' longitude east. The country spans an area of 799,380 Km<sup>2</sup> (98% of dry land and 2% of inland waters).

The climate of Mozambique is tropical, characterized by two distinct seasons: a cool, dry season from May to September and another hot and humid between October and April. Rainfall is more abundant in the central and northern parts with values ranging from 800 to 1200 mm per year. The south of the country is generally dry further inland than on the coast where annual rainfall reaches 800 mm and decreases to about 300 mm in the District of Pafuri in Gaza. Mean air temperatures generally vary between 25 ° C and 27 ° C in summer and 20 ° C and 23 ° C in winter. The total population is 20 million and 854,000 inhabitants with 48.4 % men and 51.6 %

women (INE, 2008). Most of the population lives in remote from main roads rural areas (68.2 %). The population density is 26 inhabitants per Km<sup>2</sup>. The rate of natural population growth is 2.4 % and the fertility rate is 5.2 children per woman of childbearing age. The median age of the population is 18 years. The illiteracy rate is 51.9 % (2005), HIV prevalence is 16.2 % (2005) and life expectancy is 47.9 years (2008) and infant mortality rate of 99.2 (per 1000 births - live births, 2008). The GDP per capita is 349 USD (2006) (FAO, 2009).

The central region of Mozambique consists of 4 provinces namely Zambezia, Sofala, Manica and Tete. For better understanding of this research, it is critical to understand the profile of each district. The map in chapter 1 illustrates the location of central Mozambique relative to the whole country. Most farmers in Mozambique cannot grow more than one hectare per family. Yields are very low for most crops as the basic grains, an average of about 700kg per hectare proceeds are insufficient to feed a family whose average is between five members or more for family and much less cover expenses related to school and care health. Taimo & Calegari, (2007:1)

#### **4.3.2 Zambézia Province**

Zambézia province consists of 17 districts namely Gurue, Alto-Molocue, Namacurra, Ile, Gile, Pebane, Maganja da Costa, Mocuba, Lugela, Milange, Namarroe, Morrumbala, Mopeia, Nicoadala, Inhassonge, Chinde and Quelimane. The provincial capital is the city of Quelimane , about 1600 km north of Maputo, the capital city of Mozambique. With an area of 103,478 km<sup>2</sup> it has, since 2008, 5 municipalities: Alto Molocué, Gurúè, Milange, Mocuba and Quelimane. (State Department Report [SDR] (2005) Between 1997 and 2007, Zambezia had the second fastest growing population in Mozambique second to Nampula province in the far north, accounting for an increase of over 950 thousand people, representing an increase of almost 25 % (Francisco,

1998). Zambézia is the poorest province of the country (Francisco, 1999). State Administration Minister [MAE](2005) However, the districts of Zambézia province are characterized by rich soils and heavy rainfall with floods being a common feature in some of its areas.

Namacurra District is located south of Zambézia Province, bordered to the north by the district of Mocuba, to the west the Nicoadala district, to the south, the Indian Ocean and to the east, the district of Maganja da Costa. This district had an area of 2041km<sup>2</sup> and a population of 160 897 inhabitants by 1997 (MAE, 2005). Land is in abundance and agricultural production is practiced in mixed cropping schemes based on local varieties. Though marred by the 2000 floods with heavy rains that destroyed crops, years that followed have been marked with drought characterized by irregular and below normal rains which has resulted in a situation of food insecurity that persists until today. (ibid) Namacurra district was therefore selected for this study because it has relatively stable cereal production conditions (especially rice) and it was readily accessible by the researcher.

### **4.3.3 The Sofala Province**

According to SDR, (2005) Sofala is a province of Mozambique located in the central region, with a long coastline, in a recess of the Mozambique Channel. Its capital is the coastal city of Beira, located about 1190 kilometers north from Maputo. Sofala has a total area of 67.753 km<sup>2</sup> and is divided into 12 districts of Buzi, Caia, Chemba, Cheringoma, Chibabava, Dondo, Machanga, Maringue, Marromeu, Mwanza, Gorongosa and Nhamatanda. With little more than 1.64 million residents, the population of Sofala grew 21.5 % between 1997 and 2007, recording

an increase of over 350 thousand inhabitants in this period. Sofala is the confluence linking the South, North and West through the Beira corridor, an important and very ancient route used by the countries of the hinterland. It is bordered to the north by Tete and Zambézia , Inhambane in the south , west by the Indian Ocean with Manica to the east. The capital city is Beira, built just north of the old city of Sofala on previously marshy land next to a bay where there is currently located one of the major ports in the country and Africa. Gorongosa district was chosen for the present study. The family sector of Gorongosa district consists of about 15,000 households and about 86 % of them occupy the cultivated area (SDR, 2005).

It lies to the north and west with the Macossa district the southwest with the Gondola district, south with the district Nhamatanda in the east the districts of Mwanza and Cheringoma, and northeast the district Maringué (MAE, 2005). With an area of 6722 km<sup>2</sup> and a population estimated at by 97 221 inhabitants (2005), it has a population density of 14.3 inhabitants / km<sup>2</sup>. The average annual rainfall is approximately 1241 mm (MAE, 2002:2).

The rains are distributed unevenly throughout the year, with 55-72 % of the annual rains occurring in the period from December in many seasons. Gorongosa district was selected because agriculture is the main economic activity in the district although it is widely recognized by the existence of the Gorongosa National Park. This district is generally considered the breadbasket of Sofala province due to its geographical location, its potential agro – ecological, social and economic importance. However, the current state of development of the agricultural sector of the district is below its potential. The agricultural sector in the country plays a key role in food production and security in the supply of raw materials to the domestic industry and

export, the management of natural resources and development of the rural economy (MAE, 2005).

#### **4.3.4 The Manica Province**

Manica province is located in the central region of Mozambique. Its capital is the city of Chimoio, about 1100 km north of Maputo and 200 km west of the coastal town of Beira. With an area of 1,412,248 km<sup>2</sup>, the province is divided into 9 districts and, since 2008, has 4 municipalities: Catandica, Chimoio, Manica and Gondola. Manica with a population of about 400.000 residents was growing by 31 % between 1997 and 2007(SDR, 2005).

Gondola district is situated in the central area of the Eastern Province of Manica. Its borders are, to the south, the River Revue which becomes the separation with Sussedanga district, to the northeast is Goronogosa district (Sofala Province), to the east Nhamatanda district (Sofala Province), and the southeast, the district of Buzi (Sofala Province). This district has an estimated area of 5,739 km<sup>2</sup> and a population of 186 361 as of the 1997 census. Gondola has a population density of 41.2 habitants per km<sup>2</sup>. This district has agricultural potential which dominates the economic activity of the majority households (MAE, 2005).

#### **4.3.5 The Tete Province**

Tete is located about 1570 kilometers north of Maputo, the capital. With an area of 98.417 km<sup>2</sup>, the province is divided into 12 districts and has, since 2008, three municipalities namely Moatize, Tete and Ulongué. The province borders with Zimbabwe to the west and Malawi to the north. Tete is traversed by the Zambezi River and is in this region that the main electricity power source, Cahora Bassa is located. With its capital city also called Tete, it is the third largest

of Mozambique in terms of population, coming after Nampula and Zambezia, with a total of 1 783.967 residents. Between 1997 and 2007 the population grew by almost 42 %, the largest increase in percentage terms of all Mozambican provinces. Tete province is located on top of the central region of Mozambique, bordering with Malawi on the northwest, Zambia to the northwest, Zimbabwe to the southwest and to the south by the provinces of Manica, Sofala and Zambezia. Tete province has 12 districts namely Angónia, Cahora Bassa, Changara, Chifunde, Chiuta, Macanga, Hurt, Maravia, Moatize, Mutarara, Tsangano and Zumbo (SDR, 2005).

Angonia district is situated in the extreme North-West of Tete Province, and bordered to the north, northeast and east by the territory of the neighboring Malawi, South by Tsangano district, and the district Macanga on the northwest. Angonia has an estimated total area of 3.277 km<sup>2</sup> and in 1997 had a population of 260 804 and a population density of 101.4 inhabitants/km<sup>2</sup>, in this and other districts bearing the young population (MAE, 2005).

Of the 326 000 hectares of the surface of the district it is estimated that 150.000 hectare is potential arable land potential. However, only 50.000 are operated by the family sector (MAE, 2005). The district of Angónia is recognized as a region of high agricultural potential owing to its climate, rainfall patterns and soils and has thus attracted a large community of farmers (MAE, 2005). This was the reason why the researcher selected this district for analysis.

#### **4.4 Cereal Production in Central region of Mozambique.**

This section presented, interpreted, and analyzed data gathered from the four districts of Namacurra, Gorongosa, Gondola and Angónia. Document analysis on cereal production patterns in Mozambique was critical for the appreciation of the levels of cereal production in the country.

For clarity, this section was then divided into the input sector and the output sector. The input sector dealt with the critical input factors for production of cereals, some of which were drawn from reviewed literature (Salam, 2012), and analyzed how these were applied in the Mozambique context. Agricultural production highly depends on the natural resources mainly the types of soils and rainfall patterns. In order to achieve increased production of agricultural produce however, land preparation, type of seeds, quality of seed, fertilization of soils, and sowing patterns are critical inputs in cereal production as well.

The output sector includes storage of grain after harvesting, marketing of the produce and infrastructure, agricultural extension support including farmer training. Research is a critical component of the input/output of agricultural production as well; hence it was covered under this section.

#### **4.4.1 Cereal Production Patterns in the Central region of Mozambique**

On crop production, it shows that Mozambique only generates annual surplus in maize in the order of (75 tones) and has an annual deficit of 350.000 tons of rice and 467.000 tons of wheat (FAO, 2009). Despite the great difficulties which the Mozambican smallholders encounter, their contribution in reducing poverty in the country as shown in the need to achieve stability in the production of cereals, especially maize which is the country's staple food, is important. However, there is a deficit in the production of rice because the cereal consumption amounts up to 600.000 tons per year while the country's total production is estimated at 250.000 tons in an area corresponding to 240.000 acres, the resulting deficit being covered by imports of 350.000 tones, corresponding to 58.33% of the total needs of the country INE (1994 cited in FAO, 2009).

As you can conclude along this section, the different types of producers had a clear productive specialisation. The following table shows this specialization, with the most important productions.

Table 4.3: Production of cereals in the last five years

	<b>Corn</b>	<b>Sorghum</b>	<b>Finger-millet</b>	<b>Rice</b>	<b>Total cereals</b>
2000/01	1,143,263	313,787	61,602	166,945	1,685,597
2001/02	1,235,657	314,136	49,500	167,925	1,767,218
2002/03	1,247,897	314,590	48,021	200,437	1,810,945
2004/05	1,382,139	307,543	35,935	173,770	1,899,386

Source: Department of notice. DINA, Provincial Directorate of Agriculture of Zambézia [DPAZ] (2012)

According to the report of DPAZ (2012), the agricultural sector in Mozambique is composed mainly by household sectors that practice a subsistence agriculture, which depends mainly on rainfall. In recent years, the country has registered a significant improvement of agricultural production this improvement has been attributed mainly to the expansion of cultivated areas and/or the improvement of climatic conditions in some areas of the country; there is still no empirical evidence that the growth of production in the country, may have to do with the increase in cereal productivity; indeed this has been an issue often ignored when analysing the agriculture in Mozambique.

## **4.5 The Input Sector**

This section presented, analysed and discussed data findings from the four districts. It covered land preparation, the natural resources – soils and rainfall patterns, types of seeds, quality of seeds, sowing, fertilization, weeding, harvesting of cereals in the four districts A to D.

### **4.5.1 Land Preparation**

The researcher looked at the information for this research using the research questions that formed a basis of the analysis for low production of cereals in the central region of Mozambique. As already mentioned, the data were analysed and six themes emerged. The first theme was land preparation. Participants for this study all expressed that they had enough fertile land for cultivating cereals of maize, sorghum and rice. Data also revealed that in this region most communal farmers use the rudimentary farm implements of hoes. Tractors are nowhere to be seen in these smallholder farms.

One informant confirmed the fact that in these districts there are no tractors and only rudimentary farm tools are used by farmers to prepare land by saying “Land preparation is basically by resorting to the use of the hoe and plough and animal traction, this instrument is commonly used in the regions or communities where they have cattle. I do not use tractors because there is none” Another informant also confirmed lack of mechanical farm implements by saying “land preparation is done by using short-handled hoes due to lack of tractors in the communities”.

Observations by the research team confirmed this: To clean the land for ploughing, farmers just cut trees and burnt them. In several new or relatively new fields, there were many tree stumps which the farmers eventually clear by burning or by cutting as years go by. During the planting period, these plants interfere with crops by either reducing the number of plants per hector or by growing small bushes around the stump or along the undisturbed roots. This method of land preparation, particularly by using hoes, means the depth of the prepared ground is shallow which may affect the growth of the plants' roots. This means of land preparation thus results in very low yields for the farmers. Most farmers concurred that they could produce more than what they were currently producing if they used tractors to plough. From the district directors' point of view, it is possible to attain higher yields per hector in each of the districts under study but most respondents expressed the feeling that they got far less than the expected statistics. The following table 4.4. Was constructed from data gathered to answer questions addressing the total arable land, average production quantity and the yields that farmers attained in the 2012 agricultural season.

Therefore, for the successful production of cereals it is important that preparation of land or soil is carried out with the aim of facilitating planting, to ensure a better root development and incorporate them together with the cultural residues. The sequence of events to be performed during this phase depends on the stage of exploration of the area, the level of technology to be employed, the amount of cultural residues and the characteristics of soil.

Table 4.4: Total Arable Land and Yield per Hector

<b>District</b>	<b>A (Namacurra)</b>	<b>B (Angonia)</b>	<b>C (Gondola)</b>	<b>D (Gorongosa)</b>
Total arable area	50.072 ha	84,528 ha	67,543ha	78,910 ha
Average quantity produced/ household	1.5 tons/ha	3.5 tons/ha.	2 tons/ha	2.5tons
Total possible quantity per district	66.500 tons	195 876tons (maize)	42,428tons	142 653tons
Deficit (-) / Surplus (+)	9 958 tons	99 976 tons	92 658 tons	54 622 tons

Source: District Agricultural Officers Statistical Records (2012)

All the farmers went on to explain that they prepared their land early enough to be able to use the early rains. However, in cases where there was hard soil, they had to wait for the first rains to fall so that it could be possible to break the ground. A farmer from district B (Angónia) said that “Early land preparation for opening farms for the cultivation of maize and sorghum is done in the months of September to October, shortly after the fall of the first rains” and another farmer from district C (Gondola) also expressed the same sentiments by saying “The preparation of the cultivation of maize and sorghum is in the months of September to October soon after the first rains fall”.

However, in district D (Gorongosa) and A (Namacurra), land preparation is usually done soon after winter. A farmer from district C said: “I start preparing the land immediately at the end of

winter for the production of corn and sorghum.” From district D (Namacurra), the president of all associations and a seasoned farmer said: “I start the process of preparing just at the end of the cold period for the cultivation of maize and sorghum, while for rice I start in October. In principle I try to choose almost flat land and land that is a bit – sandy.” The period of land preparation thus varies with the region. Given the level of awareness to prepare land by the farmers, it is possible for these farmers to achieve high cereal yields if they were given the right land preparation knowledge and the requisite land preparation machinery. All this was summed up by the leader of the agricultural district D who said, “..... But, the land preparation is very slow due to lack of quick instruments which have constant breakdowns. Our producers do not wait for the tractor; they just use the means at their disposal such as, the hoe and cutlass for farming land”. This means that farmers in all districts end up tilling less hector age that they could possibly achieve, further reducing the cereal yield per district. As noted in the research, the biggest challenge for farmers in all districts was the very rudimentary means of production, for example, short-handled hoe, and this is one of the key reasons for the low production of cereals in the central region of Mozambique.

#### **4.5.2 The natural resources soils and rainfall patterns**

As reiterated in the reviewed literature, Mozambique is included in the SADC countries that are potential cereal barns (countries or regions of great cereal production). Highly productive soils and a lot of water were cited as key natural resources that promote high cereal production levels in these SADC countries including Mozambique. All respondents in this research expressed the feeling that they were located in very fertile lands and that the rainfall patterns are almost always suitable for bumper harvests except in some years of floods when only the fields on higher

ground produced good yields with low lying areas experiencing crop failure. This showed that there was great potential for central Mozambique to produce high cereal yields.

### **4.5.3 Types and quality of seeds and Sowing Methods**

This theme addresses the issue of quality of seeds used by farmers in cereal production in different regions. This section discussed the different types of seeds with particular reference to the types of seeds farmers grow in the central region of Mozambique. In addition, it examined the way the seeds were sown by the farmers.

Under the programme of food production, designated by full name first PARPA, and approved by the Government in 2009, the Ministry of Agriculture, through its provincial directorates of agriculture, has purchased and allocated to farmers seed although in quantities not sufficient for all farmers throughout the vast Mozambique. As stated in Chapter 2, this research focused on production of maize, sorghum and rice. It was found out from this research that when planting the maize and sorghum seeds, the farmers use a lot of seed per whole (more than 4 seeds per hole), which contrasts with the technical recommendations using 2 seeds.

When sowing rice however, the farmers preferred either to broadcast the seed in the prepared ground as they paced from one side of the field to the other, or they planted a lot of rice in a very small portion the transplant it when the first rains fall. However most respondents in all districts expressed that the quality of seed they get from government is either insufficient or unavailable to all farmers and the farmers end up using second generation seeds from their previous harvests. A seasoned farmer from district D said, regarding the quality of the seed used by farmers, “The seed that I get from the Government is not enough. I use grains that I keep in my house from

selection of part of the production of the previous season. Some of these grains do not germinate easily, needing to use a lot of these grains in a single hole to promote germination. In the past there were organizations and seed production companies for example, the seed of Mozambique (SEMOC) which were dedicated to the production of seeds and the Government was doing the distribution and sale at very low prices” Information from the government officials revealed that failure to get seed from the local market by farmers was due to bankruptcy of the companies that formerly produced cereal seeds. The farmers thus resort to their poor seed quality which was kept in their barns without any treatment or selection. This alternative source of seed caused poor germination and poor crops.

In addition to poor seed quality a farmer from district C highlighted interesting observations when he said “the Government and other NGOs provide seed but the amount they give out is not enough to satisfy all the farmers. Thus, the solution is resorting to grain stored at home in barns from selection of part of the production of the previous marketing year even though I am not always sure whether or not it will even sprout.” As the same farmer from district C elaborated, “In the production of cereals we don't use improved seed; we use a lot of seed in each whole (5-6 grains to encourage germination among other reasons”

In all districts the government officials concurred with these responses. This shows that even if the land was well prepared and good rains fell on good soil, it was very difficult for the farmers in central Mozambique to produce cereals at capacity. It was agreed between the researcher, the farmers, focus groups, association leaders and government officials that drastic measures needed to be put in place for the production of cereal seed in Mozambique in order to achieve higher yields.

#### **4.5.4 Crop Management – Fertilization, Weeding, Pest Control and Harvesting**

Salam (2012) expressed the feeling that farmers in Pakistan were worried about low fertilizer production for their cereals, farmers in central Mozambique were satisfied with the fertility of their soils to the extent that they despised using fertilizers arguing that the land that is fertile and does not need fertilizer. It is common farming knowledge that crops occasionally suffer from nutrients deficiency at one time or another. Apparently the farmers involved in this research had no idea about this fact. This may be attributed to lack of farming training and ignorance due to lack of exposure and no or low education levels which resulted in respondents being more inclined to cultural beliefs against fertilizer. For example, a respondent from District A (Namacurra) expressed that “the soil is so fertile that there is no need for applying fertilizer”, sentiments which were expressed by farmers in all districts. Contrary to this belief, the government agriculture experts all expressed that use of fertilizers could indeed boost cereal yields in central Mozambique.

Crop management includes weed and pest control as well. Since crops are grown manually, weeding is done manually as well. In some cases the fields visited during the mid-season were observed to have tall grass growing together with the crops. This was so due to either the plants being very closely spaced with limited spaces for people to weed without breaking some plants. In some cases it was difficult to weed due to heavy rainfall. Asked if they could use herbicides, all respondents expressed that it was not possible in their districts.

For pest control however, the situation was different. It was revealed by the respondents that the farmers neither had the pesticide nor the spraying equipment that they could use if they could get the pesticides from other sources. The farmers argued that they use more seed per hole to prevent

the attack of insects and/or birds or rats that consume the seed before germination. A farmer from district C summed it up by saying “I use a lot of seed in each hole because of mice and birds that dig and eat the seed or the germinating plants. We have to plant 5 – 6 seeds in each hole because here there are many insects and pests that chew our seeds and we don’t control pests and diseases due to lack of proper equipment and pesticides for use on farms”. In Gorongosa for example, monkeys and baboons are rampant and they could be seen crossing the main road at any time of the year. If left unmonitored, these animals wreaked havoc to the crops especially green maize and this substantially reduced yield.

In addition to non-use of fertilizers, poor weeding practices and virtually no pest control, the cereal farmers in central Mozambique practiced poor harvesting mechanisms. Respondents in all districts explained that they harvest their crops manually whether they had a bumper harvest or not. Each farmer literally walked through his/her field with or without the assistance of family, picking grain or cobs as the case may be. This method has limitations related to the human factor. It was confirmed that a lot of grain was lost due to fatigue, or inability to gather that grain the harvesters failed to see, or for other reasons. Of interest was the response from respondent from district B who expressed that in district D, “He still uses traditional means of harvesting such as sickle and knife to reap rice and manually harvest the corn. It takes my family and I a lot of time to harvest as we divide the labour between harvesting and chasing away animals and birds and this results in us losing a lot of grain.” Thus, poor crop management contributed to inability to attain higher yields by the farmers in all districts.

#### **4.6 The Output Sector = Pricing, Storage, Infrastructure, and Marketing of Cereals in the Central Region of Mozambique**

Grain production cannot be complete without measures to ensure that the produced grain is well priced, stored and marketed. According to Salam (2012), prices greatly influence farmers' choices of the types of cereals they produce. The cereals under study are all well consumed in Mozambique. Being a vast country however, the cereals produced by the farmers are always below the consumption requirements since the production usually always falls below the possible output. This greatly influences government pricing decisions since demand always surpasses supply. Government thus highly subsidizes the cereal prices since substantial amounts are imported to augment the local production levels in an effort to reduce starvation.

As for the storage of grain products farmers in three districts expressed that they are hesitant to send their grain to government grain silos because if they experience grain shortage in the following season it becomes difficult to get their produce back and they would suffer from starvation. This means that the produce per individual farmer usually falls far short of bulk storage requirements. The focus groups in the three districts A, C and D, that is, Namacurra, Gondola and Gorongosa respectively, were in agreement that “the production has not been too high to seek storage in silos. So we store our produce in our household barns or in Community warehouses organised by our association.” The main challenge these farmers faced was that of lack of pest control. Thus most grain would be lost while in storage. However, for district B (Angónia), it was interesting to note that the farmers had excess produce in most seasons and they store their large granaries were built for grain storage. As one farmer puts it, “We do not have individual barns to store our products, but we built big granaries or crop storages near our

homes or communities storage of our grain”. On observation the household farmers had small storage barns but in all districts except Gondola there were large silos as shown in Figure 4.1 below. The district officials explained that these were strategic reservoirs that the government has put in place for large scale producers and the smallholder farmers do not use them. The farmers confirmed that by saying “the existing silos in Namacurra are in the interest of the local government, there is nothing for us small producers. We cannot even eat from these silos, it is all for government.”

Figure 4.1: Storage of Cereals, Gorongosa District



Source: Commerce Industry Ministry [MIC] (2012)

Such silos exist in district A, B and D. However, the small scale household farmers could be motivated to increase cereal production if government puts in place incentives for production and these silos could be fully utilized for grain storage. There are no pests in such storage reservoirs and it could benefit not only the two parties, government and household producers, but the nation at large.

According to FAO, WFP & IFAD (2011) the institutional capacity to maintain and manage a food reserve system should be evaluated carefully. Even in more liberal economies, government plays a dominant role in the implementation of a food reserve policy as well as in the supervision and operational decisions. Maintaining a food reserve to guarantee supply for a certain length of time due to seasonality of production involves substantial economic costs. Mozambican experiences over the last two decades to establish food reserves proved to be costly and difficult to administer. The government has stated that food reserve is part of an emergency policy (floods, cyclones, and drought) and not as a way of controlling supply or effect price stabilization. Currently there is an emphasis on encouraging households and a community response towards food reserves in order to avoid free food distribution in times of emergency. There is no capacity to evaluate how communities are able to respond or mitigate for natural disaster or how food markets behave in times of shortages. The National Strategy for Food Security and Nutrition contemplates government interventions to “ensure adequate food reserve for distribution in the event of sudden and unexpected natural disasters, when there is a need for rapid distribution of food aid and local or imported supplies cannot be obtained quickly”. In colonial times, the former Cereal Institute of Mozambique, a monopoly to state unit to trade cereals, kept stocks in specific food deficit areas. Soon after independence, severe flooding hit the country, and an FAO mission recommended the establishment of a revolving stock of 60.000

tons of cereals. An initial stock of 5.000 tons was provided by World Food Program. Expected donations from other donors to complete the target never materialized. Four successive replenishments of 5.000 tonnes were made. Other problems associated with the National reserve were the high cost of handling and storage, and the corruption that was involved in the management of the reserve. The emergency appeal launched in 1992 proposed the setting up of 60.000 tons to cover delays in food shipments, but donors did not respond. The European Union maintained a reserve of 20.000 tons; the cereal was used and not replenished. A further 15.000 tons was established in Beira (FAO, 2011). The stock was not used and deteriorates due to delays in decisions how to use the grain; finally it was sold for animal feed at a later date. The government continues to express interest in having a strategic stock and further studies have been commissioned to investigate the viability of the proposal. The late 80s and early 90s were marked by a strong dependency on food aid. With the end of war and a sharp increase in production demand for food aid was reduced.

Mozambique is well known for its rugged terrain and poor infrastructure. The roads are very poor and there are some areas where there are virtually no roads. It was very difficult for the research team to access some remote areas hence only those areas close to the accessible roads were focused on in all districts. This means that the farmers in remote areas walk long distances to get to the roads thus most farmers choose to settle in areas that are close to roads. This results in huge land lying idle while people crowd in some places. The pieces of land utilized for crop production along the roads is therefore much smaller than the land that would be allocated to those farmers who choose to settle in the remote areas. Poor infrastructure thus hinders large scale cereal production by the farmers. Even the government extension workers and officials confirmed that they do not visit remote areas because there are no roads. In addition, poor

infrastructure implies that it would be difficult for farmers to access agricultural facilities and the farmers only take small quantities of goods when they visit shops thus they cannot procure large quantities of agricultural inputs which negatively affects production. Even for those farmers close to the roads it was observed that there are no roads to their fields and they manually carry their inputs to the fields and then carry their produce to their homes during harvest time. This limits the volumes of cereals each farmer produced.

The concentration of cereals produced depends on the location of the farms. In Namacurra more rice and maize were produced than elsewhere while in Angonia, Gondola and Gorongosa more maize and sorghum were produced than rice. Thus, whereas one district did not have much excess produce, it was possible that there was excess produce of one crop or another in other districts. This means that marketing considerations are critical in the districts. In addition, it was in this research's interest to find out the factors the farmers considered critical in producing large volumes of grain. Responses from respondents in all districts agreed that the natural resources, inputs and outputs were all critical considerations in agriculture in general and cereals in particular. As one farmer explained, "here in Namacurra, there is more rice production followed by maize with very few quantities of sorghum. This is because the plain area is low enough to favour the cultivation of rice with maize being grown on fields located on higher ground." The government officials also affirmed that the types of soils and rainfall patterns in district A favoured production of more rice than in other regions, with region B being suited for mainly maize production and the other two being suitable for maize and sorghum production. This is owing to the nature of the soil and differences in agro - ecology (Sitoe, 2005) in the provinces of the regions in the centre of Mozambique.

These production patterns have implications for marketing of the produce. Though cereal production by household farmers in central Mozambique is basically subsistence as explained earlier, there is a large flow of buyers who come from the South of the country, basically demanding maize and in the north people come from Malawi looking for maize. The big challenge for farmers is to price their produce at competitive prices. Usually low prices take precedence immediately after harvest and with higher prices being charged later on or when there is occurrence of bad harvest. However, the low prices negatively affect the farmers since they need money to pay debts incurred during production, to pay for labour and for school fees for their children as well as land taxes. However, producers of rice in district A suffer because the producers are forced to sell only rice at a prices below the cost of production due to the high costs of producing rice and the availability of rice in shops from large scale producers or from imports.

Thus, the inputs and outputs used in cereal production in central Mozambique were all on the downward trend. This greatly affected the volumes that the farmers could produce even if the natural resources were highly favourable for production of the cereals in central Mozambique.

#### **4.6.1 The Role of Research in Cereal Production in the Central Region of Mozambique**

As alluded to earlier, the use of traditional farming methods, the low quality of seed that was planted in the central region of Mozambique, the lack of pest and herbicides control and the storage challenges faced by the household farmers all point to a weak relationship between the research system of a country in agriculture. There is need by government to identify areas of focus and channel funds for agricultural research. There is a certain concentration for certain areas of research over others, for example, the area of plant sciences covers 38% of the

technicians of IIAM, 29% against research on natural resources and 28% in the area of animal science. (Uaiene, 2006) Here, no mention was even made for agricultural research. However, through the State General Budget (OGE), there has been significant progress in channeling of the funds needed for agrarian researches that take into account the needs of local development based on agro-ecological potential, and there have been great strides in increasing production and productivity. Agricultural research is closely related to the analytical capacity in the agrarian sector in Mozambique and a well-structured research system may involve government, the private sector, Non-Governmental Organizations (NGOs) and learning institutions as (Salam, 2012) highlighted in his paper.

Mozambique currently lags behind all other countries in Southern and East Africa in the field of maize yield. In 2004 his income on corn hit an average of 960/ ha compared with 1500kg/ ha for Kenya, 1100kg/ ha for Malawi, and 2600 kg/ ha for South Africa (FAOSTAT, 2005 cites Uaiene, 2006, p.1). These low yields are a reflection limited use by Mozambique irrigation technologies and inputs that increase income such as fertilizers and improved seeds (Uaiene, 2006).

#### **4.6.2 Technology and Human Resources**

The productive activity demands the use of different technological means as a way to reach the best results along the productive process. This section attempted to analyse the role of technology in cereal production in the central region of Mozambique. As mentioned earlier, the most common tools used in central Mozambique agriculture are hoes, sickles, knives and to a lesser extent, tractors. There is no irrigation and farmers rely on the natural rainfall for their crops. Discussion with focus groups throughout the district brought out the following sentiments

from farmers across all districts, “in our district there is an absence of motor pumps, motor cultivators, tractors, trailers and any advanced agricultural equipment to be used in our farms. We just depend on the rains, there is no irrigation here” Even from the intervention of the members of the government regarding the existence and availability of the means for flexible cereal production in the country and in the districts where the study was taken in particular, there was clear evidence that there was no mechanized equipment available for farmers. According to Mosca (2010) there is very little investment in the Mozambican cereal production sector with the government opting to invest in sugar, cashew, and tobacco and cotton where there are advanced improvements.

To shift cereal production from subsistence to productive levels and achieve positive incomes for the cereal farmers as well as possibly reduce poverty levels, there is need to introduce technology innovation in the cross section of the cereal production process and support services. Moreover, it can be affirmed that the Mozambican government shows to be reserved on the agrarian sector financing, particularly in cereal production because of being a sector with few benefits comparatively to other sectors. Figure 4.2 below clearly illustrates the consequences of applying rudimentary farming practices in agriculture. The crop is very healthy but poor germination is evident as alluded to earlier on.

Figure 4.2: Technology Used, Namacura district



Source: Author, 2013

Thus reliance on traditional family production models falls short of maximizing cereal production in central Mozambique.

#### **4.6.3 Technical Assistance in Cereal Production**

The Support of the Government and other institutions in the production of cereals is critical. Studies have shown that individuals organized in associations and / or groups of producers allow better intervention, facilitating better monitoring and evaluation of the performance of resources as such beneficiaries well organized, with very clear objectives. Thus, this section was focused on the role of technical assistance in respect of the cereal producers associations because it difficult to target or assist individual farmers in isolation.

Both the government and other entities responsible for providing assistance or other support, the associations come as a valid and only viable alternative option for forwarding all types of services to a certain target group. Thus inquiry was made about the government and/or other organizations' support for farmers in the smallholder sector in each district.

The association leaders in all districts confirmed that district extension workers from government and other organizations have offered them technical assistance in producing cereals. One of the respondents had this to say, "There has been extension workers from government and other NGOs who used to come to our farms to teach us many important things on production, also sometimes they called us for training and taught us many things; both on how to produce and sell our products. They gave us seed and some pesticides, although not for all of us and not always. They also taught us how to keep the products in improved barns".

However, from observation it revealed that if these farmers received any technical assistance, either it was irrelevant or they did not understand what they were being taught. The farming methods they employed were divorced from modern technical teachings. Therefore more questions were asked and some farmers then revealed that most of this training was targeted at farmers of other crops not cereals. As two of the respondents elaborated "We get training through the following organizations, ISCO (Trade Union Institute for Development Cooperation and Emilia Romagna), NAFEZA (Core Association Sheer Zambézia), ARC (Association of Recreational Culture Solidarity) , plus we get support of seed from the government despite it not being enough. We do not receive funding for implements in cereal production" and "... we get training and skills through field workers, both government and FAO (Food Agriculture Organization) Caritas, Christian Council, World Vision, Care, among others. We also receive

support from seeds, although not sufficient. We did not receive funding for implements in cereal production, only those in the production of cotton and tobacco were given funds for implements” This was confirmed by respondents in other districts as well as by government official who added that some of these organizations no longer support the farmers, especially in Gorongosa where they cite security fears.

Basing on the statements and analysis of the inquired participants, it can be stated that the government offers assistance to the farmers was at an unsatisfactory level. It is also relevant to point out that there is little covering offered either by the government as well as other sectors in the Mozambican productive sector. Different sectors in the family productive process play an important role to make agriculture easier. The assistance offered by the government and other institutions is relevant and it needs more than what is done because the producers of cereals do not have the know-how of agriculture and other agricultural training areas. None of the interviewed groups referred to any financial support thus the study showed that there was no reflection of a financial plan for the cereals producers.

#### **4.6.4 Policy Considerations in Cereal Production in Central Mozambique**

Government policy in agriculture is critical especially as every country is expected to live up to the United Nations’ Millenium Development Goal of eradication of hunger. It is possible for Mozambique to achieve high level of cereal production if government puts in place relevant intervention policies. This section thus, looked into policy considerations for cereal production in Mozambique, with particular reference to central Mozambique districts. This section examined only the land tenure and food security policies in view of the objectives of this research.

#### **4.6.5 The Land Tenure**

In Mozambique, the land belongs to the state and community leaders legalize the exploitation of the land and grants it to the citizens for use according to law as amended in 1997, according the article 109, and the land is considered state property and must not be sold or otherwise alienated, mortgaged or pledged. As a universal means of creating wealth and social well-being, the use and enjoyment of land is the right of all Mozambicans (FAO, 2009). The law gave more power to community leaders to about land use Data from the interviews and focus group discussions revealed that in Mozambique land belong to the state and as such the villagers are allocated land for agriculture by local community leaders.

According to (FAO, 2011) many analysts consider that the most important asset for the peasant community is the right to use the land, and although this is an over-simplification of present rural livelihoods in Mozambique, it is clear that land is one of the central issues for stability and food security. A legal framework was established to guarantee farmer land tenure, thus creating confidence for investments. However, illiteracy, lack of negotiating skills, isolation, and traditional beliefs has hampered the ability of the small-scale farming sector to take advantage of the law. An increasing number of foreign commercial farmer and companies have requested legal rights to use the land creating conflicts with local communities. The Land Tenure Law is very ambiguous on several issues: there is lack of definition in the terminology used that is public interest land, reserved land and ways to compensate communities for losses of land rights. In this context, several NGOs are helping small farmers understand the law and stand up for their rights. In particular the implementation of the law does not appear to be protecting pasture rights and the rights to the use of the fauna and flora from the forests. There are some areas where land

pressure is an issue; a situation that will become even more evident over the next decade. More recently the management of natural resources has come to the forefront of government policy due to the massive undertaking of the cross-border game reserve; participation and protection of rights of residents in relation to the exploration of the forests and fauna. Problems are faced when implementing the laws and procedures due to the lack of capacity on the part of the government, the lack of information available to communities for rights protection and inexperience in the management of processes of participatory planning.

In analysing and interpreting the data and the researcher's observation in the field showed that land belonged to the state through the government representatives or community leaders who are responsible for the allocation of land to interested parties in all districts. However in Gorongosa district there was conflict issues raised. These resulted when community leaders sometimes granted the same piece of land to two farmers. In Angónia, due to the prevalence and subsequent exploitation of other natural resources (coal in particular), there were cases of scrambles for land in which case in some areas land sizes had to be reduced in order to accommodate more applicants. Thus, over the years, land for cereal production has been very easy to obtain, and some has been passed on through inheritance which is also within the statutes. Respondents in all districts confirmed that land was not difficult to secure. With abundance of land, this research found out that there is great potential for cereal production in central Mozambique.

#### **4.6.6 Food security**

Food security is referred to as the right that everybody has every time to have physical, economical and sustainable or adequate food, in quantity, acceptable quality in the cultural context to satisfy the needs preferable food for active and health life. In this context, there are five implicit dimensions regarding the production and availability of foodstuff namely: Access, use, adaptation and stability of the foodstuff in a given region or family.

As was evident in research, production levels by cereal farmers in all districts fell far short of capacity. Though the individual farmers may have had sufficient or excess grain in some districts (particularly Angónia and Gorongosa), these supplies were not sufficient enough for the same farmers to create buffer stocks for future consumption or even for self-sustenance for more than one season, example one of the participants of District D said "I have been hungry because I have a lack of food ,maize and sorghum last year is over and this time to live I go to work in the fields of others to have food". All in all, the situation of food security within the rural populations of central Mozambique was found to be unstable. Agriculture in recent years has suffered from irregular rainfalls, with long hot and dry seasons which affect the production of grains in particular. Such drastic climatic changes have affected the levels of production and productivity which in long terms, especially production that relies on the natural climatic environment. In its report about the climatic changes, FAO (2009), calls for attention to the necessity of taking urgent measures to mitigate the effect of climate changes in the medium and long terms. With all this, the food security issue in Mozambique remains a challenge that all stakeholders need to diligently address.

## **4.7 Conclusion**

Data generated were presented, analyzed and interpreted. From the findings the researcher concluded that land belong to the state and is distributed to the people through their government representatives or community leaders. It was seen that in the districts of Namacura, Gorongosa, Gondola and Angonia land preparation for the production of cereals is done using rudimentary farm implements such as hoes. It was noted that the biggest problem for farmers is the continued use of rudimentary tools such as the hoe, and this is one of the key reasons for the low production of cereals in central Mozambique. Regarding the market, it has been understood that there are disagreements among districts studied because the producers sell cereals at very low prices and are disorganized, so the resources used during the production of cereals are not recovered. The following chapter which is the last of this thesis concentrates on summary of the thesis, conclusions drawn from the findings and finally recommendations.

## **CHAPTER 5: FINDINGS, DISCUSSION, CONCLUSIONS, RECOMMENDATIONS AND SUMMARY**

### **5. Introduction**

The summary of this study is presented in this chapter. Major conclusions are highlighted based on the research questions. The researcher also highlights the recommendations that will be instrumental to policy makers and trainers as they strive to make farmers more productive and reduce poverty and hunger in Mozambique.

#### **5.1 Findings**

The findings from this research indicated that the land belongs to the state and that the government representatives or leaders of communities make the allocation to those concerned. Data clearly show that in the districts of Namacurra, Gorongosa, Gondola and Angónia, community leaders are a key part in the allocation of land for the production of cereals. Data also show that there have been land allocation conflicts as was observed in the district of Gorongosa while in Angonia more people were involved in agriculture than in years prior to the exploitation of mining resources in the province.

In relation to the preparation of the land for the production of cereals data revealed that the farmers in the study area still use rudimentary tools for example, the use of traditional hoes and cutlasses, which contribute to the low production of cereals in the central region of Mozambique.

With regards to types of cereal production data reveal that the main cereals are produced in the central region of Mozambique are maize, rice, and sorghum. Among them, the most prevalent is the production of corn. These products are harvested using crude instruments such as, knives, sickles and hoes. Practically this is noticeable in all districts studied during the period of harvest the farmers lose a lot of produce especially when harvesting rice and sorghum. In the case of maize there is more wastage when it is being threshed.

As regards the process of storage data show that in all the districts people use the household barn system, which means that, when there is surplus in cereal production it is stored in homemade barns. This system makes the produce susceptible or prone to pests. Even though there are silos in Gorongosa, these are for large producers of cereals and are not used by the small scale producers.

In relation to the cereal market data showed that production of cereals in all the districts is still merely for subsistence and very little, if any, could be set aside for the market. However, there is a large flow of buyers coming from the South of the country to Gorongosa seeking for corn basically, and to Angónia also, many buyers from Malawi come demanding for corn. Data indicated that the great challenge for farmers is that they sell their cereals at very low prices agreeing with what Uaiene (2006) stated, and the market is disorganized. In general there is no structured market because cereal production in the central region of Mozambique is for subsistence.

In relation to quality of seed used data showed that generally, the farmers used seed from the selection of the part of the production of the previous year due to the lack of certified seed, a fact that contributes to the low production and productivity of cereals in the central region of

Mozambique. However, under the Program of food production, designated by PEMFA- Public expenditure management and financial accountability, and approved by the government in 2009, the Ministry of Agriculture through its provincial directorates of agriculture, do purchase and allocate seed to farmers though the quantities are not sufficient for all farmers distributed across the vast Mozambique. The issue of more seeds used during planting (more than 4 seeds), is in contrast with the technical recommendations (2 seeds per hole), is directly related to the need for prevention of the attack of rats, insects and/or birds that consume seed before germination.

The seed used in the production of cereals has not been certified because the farmers use grain instead resulting in difficulties in seed germination. Support from the Government and organizations have been very isolated or non-existent in the distribution of seed, as many businesses closed. This research also established that training and technical assistance provided has been very weak and in some cases, irrelevant. These observations lead to an assertion that though central Mozambique has abundant land with good soils and farmers who were keen to produce cereals, the conditions under which they operated made it difficult for them to attain their production capacity.

Another revelation for the low production is lack of tractors, cultivators, animal-drawn plows, and pumps for irrigation of fields, improved seeds and pesticides. Clearly the production of cereals in central Mozambique still depends on rain and no irrigation system because agriculture obeys normal growing seasons, so it continues to produce in limited quantities while the family or population grows geometrically.

With regard to food security data revealed that there is high food insecurity in these districts irrespective of their high production potential. In addition, the research also revealed that there is

need to establish secure and systematic means of preserving the harvested grain. Infrastructure is deplorable in the central region like elsewhere in rural Mozambique. The research found out that movement of goods was very difficult for the farmers in all the districts. The poor infrastructure affected the farmers throughout the agricultural process from input sourcing to harvesting of their produce. This significantly influenced the hectare under cultivation, further reducing volumes of grain.

In relation to technologies and human resources data reveal that there is very low use of tractors, cultivators, ploughs of animal traction, motor pumps for irrigation of the fields, hybrid seed, as well as pesticides for the control of pests and diseases. Based on (Mosca, 2010) there is little investment in the agricultural sector for motivation and encouragement of this productive sector.

As regards the support of government and other institutions in cereal production, data revealed that the government provides assistance to farmers at a level still not satisfactory. Data show that there are different actors in the process of production; however family members play a very prominent role in the promotion of agriculture. Data also indicate that there are interventions carried out by different partners in this key sector. The assistance of the government and institutions is so important and needs to be improved, because the producers of cereals do not boast of training in the area of agriculture. For this reason the assistance is considered isolated and insignificant by the producers of cereals.

Data indicate that financial support for the production of cereals is non-existent and that reduced the levels of cereal production. Data also indicate that government does not take action, neither does it have strategies that streamline the sector of production of cereals, for example, the sector of seeds where existing policies do not only seem to protect the farmer. In addition, this research

revealed that organizations that want to help the farmers but are facing enormous difficulties due to lack of clear policy on production and the deteriorating security situation especially in Gorongosa.

## **5.2 Discussion**

In the context of possession and preparation of the land the interviewees were unanimous in asserting that the community leaders are a key part in the allocation of land for the production of cereals. This is in line with law on the use and utilization of land approved in 1997 says that Local Communities are to be treated as legal entities that have power over communal land (ORAM & ROSA, 2010).

As for the preparation of the land for the cultivation of cereals data revealed that the system of ploughing using traditional hoe and cutlass, contributes to low cereal production. This was confirmed by Nakhuma et al (1999) who assert that the central region of Mozambique is faced with a considerable limitation of the use of technologies to reduce hunger. In addition Mosca, (2011) says that the change in agricultural technology in Mozambique is particularly urgent for the central region of Mozambique, because it is a region that has potential, but remains poor in cereal production.

In relation to types of cereals grown the study confirms what Siteo (2005) and Uaiene (2006) say that maize, rice and the sorghum are best grown in the Central region of Mozambique, with more predominance of corn.

The cereals market is so weak due to the practice of a cereal production of subsistence that, because of this, cereals are mostly not for sale. According to (Uaene, 2006) the lack of markets

for domestic production of cereals are contributing poverty in a great way, at time that the markets of the agricultural sector are not perfect (Negrão, 2002).

The producers have unanimously expressed concern over the use of seed from the selection of the part of production of the previous production year due to lack of certified seed, a fact that contributes to the low production and productivity of cereals in the central region of Mozambique. According to Nakhuma, (1999), for the increase of production of cereals it is necessary to improve the seed used during the process of cultivation. The seed saved over some years may be spent (bad) and lose the good characteristics of good germination, strength and good production (Sanchez, 2011).

About technology and human resources the interviewees reported that cereal production is further hampered by the use of rudimentary instruments throughout the process from cereal production, harvesting and storage. The agricultural sector in Mozambique is composed mainly of the household sector, which practice subsistence agriculture, which depends mainly on the rain (ESAF, 2003). The farmers in central Mozambique thus rely on natural rain for production. The season 2011/2012 was characterized by food insecurity due to drought and at the same time the poor families were facing difficulties in accessing food (TIA, 2002). Central Mozambique is endowed with massive water reserves. During the research work, it was not possible to see any existence of irrigation systems for the respective areas. In accordance with the documents in a study it was found that the main river systems remain untapped, for example, the fluvial system of the Zambezi and Save Rivers. Due to the abundance of water in the central region of Mozambique, irrigation can become an overall strategy for the development of the agricultural sector. According to the information of the CPC and TIA, in rural areas of Mozambique, family

farming is mainly composed of small rural properties (those who cultivate less than 5 hectares) and it is possible to utilize irrigation in such limited hectare. Lack of irrigation systems results in very low productivity in a land with abundant natural resources conducive to cereal production in an area reported to have chronic malnutrition rates of above 45% (IDS, 2011).

Agriculture is going through a deep crisis and it is necessary to invest in the sector, to overcome hunger, malnutrition and poverty. The population is growing and production is not keeping pace with this growth. The analysis carried out in various documents stresses that it is not possible to control these challenges without prioritizing agriculture; for example, Mosca (2011) highlights that the families that leave in absolute poverty or hunger in Mozambique are those that do not depend on the agriculture sector. The lack of capacity of utilizing equipment is the biggest embarrassment for the farmers. Finally, technical training and support services are critical components that the farmers under investigation expressed that the earnestly required. All these concerns noted under discussion are evidence for the low cereal production that suffices in central region of Mozambique, which has potential to produce high volumes of cereals.

### **5.3 Conclusions**

From the above findings the researcher concludes that:

Cereal production in the central region of Mozambique consists of subsistence crop production, producing just enough to eat. This is mainly caused by the use of rudimentary tools for producing, harvesting and storage as well as lack of financial support in grain production in the

central region of Mozambique. Seed quality and lack of modern farm implements contribute to low cereal production as well.

No companies ensure the allocation of good quality seeds in the central region of Mozambique as in neighbouring countries such as Tanzania and Malawi. Based on this study, it is concluded that the poor seed quality planted by farmers in central Mozambique has poor germination result or percentage in decreasing volumes of cereals produced.

Use of technology for the production of cereals in central region of Mozambique is minimal especially in land preparation, crop management, harvesting and storage. The lack of mechanization has affected farming methods and irrigation. Therefore cereal production in central Mozambique remains low.

The central region of Mozambique possesses large stretches of land with fertile soils that are capable of producing large volumes of cereals for the reduction of hunger and poverty for not only the central region but for the country as a whole. The next section discusses the recommendations for the topic, a critical analysis of cereal production potential in central Mozambique.

#### **5.4 Recommendations**

The researcher offers recommendations from a constructivist's perspective. The researcher's propositions are based on the assumptions that for meaningful cereal production to take place there should be meaningful support from the central government of Mozambique. Hence recommendations are grounded on change on the agricultural household practices. The researcher identified areas where improvement need to take place so that there can be meaningful

cereal production in the central region of Mozambique. Recommendations are therefore laid out in two main areas, namely, household producers and government, with recommendations for further study comprising the last but not least component.

#### **5.4.1 Recommendations for households**

For the transformation of this sector from subsistence to productive farming and to achieve yields considered positive, land preparation, crop management and production output and storage should be replaced by the introduction of technological innovation. This would ensure high quality seeds, advanced and mechanized land preparation, planting methods, weeding and pest control, fertilization, more productive harvesting and storage mechanisms.

It is recommended that the farmers in Namacurra, Angónia, Gondola and Gorongosa use quality seed and new seeds every 4 years. Farmers must buy new seeds and avoid recycling second (and probably 10<sup>th</sup>) generation seeds. In line with seed quality, they should also observe planting recommendations for the type of cereal they want to produce in terms of depth and number of seeds per hole. They should use treated seeds which reduce attracting pests. The farmers of the central Region are recommended to try to preserve the soil through avoiding forest fires which destroy not only the natural flora and fauna but the soils as well. The farmers also recommend applying fertilizers that are best for their soil types as this boosts output like the Pakistan farmers Salam (2012).

Farmers should harvest their crops and thrush them with diligence to avoid grain waste.

The farmers associations should ensure that relevant and regular technical training in the use of equipment, plant management, pest control and storage is delivered to the farmers either by government or other institutions or organizations.

#### **5.4.2 Recommendations for policy makers**

In order to motivate farmers and promote increased cereal production, government plays a critical role in agriculture. It is recommended that government establishes policy to promote agriculture in Mozambique through engaging the necessary and appropriate strategies that promote cereal production in order to reduce hunger, starvation, malnutrition, and poverty,

It is recommended that government takes a proactive role in research to establish seed quality, farming mechanisms, and grain storage. The government should set cereal prices that stimulate production of grain.

The government should create more and relevant conditions for the use of technology in farming including use of tractors and plows to facilitate the production of cereals as well as encouraging use of irrigation in cereal production.

The government could open up storage facilities for farmers who meet a stipulated production level, for example, by lowering the tax the farmers pay for storage and prioritize those farmers who store grain in silos in food allocation during draught periods.

The government could develop infrastructure in farms through engaging the farmers or other organizations; for example, NGOs.

The government could set aside a specific budget for agriculture, or involve other institutions (for example banks), in availing subsidized finance for cereal production. This could be through provision of inputs and technical training.

### **5.4.3 Recommendations for further research**

It is important to note that this research, like other researches, is not conclusive. The following are areas for further research:

As noted from the participants, NGOs and other organizations have stopped offering farmers assistance. There is need to find out why NGOs and other organizations which used to offer training in cereal production have stopped when the country still suffers from grain deficit.

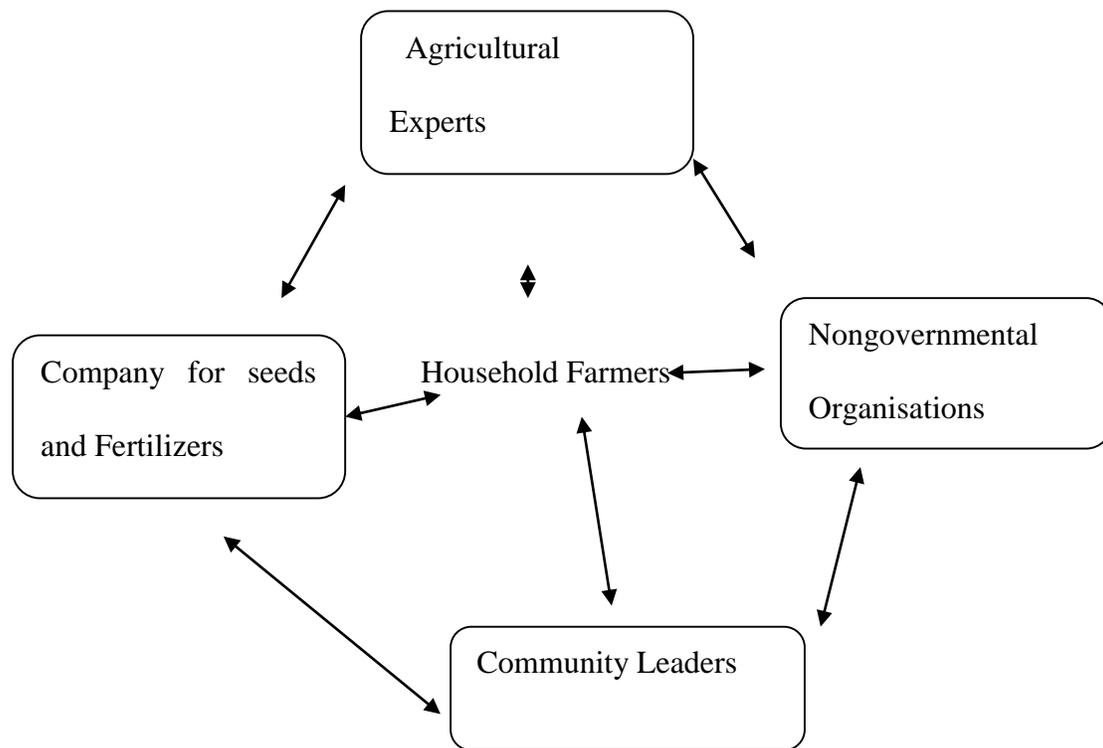
Research should be carried out to establish the preparedness of farmers to change from manual to mechanised production in order to avoid channelling resources to people who do not appreciate them due to the respondents' low literacy rate. This research could set out strategies government could take to promote mechanized production in central Mozambique.

## **5.5 Contribution of Thesis**

### **5.5.1 Participatory Agricultural Model**

This thesis proposes that the Household Farmer be involved in developing training strategies for increasing cereal production through a participatory model. It is therefore proposed that household farmers work effectively in a participatory way with community leaders, government, non-government organization and private sector companies to ensure success in cereal production. The participatory household development model is illustrated in figure 5.1.

Figure 5.1: Participatory Household Development Model



Source: Author, 2013

Through implementing this model the government will gain foresight as to what is actually transpiring in agricultural production in central region of Mozambique and appreciate the concerns in a more realistic manner. This is expected to prompt government to take drastic mitigatory measures in designing strategies that address low cereal production urgently given the country's high cereal production potential.

Through this study the stakeholders will appreciate participatory model to support the household farmers to be responsible for their development and improved cereal production. This could also influence the government to promote and instill more basic agricultural schools to train technicians with expertise in the production of cereals as well as implement a workable and

realistic green revolution, as in China and India. This could also make government create more accessible warehouses for anticipated improved cereal production.

The private sector may identify a business opportunity in the agricultural research, training and development of cereal producers and come forward with proposals to assist government cereal production in the country. In addition, another gap that is clear is the lack of quality, certified seed, and an area where private sector can play a critical role.

## **5.1 Summary**

In Chapter 1 the researcher looked into what prompted him to choose this area for research. It highlighted the background to the study, problem, purpose, research questions and significance of the study. It was observed that Central Mozambique has high cereal production potential and is endowed with agricultural watersheds with more permanent water flow than in the south, while people suffer from hunger and there is food insecurity in the country. It was expected that these areas should be producers of agriculture surplus.

In Chapter 2 based on the research questions the researcher did a related literature study of the theoretical and conceptual frame work so as to draw similarities between theory and other countries' experience.

Chapter 3 looked at the research methodology. The qualitative research paradigm was adopted. The research method used was a case study involving four districts from four provinces of central Mozambique. This was done to gain insight into the production potential for cereals in Mozambique, the central province being the vast area where the natural environment is most suited for agriculture in the country. This research was prompted by incidences of food

shortages, starvation and poverty levels in these areas as reported on national television and papers from time to time.

Chapter 4 looked at presentation, analysis and interpretation of the data. The researcher went into the field to generate data through unstructured questions, focus group discussions, one-on-one interviews, and document analysis. Data analysis was done concurrently with data generation. Emergent themes were followed up and theories were derived from the data.

Chapter 5 concludes the research by giving a summary of the research, findings, discussion conclusions and recommendations.

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## APPENDICES

### APPENDIX 1: QUESTIONNAIRE FOR GOVERNMENT OFFICIALS

**PREPARED BY:** ARMINDO MUSSA TAMBO, PhD CANDIDATE

**UNIVERSITY:** ZIMBABWE OPEN UNIVERSITY

**RESEARCH TOPIC:** A CRITICAL ANALYSIS OF THE POTENTIAL OF  
CEREAL PRODUCTION IN CENTRAL MOZAMBIQUE.

#### Research Questionnaire

This questionnaire is designed to gather as much information as possible about cereal production in Central Mozambique. Please tick in the space provided or use the space given to answer the questions and feel free to use additional paper for additional information. To ensure confidentiality please do not write your name, email or cell phone number on this questionnaire.

Thank you for participating in this interview.

Date of interview \_\_\_\_\_

This should not be on the questionnaire. You should have this as your way of recording the questionnaires distributed.

#### A. DEMOGRAPHIC DATA

1. Position: \_\_\_\_\_

2. Gender: Male  Female

Level of education in Cereal production supervision a) certificate in Agriculture b) diploma c) degree d) Master's e) other Specify

Experience in Cereal production supervision a) 1 year and below b) 2 – 5 years c) 6-9 years d) 10 years and above

**B. CEREAL PRODUCTION AND POTENTIAL IN CENTRAL MOZAMBIQUE**

1. What is the total arable area of Central Mozambique per district?

District	Total Arable area
Chinde	
Mocuba	
Morrumbala	

2. What is the quantity of cereals produced by farmers currently?

3. What is the average quantity produced per household? A)One ton and below b) 2-5 tones c)6- 9 tones d) 10 tones and above

4. In a good season, what is the total possible quantity of cereals that could are produced by the farmers per district?

District	Possible Production  (Quantity)

Chinde	
Mocuba	
Morrumbala	

5. Do the farmers receive any training in cereal production? Yes  No

If “YES”, please indicate the name of the training colleges or institutions, the length of the course and the qualification obtained.

Name of Training Institution	Duration of Course	Qualification

6. How do the farmers get the land?

7. Indicate if the land is for ownership  or for leasing

8. How do farmers prepare the land for cereal production?

9. What Is it the best way to prepare cereal production land? Yes  No

Please explain

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10. Do the farmers receive training on crop management and storage? Yes
- No

11. What types of seeds do the farmers use mostly?

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12. Which specific cereals are grown in Central Mozambique?

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13. Does Government give any support to farmers who produce cereals? Yes
- No

Please explain

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14. How do the farmers prepare their land for cropping?

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15. To what extent do the farmers use the best farming practices?

Use

always, often, etc

Please explain

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16. How often do cereal farmers use chemicals in cereal production?

use qualifiers

Please explain

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17. Give any other information critical for cereal production

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C. GOVERNMENT CEREAL PRODUCTION EXPECTATIONS

What do you expect the farmers to do in order to produce maximum quantities of cereals in Central Mozambique in each of the following situations?

1. Selection of seeds

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2. Land preparation

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3. Use of chemicals

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4. Harvesting of cereals

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5. Storage of cereals

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6. Marketing of cereals

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7. Any other information on cereal production

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**THANK YOU FOR YOUR TIME**

APPENDIX 2: Map of Mozambique



APPENDIX 3: ALLOWANCE LETTER



REPÚBLICA DE MOÇAMBIQUE

GOVERNO DA PROVÍNCIA DA ZAMBÉZIA  
DIRECÇÃO PROVINCIAL DE AGRICULTURA DA ZAMBÉZIA

CREDECIAL

Para devidos efeitos está Credenciado o Sr. Armindo Tambo, cidadão moçambicano, residente na cidade de Quelimane, Província da Zambézia, para junto ao Serviço Distrital das Actividades Económicas (SADEs), proceder o levantamento de dados na área agrícola para fins de investigação científica, no âmbito do seu estudo com o tema: CRITICAL ANALYSIS OF POTENTIAL OF CEREAL PRODUCTION IN CENTRAL REGION OF MOZAMBIQUE.

Para que não lhe seja colocado qualquer impedimento, passou-se a presente Credencial que por ser verdade, vai por esta Direcção Provincial de Agricultura de Zambézia, assinada e carimbada com tinta de óleo em uso nesta Direcção.....

Quelimane, aos onze de Novembro de dois mil e treze.....

10 Direcção Provincial  
*Armindo Tambo*  
Ilmo Afonso José Bande  
(Téc. Superior Agro-Pecuário N1)  
DIRECÇÃO PROVINCIAL DE AGRICULTURA DA ZAMBÉZIA