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Development of A Risk Reduction Model for After-sales Service on Chinese Agricultural Machinery in South Africa

by

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I, ______Xiaoshun Qin______ declare that -

the thesis, which I hereby submit for the degree at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

I have obtained, for the research described in this work, the applicable research ethics approval. I have observed the ethical standards required in terms of the University of Pretoria's Code of ethics for researchers and the Policy guidelines for responsible research.

Abstract

Development of A Risk Reduction Model for After-sales Service on Chinese Agricultural Machinery in South Africa

There is a plentiful of arable land in Africa and South Africa. Africa remains the region all over the world with the lowest power usage and the lowest level of agricultural mechanization (Daum and Birner 2019; Makini et al. 2020). As the development of cross-border e-commerce and economy progress, more and more Chinese farm equipment has been sold in Africa and South Africa. As of now, one of the most significant problems that trap the farmers and users in Africa and South Africa is after-sales service. However, many researchers focus on agricultural mechanization in Sub-Sahara Africa (Mrema, Kienzle, and Mpagalile 2018; Makini et al. 2020). Few academics are concentrating on the risk reduction of after-sales service of agricultural machinery in Africa and South Africa, which is largely beneficial to the sustainable agri-machinery enterprise as well as agricultural economic growth. This research aims to meet this gap mentioned above. This research aims to develop a risk reduction model of after-sales service on Chinese agricultural machinery in South Africa.

The information on arable land and agricultural mechanization in Africa and South Africa will be shown in the literature review. The development process of Chinese farm machinery, the status quo of export on the farm machine as well as Chinese agricultural equipment in Africa and South Africa will be addressed in the literature review. Furthermore, the detailed knowledge of the after-sales service of agricultural machinery and risk management will also be elaborated in this part.

This study's research methodology is an explanatory research method and design in which quantitative data will be collected and analyzed first, followed by qualitative data collection and analysis. The research population in this study includes staff, workers, directors, managers, CEOs as well as presidents who work at agricultural machinery enterprises. The government officials, staff, fellows, directors who research agricultural machinery and provide the service, information and knowledge for agri-machinery users have also been involved in this study. Meanwhile, the research population consists of academics, including professors, doctors and researchers whose study is about after-sales service of agricultural machinery or the relevant. On the other hand, the small-holder farmers or users who make use of farm machinery in both South Africa and China as well as other relevant people who know the after-sales service of agricultural machinery are also in the probe of the study population. Seven hundred thirty-nine closed-end questionnaires have been collected in Shandong province and Henan province in China. Due to the Covid-19, we cannot gather the questionnaires in South Africa. Furthermore, focus-group interviews have been conducted in South Africa and China.

The principal axis factoring (PAF) with Promax rotation is employed to analyze the factors that influence the research's agricultural machinery's risk reduction. Bartlett's Test of Sphericity was highly significant at a p-value of 0.05, implying that the data is suitable for the factor analysis. Furthermore, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) was 0.903 and was more significant than 0.500, implying that the sample was adequate for the factor analysis. The result shows that experts (0.879), spare parts (0.841), and timely repair (0.823) are revealed to be the top three high loading factors that impact the risk reduction of agricultural machinery. A multiple regression analysis (MRA) is utilized to analyze the data collected from the structured questionnaires. Evidence from this study suggests that combining these financial resource factors have a large effect (F2 = 0.802) on the after-sales service of farm equipment. An analysis of the data using the structural equation modeling (SEM) procedure shows relative contributions of a better understanding of risk reduction for after-sale services on agricultural machinery. From the standardized estimates, the study reveals that all the hypotheses have been supported. Finally, the risk reduction model of the after-sales service has been certified by means of the method employed mentioned above. Furthermore, the thematic content analysis is employed to analyze the data from the focus-group interviews conducted both in South Africa and China.

In conclusion, the findings obtained from the questionnaires and focus-group interviews do indeed meet the research questions and validate the objectives largely. The risk reduction of agricultural machinery can facilitate sustainable agri-machinery enterprises that can enhance and improve the agricultural economic growth. Finally, this research provides an empirical contribution to the socio-economic sphere and literature via which it can benefit the South African and Chinese agricultural economy and policy-making sector.

Keywords: Agricultural machinery; farm equipment; after-sales service; factor, risk reduction; risk management; mechanization; agricultural economy

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TABLE OF CONTENTS

List of Tables

List of Figures

List of Acronyms

ADCC	Asymmetric Dynamic Conditional Correlation
AEG	Agricultural Economic Growth
AM	Agricultural Machinery
AMOS	Analysis of Moment Structure
ANSI	American National Standards Institute
ARCH	Autoregressive Conditional Heteroskedasticity
ASS	After-sales Services
ASSAMRR	After-sales Service of Agricultural Machinery Risk Reduction
ATC	Access to Credit
BM	Breakdown Maintenance
CBM	Condition-based Maintenance
CCC	Constant Conditional Correlation
CEO	Chief Executive Officer
CFGI	Chinese Focus-group Interview
CFI	Comparative Fit Index
COSO	Committee of Sponsoring Organizations
CRRI	Customer Risk Reduction Indicator
CS	Customer Satisfaction
CSR	Corporate Social Responsibility
DAFF	Department of Agriculture, Fishery and Forest
DCC	Dynamic Conditional Correlation
DEA	Department of Environmental Affairs
DOM	Design-Out Maintenance
E-GARCH	Generalized Autoregressive Conditional Heteroscedasticity
ERM	Enterprise Risk Management
EU	European Union
EVT	Extreme Value Theory
FAO	Food and Agriculture Organization
FBM	Failure-Based Maintenance
FOCAC	Forum on China-Africa Cooperation
FR	Financial Resources
FTM	Fixed-Time Maintenance

GARCH	Generalized Autoregressive Conditional Heteroscedasticity
GFI	The goodness of Fit Index
ICRM	Internal Control Risk Management
IEEE	Institute of Electrical and Electronics Engineers
IPMA	International Project Management Association
KMO	Kaiser-Meyer-Olkin
MRA	Multiple regression analysis
MRRI	Mechanical Risk Reduction Indicator
OLS	Ordinary Least Squares
PAF	Principal Axis Factoring
PC	Personal Computers
POT	Peaks-over-Threshold
RCM	Reliability-Centred Maintenance
REB	Research Ethics Boards
RM	Risk Management
RMB	Rin Min Bi
RMSEA	Root Means Square Error of Approximation
RMT	Risk Management Theory
SA	South Africa
SAE	Sustainable Agricultural Enterprise
SAFGI	South African Focus-group Interview
SD	Standard Deviation
SEM	Structural Equation Modelling
SLU	Skill-Level Upgrade
SMRA	Standard Multiple Regression Analysis
SPSS	Statistical Data Analysis Software
SSA	Sub-Saharan Africa
TBM	Time-Based Maintenance
TCA	Thematic content analysis
TPM	Total Productive Maintenance
UIS	User Information System
UNIDO	United Nations Industrial Development Organization
USA	United States of America
USD	USA dollar
VARMA	Vector Autoregressive Moving Average Model

2WT	Two-wheeled Tractors
YTO	Yi Tuo

PART 1: BACKGROUND, INTRODUCTION AND LITERATURE REVIEW

Chapter 1: Introduction

1.1 Introduction and background

1.1.1 The land use in Africa

A number of studies (Kariuki 2011; Havnevik et al. 2007; Schaffnit-Chatterjee 2014) pointed out that Africa had a large tract of unwanted, arable land throughout the continent; meanwhile, 400 million hectares, nearly half of global idle land, were available, which can be used for agriculture. Although more than half of the unused land all over the world was in Africa, less than 10% of the African land was currently cultivated. Simultaneously, Claire (2014) indicated that unlike many other continents or countries of the world, there was a vacuum for agriculture to exploit and develop in Africa. All in all, according to Kariuki (2011), lots of evidences appeared that Africa had the vastest underutilized land comparing to other countries of the world.

1.1.2 The agricultural mechanization in Africa

From the above mentioned, it was evident that there was much more arable land in Africa. According to Karim et al. (2013), there was a tremendous potential to improve agricultural production in African countries. Furthermore, the accomplishment of this potential would demand the development and utilization of constantly increased levels of agri-machinery and the appropriate farm equipment. Karim et al. (2013) indicated that in recent years, multiple governments in many African countries have been facilitating peasants and farmers to use largely the agricultural machine by means of government development projects and additional incentives. Regrettably, these efforts have almost entirely failed to influence the utilization of agricultural equipment in the farming work, which was still underneath what had been forecasted. Some of the studies (Kienzle & Fao 2013; Ashburner & Kienzie 2011; Economics 2015) showed that Africa remained the region all over the world with the lowest level of agricultural machinery and the lowest power usage, compared with Asia. Moreover, Asia had more tractors in use than Africa. However, intensively cultivated lands of Asia and Latin America have experienced significant mechanisation levels, while adoption rates in Africa are low (Kienzle & Fao 2013; Ashburner & Kienzie 2011; Economics 2015).

1.1.3 Chinese agricultural machinery in Africa

In the past two decades, due to cross-border e-commerce, more and more Chinese agricultural machinery has been sold to Africa, where both the commercial farmers and small-holder farmers need Chinese farm equipment, such as tractors, harvesting machines, seeders, threshers, ploughs, tillage and irrigation system etc. As Kienzle & Fao (2013) mentioned in their research, the newly emerging industrial economies, such as China, have successfully provided novel sources of farm machinery that is continually coming on to local African markets. Simultaneously, this Chinese agricultural machinery (Safdar & Gevelt, 2020) is often more suitable and affordable for African conditions and is quite cheaper than machinery manufactured in North America or Western Europe.

1.1.4 Farmers in Africa need after-sales service

The Chinese agricultural machinery is affordable for African farmers and users, which leads to many Chinese farm machinery being sold to African countries due to the development of cross-border e-commerce. Moreover, there were serious problems of the after-sales service (ASS) that puzzled the African farmer, which can bring bad reputation and detrimental effectiveness for the brand of agricultural machinery. Adu-Baffour, Daum and Birner (2019), Kirui (2019) and Daum and Birner (2020), in their study, stated that African farmers might sometimes lack the mechanical skills on the operation of agricultural equipment. Meanwhile, they didn't have convenient access to services to repair and maintain farm equipment on time. Moreover, the first important thing of agricultural machinery in Africa was that there might be fewer workshop areas to repair the agricultural equipment (Adu-Baffour, Daum, and Birner 2019; Kirui 2019; Daum and Birner 2020). On the other hand, the other issue was that it was difficult to obtain the spare parts because the types of farm equipment were manufactured outside the country, or the component required for the agricultural machinery was imported (Adu-Baffour, Daum, and Birner 2019; Kirui 2019; Daum and Birner 2020).

As mentioned above, the research generally concentrated on the arable land in Africa, the African agricultural mechanization as well as more and more agricultural machinery used in Africa. However, very little researches are available on the treatment of the after-sales service (ASS) of agricultural machinery (AM) in Africa, especially for the Chinese farm equipment which is sold to Africa through cross-border e-commerce. As few researchers focus on the risk reduction of after-sales service of agricultural machinery (Kundu and Ramdas 2019 and Qin, Jiang, and Pretorius 2021) relating to the sustainable farming enterprises and the growth of agri-economy in Africa, there is a gap to research this topic in a bid to benefit the stakeholders in Africa. Therefore, it is crucial to research how to formulate a novel model of the risk reduction of after-sales service on Chinese agricultural machines in South Africa, which can enhance the utilization of agricultural machinery, such as tractors, ploughs, seeders, threshers, irrigation pumps and harvesting machines etc. This can also bring lessons to other countries whether developed or developing in Africa. Meanwhile, this can be helpful and beneficial to sustainable agri-enterprises and the growth of agri-economy. Furthermore, the risk reduction of after-sales service is one of the most significant elements for African farmers to use farm equipment. Finally, it is also more significant to improve the implementation of arable land in order to increase the productivity of agriculture, to reduce the manual labour input of African people and to address the problem of poverty and starvation by means of providing excellent after-sales service of agricultural machinery.

1.2 Problem statement

Before the researcher arrived in South Africa, a conversation and discussion were held between several sales managers and after-sales managers in three large agricultural enterprises and another medium- and small-firm and the researcher. The main issue for them who sold Chinese agricultural machinery to Africa was of after-sales service.

In Africa, there was primarily arable land throughout the continent; furthermore, the level of mechanization was lower than most countries all over the world (Sims and Kienzle 2006; Ashburner and Kienzie 2011; Mrema, Kienzle, and Mpagalile 2018; Daum and Birner 2020). From African farmers' point of view, they usually preferred Chinese agricultural machinery, such as tractors, harvesting machines, threshers, as well as an irrigation system due to the affordable price. Nevertheless, end-users always complained about after-sales, such as spare parts (Mirčevski, Mihajlović, Milunović, Milojević, Damnjanović, Žugić, et al., 2018), maintenance (Shiming Li, 2020), training course (Man et al., 2016), feedback (Baz et al., 2020), as well as timely repair (Carr, 2017). If the risk of after-sales service can be managed, more and more farmers, including commercial farmers and small-holder farmers in Africa, would like to employ affordable and high-quality Chinese agricultural machinery. Furthermore, this can benefit African farmers, who can get rid of drudgery and improve their productivity. It's more helpful and beneficial for meeting poverty, providing more opportunity in terms of employment as well as enhancing the development and growth of the agricultural economy.

According to literature reviews, there were a plentiful of researchers and academics focusing on agricultural mechanization in Sub-Sahara Africa and South Africa. Fewer researchers debated that the after-sale service of agricultural machinery played an essential role in sustainable agri-enterprise and agricultural economic growth. Consequently, it is much more significant to study the issue of after-sales service in Africa and South Africa. Also, there is no novel model of after-sales service of Chinese agri-machinery in South Africa. It is crucial and urgent to form this kind of risk reduction model to test the relationships among after-sales service, sustainable agri-enterprises and the growth of agri-economy. In this study, a mixture of quantitative and qualitative methods will be employed for collecting and analyzing data in order to identify and validate the conceptual framework of after-sales service of agricultural machinery. Finally, it aims to develop a risk reduction model of after-sales service on Chinese agricultural machinery in South Africa. This model will be tested and formulated in Chapters 7 and 8.

1.3 Research aim

Numerous researchers focused on agricultural mechanization in Sub-Saharan Africa and Africa. However, they also mentioned the after-sale service of agricultural machinery when they researched agri-mechanization in Africa, especially in Sub-Sahara Africa. Nevertheless, fewer academics and researchers were and are addressing the role of after-sales service of agricultural machinery and the relationship between after-sales services (ASS) of Chinese agricultural machinery (AM), sustainable agri-enterprise and agricultural economic growth.

This research aims to develop a risk reduction model of after-sale service of Chinese farm machinery in South Africa, leading to or facilitating sustainable farm equipment enterprises. This can ensure more and more customers use farm equipment which can provide them with convenience and high productivity. Moreover, it can benefit Africa's stakeholders to improve agricultural productivity and get rid of the drudgery. It can also increase agri-employment, alleviate poverty and meet the issue of starvation in the context of agriculture. At the same time, it can further assist the policy-maker in formulating the beneficial policy for involvement in the context of agriculture. It can enhance and improve the growth of the sustainable agricultural economy in South Africa.

As mentioned before, the main aim of this study is to form a novel risk reduction model of ASS of AS. This new model is based on the conceptual framework formulated in Section 3.3. This model will be tested and verified by data collection and analysis in Chapters 6 and 7. Furthermore, the novel risk reduction of final-version will be presented in Chapter 8 following certification and validation to some extent.

1.4 Research objective

In this section, the main objective and specific objectives will be presented in the following section.

1.4.1 The general objective

The overall objective of this study is to formulate a risk-reduction model of after-sales services (ASS) on Chinese agricultural machinery (AM) in South Africa (SA).

1.4.2 Specific objectives

In order to meet the main objective, the specific goals of the research are formulated for this research as follows:

- To determine the after-sales service factors that influence the risk reduction of after-sales service on agricultural machinery
- To judge the relationship between financial resources and mechanical risk reduction, customer risk reduction regarding after-sales service of agricultural machinery and risk reduction of ASS of AM
- To determine the factors that affect the financial resources of after-sales service of agricultural machinery
- To judge the relationship among risk reduction of agricultural machinery, sustainable agri-enterprises and the growth of the agricultural economy

1.5 Research questions

According to the general objective and specific objectives of this study, the relevant and corresponding research questions are elaborated as follows：

- What are factors of the after-sales service that influence the risk reduction of after-sales service on agricultural machinery?
- What is the relationship between financial resources and mechanical risk reduction, customer risk reduction regarding after-sales service of agricultural machinery and risk reduction of ASS of AM?
- What are the factors that affect the financial resources of the after-sales service of the agricultural machine?
- What is the relationship between risk reduction of agricultural machinery, sustainable agri-enterprises and the growth of the agricultural economy?

1.6 A brief introduction of the research methodology

The study has adopted a sequential explanatory research design in which a combination of quantitative and qualitative research methodology was employed. This method's advantage and benefit are that the data collected from different designs can be analyzed sequentially and orderly, making the analysis more reliable and validated.

The secondary data was collected in a bid to derive factors that influenced the after-sales service of agricultural machinery from the literature review at the first stage. Furthermore, the data instrument of questionnaires and focus group interviews will be employed to collect data in a bid to test and identify the six factors that affect the after-sales service of agricultural machinery in this study.

Research participants in this study are staff, workers, directors, managers, CEOs, and presidents who work at agricultural machinery enterprises. In addition, the government officials, staff, fellows, the directors who are professionals in agricultural machinery and provide the after-sales service, information and knowledge for agri-machinery users are also involved in this research. Meanwhile, academics, including professors, doctors and researchers whose studies are about after-sales service of agricultural machinery or relevant is part of participants. Small-holder farmers or users who make use of farm machinery in both South Africa and China, as well as other relevant people who know the after-sales service of agricultural machinery, are the interviewees or participants in the process of quanti- and quali- data collection.

Moreover, the total amount of 739 questionnaires using a Likert scale were collected in Shandong province and Henan province in China to examine the relationship among risk reduction of after-sales service of agricultural machinery, sustainable agri-enterprise and agri-economy growth. Moreover, descriptive analysis is utilized to demonstrate the essential information and characteristics of the variables and participants involved. The descriptive output offers the means, standard deviation, frequencies, as well as percentages. In addition, Spearman's rho correlation analysis is also used to explore the relationships or correlations among the variables of risk reduction of after-sales service of agricultural machinery, sustainable agri-enterprise and agri-economy growth in the understanding of correlation relationship of these variables in the context of model development. The study uses a hierarchical multiple regression model to determine further the relationship between these variables mentioned above. Qualitative data collection and analysis are employed to gather data from the focus group interview and analyze them to validate and strengthen the risk reduction model. The data analysis instrument of SPSS and SMOS (SPSS) is used in this study for the appropriate data analysis.

1.7 The motivation of the study

The motivation for this research is as follows:

- The close relationship and frequent economic commercial exchanging between China and Africa

According to Forum on China-Africa Cooperation, China has established diplomatic relations with many countries in Africa; furthermore, the relationship between China and Africa may develop well in the long term in order to benefit 2.6 billion people of both China and Africa (Forum on China-Africa Cooperation, 2018a). The trade between China and Africa has developed very fast. Between 2000 and 2017, the overall commercial volume between Africa and China increased by 17 times (Xinhua, 2018).

In addition, China has become Africa's largest trade collaborator for nine continuous years. In 2017, Chinese trade with Africa increased 14% year on year, compared to US$ 170 billion. Consequently, the fast growth continued into the first half of 2018, when the trading amount plummeted 16% to nearly US$ 100 billion (Xinhua, 2018).

On the basis of the statistics published by China Customs, the import and export volume of China-Africa trade in 2017 reached US$ 170 billion, up 14.13% year on year, 2.71 percentage points higher than the general increase of foreign exchange in the same period. Among these, Chinese exports to Africa reached US$ 94.74 billion, up 2.7%; Chinese imports from Africa amounted to US$ 75.26 billion, up 32.8% (Ministry of Commerce of the People's Republic of China, 2018).

FOCAC (Forum on China-Africa Cooperation) held by SA and China in 2015 and 2018, respectively, initiated "Top Ten Major Cooperation Projects" and "Eight Major Initiatives" for China and Africa (Forum on China-Africa Cooperation, 2018). This forum was co-held by China and South Africa (Forum on China-Africa Cooperation 2018a; Forum on China-Africa Cooperation 2018). The collaboration pertaining to agriculture has been placed in prominent and primary positions for both China and Africa (Forum on China-Africa Cooperation, 2018a).

- **Chinese Agricultural machinery is one of the most significant imports to Africa and more suitable to the African market.**

According to the analysis of Zhang and Cao (2016), the Chinese agricultural machinery exported to Africa was 9.64% of the total and was ranked as third-country, all of which exported to Africa all over the world. Moreover, they further indicated that the export of Chinese agricultural machinery to Africa had room for improvement and opportunity in the future.

On the other hand, Ning (2017) and Ma (2016) demonstrated that the status quo of small-holder farmers or agricultural users in Africa was similar to the history and experience of Chinese farmers. They used to utilize the small- and medium-farm machinery with high-quality and low-price in Africa and South Africa. Moreover, the usage of agricultural machinery was similar between Africa and China. Furthermore, Chinese agricultural machinery can be more suitable and affordable for African farmers and agricultural markets of machinery (Ning, 2017).

- **The main concern of the enterprise of Chinese agricultural machinery**

Before commencing this research of agricultural machinery, three large enterprises as well as five small firms, where they manufacture tractors, ploughs, seeders, combine harvesters, threshers and irrigation equipment and so on, have been visited by the researcher. The main issue for them was of after-sales service of agricultural machinery, which was sold to Africa by means of cross-border e-commerce.

In short, the fundamental and primary motivation of this study is to formulate the risk reduction model of after-sales service on Chinese agricultural machinery in Africa and South Africa, where the farmers also may need numerous of China's farm machinery due to its suitability to African market and users. This exploration assists the AM enterprise in seeking the crucial factors that impact the ASS and financial resources to provide appropriate and effective after-sales service. Furthermore, it can facilitate the policy-maker to formulate the proper policy to benefit the stakeholders in the context of agriculture in Africa. This novel model will be employed to determine the characteristics and mutual and multi relationships that are likely to reduce the risk of after-sales service of agricultural machinery in order to further accelerate the development of sustainable enterprises and economic growth both in China and Africa.

1.8 Scope and limitation of the research

The study primarily focuses on the effect of after-sales service of agricultural machinery, mainly on the Chinese farm machinery in Africa, so delimitation is all the after-sales service of Chinese agricultural machinery in South Africa, neither USA's nor EU's.

The stakeholders of after-sales service on Chinese agricultural equipment in South Africa include Chinese entrepreneurs, managers, sales directors, after-sales service managers, South African retailers, South African dealers, African after-sales service personnel, African-China co-manufacturers and so on.

As mentioned in the previous section, the study should be conducted to distribute and collect the questionnaires from both Chinese enterprises and South African agri-participants. On the other hand, participants including sales managers, after-sales managers, CEOs and officials in the division of agriculture on the Chinese side and farmers on the South African side should be involved in focus-group interviews. Due to the restrictive issues, such as time, cost, the broadness of scope of the survey and the outbreak of pandemic in China and South Africa, respectively, quanti-data collection in South Africa has been limited, and this brings the inconvenience of the quali-data collection in both China and South Africa. Furthermore, it makes data collection difficult in terms of broadness. The after-sales service's ethical and privacy concerns can also limit access to certain types of research data. There was also an unexpected issue that limited the data gathering in South Africa, which was Covid-19. This makes lots of difficulty and obstacles for the researcher to collect the data needed.

1.9 Importance of the report

The importance of this study is explained in the following section.

- To formulate the risk reduction model of after-sales service of agricultural machinery

This study aims to formulate the risk reduction model of after-sales services of Chinese agricultural machinery in South Africa. The factors that influence the after-sales service of agricultural machinery have been examined. Those factors are mainly expert\technician, timely repair, spare parts, maintenance, training course as well as user information system. Furthermore, the factors that impact the ASS of AM are saving, overdraft, access to credit, sponsor and grant, which have been examined through quantitative and qualitative data analysis. Moreover, the correlation and regression examination of ASS of AM, the sustainable agri-machinery enterprise and the growth of agri-economy will be demonstrated in Chapter 7. Finally, the risk reduction model of ASS of AM has been generated as novel knowledge and innovation to provide guidance and advice for agri-machinery enterprises and policy-makers in the division of agriculture.

- The novel risk reduction model can assist the stakeholders or policy-makers in facilitating the policy

The provision and formation of this novel risk reduction model of ASS of AM are beneficial and useful for stakeholders involved in this field of AM and policy-makers for AM policy development to develop and facilitate the proper and suitable regulations, laws and policies. In addition, the novel regulations, laws and policies of AM designed by policy-makers can further improve the usage of AM for South African customers, facilitate more interest and benefit obtaining of stakeholders, be helpful to coordinate the relationships among stakeholders, agri-enterprises and governments. All intentions are to reduce the risk of ASS of AM, so more and more farmers can use the AM to improve the agri-productivity and quantity and get rid of drudgery. In a nutshell, this can further meet a series of social and economic issues from a certain angle, such as poverty, rural revitalization, employment, sustainable agri-enterprises and the growth of agri-economy.

- The novel risk reduction model can help the farmers improve agri-productivity, further stimulating the growth of the agri-economy.

The agri-machinery enterprises focus on improving the after-sales service of AM to satisfy the customers in a bid to stimulate more and more customers and users to purchase the products. However, this can boost the sustainable agri-machinery enterprise survival and development in the context of inexorable competition. If the above mentioned is met, the mechanization in Africa is easily accomplished. Furthermore, it accelerates agricultural productivity in Africa. Finally, it can accelerate the improvement and enhancement of the agricultural economy, so this research advises the stakeholders to promote agri-economic growth, which can accordingly solve the issues of poverty, starvation, and unemployment as well as inequality etc.

1.10 Structure of the research

This thesis is subdivided into eight chapters which will address the four objectives of the study, organized as follows:

Chapter 1 introduces the status quo of the arable land and agricultural mechanization in Africa. The background and the importance of this study are addressed. Furthermore, the research objectives and questions are illustrated to be explored following the problem statement. A brief introduction of the research methodology has been explained. Meanwhile, this research motive and importance have been discussed.

Chapter 2 discusses the literature review of the status quo on agricultural machinery, mechanization, after-sales service and risk management. Furthermore, the agriculture machinery situation in China and South Africa will be introduced. The definition of after-sales service will be explained in detail. In addition, a comparison of after-sales service between automatic and agricultural machinery will be argued in this section. Typically, six factors of after-sales service of agricultural machinery would be collected from the literature review. The research status quo of project management and risk management will be presented, respectively. Finally, the model, definition and global latest development of them is also illustrated in this part.

Chapter 3 presents the theoretical framework. The theories of risk management will be stated as detailed and comprehensively as possible. Through the comparison with other theories, the enterprise comprehensive risk management and portfolio theory will be chosen as the foundational and cardinal theories for this study. In addition, the theoretical framework of risk reduction of after-sales service on agricultural machinery will be formulated following the extraction of the six factors of ASS on AM elicited from the literature review, data collection and data analysis.

Chapter 4 highlights mainly the research design and methodology. The study will adopt a sequential explanatory research design in which a combination of the quantitative and qualitative research methodology is employed in this study. However, the research participants in this study are people in agricultural machinery enterprises, the officials familiar with agricultural machinery in government, users of agri-equipment, and academics whose research interests are about this, small-holder farmers and stakeholders in this area.

Both quantitative and qualitative data collection and data analysis will be employed in this study in a bid to examine the relationship among risk reduction of after-sales service of agricultural machinery, sustainable agri-enterprise and agri-economy growth. Firstly, quantitative data collection and data analysis are employed to test the model initially formulated in Chapter 3. Secondly, qualitative data collection and data analysis, namely focus group interviews, will be employed to validate and enhance the results obtained from the quantitative data collection and analysis. In addition, the data analysis instruments of SPSS and AMOS (SPSS) are used in this study for the appropriate data analysis.

Chapter 5 demonstrates the process of collecting primary data. In this study, research participants, as discussed previously, are relevant participants in agricultural machinery enterprises, and officials familiar with agricultural machinery in government, users of agri-equipment, and academics whose research interests are about this, small-holder farmers and stakeholders in this area.

The data sampling methods employed in this study are both simple random, snowball and purposive sampling. Furthermore, a total amount of 739 questionnaires in which Likert scales have been collected in Shandong province and Henan province. Moreover, the focus group interviews are conducted in both China and South Africa. Finally, data analysis is presented comprehensively in Chapters 6 and 7.

Chapter 6 presents the results of the quantitative and qualitative data collection. The research results of a pilot test to determine the factors of ASS of AM will be represented in this chapter at first. Furthermore, the questionnaire has been used as the data collection method of quantitative data in Shandong province and Henan province of China. Due to the Covid-19, the questionnaire disseminated in South Africa cannot be collected at the finalisation of this research. On the other hand, qualitative data has been obtained through the focus-group discussion conducted in China and South Africa, respectively. The explicit outcome of the quantitative and qualitative results will be illustrated in this chapter.

Chapter 7 demonstrates the data analysis and the discussion of consequences. The factors that impact the after-sales service of agricultural machinery have been analyzed and illustrated by principal axis factoring (PAF) with Promax rotation. Before the PAF, the data was examined for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests. The factors that affect the financial resources have been estimated using the multiple regression analysis (MRA). It reveals that grant (Beta = 0.374, p = 0.000) has the most significant impact on the financial resources of the after-sale services of the agricultural machinery, followed by sponsorship (Beta = 0.154, p = 0.000), and access to credit (Beta = 0.153, p = 0.002). The relationship among after-sales service of agricultural machinery, sustainable agri-machinery enterprise and the growth of agri-economy has been examined in this chapter as well. Hypotheses testing and structural model have also been examined and validated by means of quantitative and qualitative data analysis. Furthermore, the purpose of utilizing the qualitative method in this research should be to enrich the results obtained from quantitative data and discussion. Finally, the explicit explanation of qualitative data will be illustrated in this chapter.

Chapter 8, The final chapter, aims to display the conclusion, limitation, recommendation as well as future work. Moreover, the findings regarding research questions answered and study objectives met will be shown in this chapter; meanwhile, a revised risk reduction model of after-sales service on agricultural machinery resulting from the explanatory method will be presented in this chapter as well. In addition, the limitations of this research will be displayed in this section. Furthermore, recommendations for future study will also be explained in this section. However, in the prospective study, the combination of agri-machination, poverty and rural revitalization will be much more beneficial for agri-stakeholders which can bridge the gap in terms of poverty as well as rural sustainability.

1.11 Summary of the main finding

In this section, the research background, problem statement, study significance, research questions and objectives, as well as the motive of undertaking this study have been presented and discussed explicitly. The principal research methodology has been introduced as well, following the structure of this thesis which consists of eight chapters.

In the next chapter, the literature review will be presented more comprehensively in the context of arable land and the status quo of agricultural mechanization in Africa and South Africa. Moreover, agricultural machinery, after-sales service of agricultural machinery as well as risk management will be demonstrated in the same chapter as well. Furthermore, the six factors of after-sales service, including technician, spare parts, timing repairing, maintenance, training course, user information management system, will be elicited from the literature review.

Chapter 2: Literature Review

2.1 Introduction

In this chapter, the discussion will be demonstrated in terms of arable land and the status quo of agricultural mechanization in Africa and South Africa. Furthermore, the literature review regarding agricultural machinery, after-sales service of agricultural machinery as well as risk management will be illustrated in this section. However, there are multiple pieces of research focusing on mechanization; nevertheless, few studies concentrate on the relationship between risk reduction of after-sales service and sustainable agri-machinery enterprises and the growth of agri-economy. In addition, the factors of after-sales service, including technician, spare parts, timely repairing, maintenance, training course, and farm machinery user information management system, will be addressed in this section. They are essentially refined and interpreted from the literature review. Meanwhile, the comparison between customer satisfaction, after-sales service, maintenance and logistics will be explained more explicitly in this chapter. The five steps of risk management are discussed thoroughly as well in this section. Risk identification, analysis and control are crucial to the risk reduction of after-sales service of agricultural machinery.

2.2 Arable land and agricultural mechanization in Africa and South Africa

The status quo of arable land and agricultural mechanization in Africa and South Africa will be displayed and demonstrated in this section.

2.2.1 The situation of land usage in Africa

A number of studies (Kariuki 2011; Havnevik et al. 2007; Schaffnit-Chatterjee 2014) pointed out that Africa had a large tract of uncultivated, arable land throughout the continent; meanwhile, 400 million hectares, nearly half of the global, were available in Africa. This land can be used for agriculture.

Peters (2004) indicated that land was relatively more plentiful and rich in the continent of Africa than others. Simultaneously, a similar result that there was more abundant and rich land in Africa can be found in the research of Jayne et al. (2016), Jayne, Anriquez, and Collier (2013) and the Food and Agriculture Organization (2011). According to the study of Jayne, Chamberlin, and Headey (2014), it was shown that 52% of the world's remaining arable land was in Africa.

Although more than half of the unused land all over the world was in Africa, less than 10% of the African land was currently cultivated. At the same time, Schaffnit-Chatterjee (2014) indicated that Africa had a vacuum for agriculture to exploit and develop, unlike other continents or countries of the world.

All in all, according to Kariuki (2011), Africa had the vastest underutilized land reserve all over the world. Moreover, because numerous and multitudinous underutilized land was in Africa and further the productivity of cropland in Africa was very low, it's more significant and imperative to employ and enhance agricultural mechanization in Africa. The relative detail pertaining to agricultural mechanization will be addressed in the next subsection.

2.2.2 The status quo of land in South Africa

According to World Bank (2018), land area in South Africa was reported at 1,221,037 square kilometres. The surface area, land area and water area (World Bank, 2018) were shown as follows:

- Surface area: 1,221,037 square kilometers (471,445 square miles) (World Bank, 2018)
- Land area: 1,214,470 square kilometers, (468,910 square miles), 99.62% of surface area (World Bank, 2018)
- Water area: 4,620 square kilometres, (1,780 square miles), 0.38% of the surface area (World Bank, 2018)

In accordance with the land use map described by DEA (Department of Environmental Affairs), cited by Tongwane et al. (2016), woodlands/savanna occupied 30% of land cover in SA (South Africa), and grasslands were 20% of it, whilst natural forests of land cover in SA was less than 0.5% of the land area (122 million ha). Meanwhile, agricultural product activities utilized roughly 7% of the land cover. Moreover, perennial crops are dedicated approximately 8% towards the cropland area (Tongwane et al., 2016). The land utilized for field crops planting and grown in South Africa were areas where farmers planted the irrigated and dryland commercial crops, semi-commercial crops (or subsistence farming) and sugarcane (Tongwane et al., 2016). Main annual crops produced in South Africa included vegetables, oilseeds, cereals, forages and root crops (Tongwane et al., 2016).

Moreover, according to Tongwane et al. (2016), national soil was classified into different categories, including high activity clay mineral soils, sandy mineral soils, volcanic mineral soils and low activity clay mineral soils. The high activity clay mineral soils (66%) were shown a predominance. In addition, sandy mineral soils, volcanic mineral soils and low activity clay mineral soils in South Africa were 20%, 8% and 5%, respectively. Meanwhile, spodic (ash) mineral soils and wetland contributed an aggregate total of less than 1% in South Africa.

DAFF (Department of Agriculture, Fishery and Forest) argued that maize was one of the key and fundamental crops in South Africa, as it was the staple food and the prominent feed grain of the majority of the South African population, as cited by Tongwane et al. (2016). From 2008/09 to 2012/13 agricultural seasons, the entire land that was planted to maize by both commercial and small-holder farmers averaged 3 million ha, according to the explanation of DAFF, cited by Tongwane et al. (2016). DEA in 2014 indicated that wheat was the second largest annual crop that was grown in South Africa, quoted by Tongwane et al. (2016).

On the other hand, according to Cousins (2010), Lahiff, Davis, and Manenzhe (2012), Berg et al. (2013), Kloppers and Pienaar (2014), Musakwa, E. N. Makonia, M. Kangetheb (2014), Tongwane et al. (2016), Kepe and Hall (2018), Adisa et al. (2018) and Akinyemi and Mushunje (2019), land reform was a lasting and long-term issue that puzzled the South African government, farmers and stakeholders.

2.2.3 The agricultural mechanization in Africa

From the above mentioned, it should be obvious and evident that there was much more arable land in Africa where it was more critical and urgent for farmers to employ agricultural machinery to exploit and strengthen land production efficiency and improve agricultural productivity.

In the light of FAO (Clarke, 1997), the terminology “Agricultural Mechanization” was usually defined as applying tractors, implements, agri-tools, and machinery to accomplish agricultural activity and production. At the same time, Diao, Silver, and Takeshima (2016) indicated that generally speaking, agricultural mechanization referred to technological change to engage in agricultural operations by means of the adoption of the non-human source of power. Furthermore, Houmy et al. (2013), on the basis of the definition of agricultural mechanization, explained the power of source utilized in agriculture was respectively manpower, animal and motorized (electric and fossil fuel). Moreover, Houmy et al. (2013) commented mechanization of agriculture included the manufacture, allocation, maintenance, repairing, management, as well as utilization of agricultural tools, appliances, and types of machinery. Furthermore, it also applied to agricultural land utilization, crop management and production, harvesting, preparation for grain storage, on-farm procedure and rural transport of agri-products.

However, Houmy et al. (2013) further explained that agricultural mechanization was always linked exclusively with tractors and sophisticated farm equipment – so-called “tractorization” as well. In accordance with FAO and UNIDO (2009), one of the fundamental elements to be successful in Latin America and Asia was agricultural mechanization. By contrast, the use of tractors in Sub-Saharan Africa (SSA) has evidenced less growth over the past 40 years, compared with other global regions, such as Asia, where tractors used over the same time have increased ten times (FAO and UNIDO, 2009). FAO and UNIDO (2009) further indicated that the most significant and primary source of power for land in Africa depended on human muscle power. For example, in Central Africa, 80 per cent of cultivated land relied on human muscle power, compared to 50 per cent of working manually in eastern and southern Africa (FAO and UNIDO 2009).

On the other hand, Sims and Kienzle (2006) commented that in spite of the use of tractors and draught animal power in seven African countries increases gradually, the percentage of agricultural land prepared and weeded by hand was dramatically and unexpectedly large, around 65 percent.

As shown in Table 2.1, the use of hand power in Sub-Saharan Africa was nearly three times that of Asia, the Near East and North Africa (FAO/UNIDO, 2008). Besides, Latin America and the Caribbean, where animal use for the agricultural operation was equivalent; however, the use of engine or farm machinery was fivefold than Sub-Sahara Africa, as shown in Table 2.1.

Table 2.1: Farm power sources (percentages)

Region	Hand	Animal	Engine
SSA	65	25	10
3 other developing regions*	25	25	50

* Asia, Near East and North Africa, Latin America and Caribbean.

Source: FAO, 2005 (FAO/UNIDO, 2008)

Figure 2.1 illustrates that eastern Africa had more utilization of human power than northern Africa, Asia, and Latin America, while tractor power was the least among all four regions. Nevertheless, northern Africa had the highest percentage of tractor power, compared to eastern Africa, Asia and Latin America, where the portions of tractor power were 15%, 40% and 50%, respectively (FAO/UNIDO 2008; Sims, Hilmi, and Kienzle 2016).

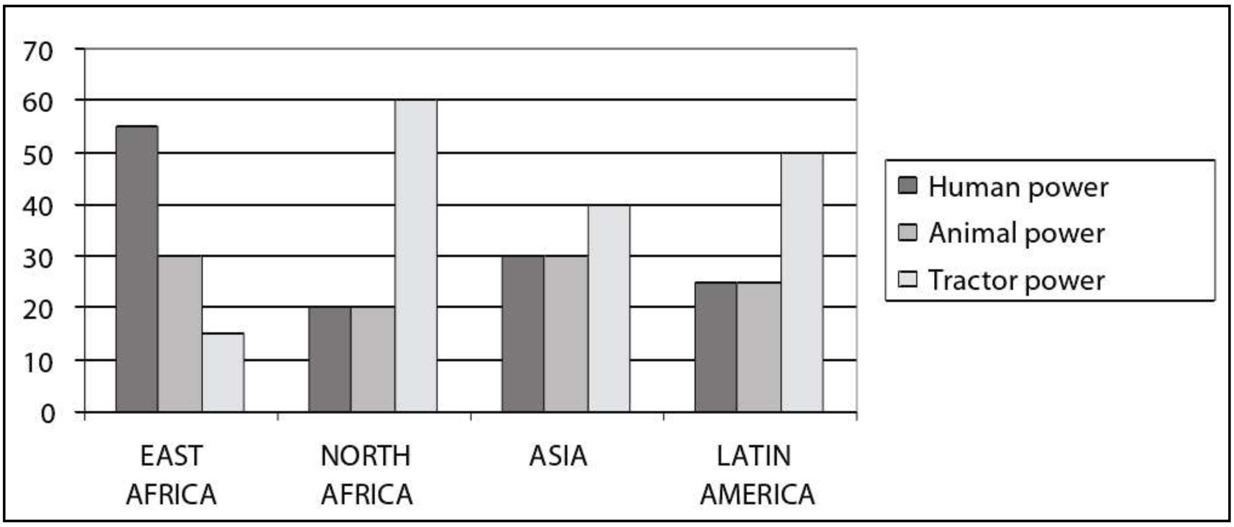

Figure 2.1: A farm power source (in percentages) in Africa, Asia and Latin America (FAO/UNIDO, 2008)

Also, Pingali (2007b) mentioned that extension and expansion of land had historically been associated with richness and enrichment of land with society's high-speed development. Meanwhile, the spread of agricultural mechanization in sub-Saharan Africa has been slower than what has happened in China and India (Pingali 2007b).

According to Karim et al. (2013), in African countries, there was a large potential to improve agricultural productivity. On the other hand, the realization of this potential would request the development and utilization of advanced and high-tech farm power and suitable agri-equipment. Karim et al. (2013) indicated that due to the development projects and other initiatives, many African governments had been stimulating farmers to improve the use of agricultural equipment. However, these efforts had, for the most part, failed to conduct the use of agricultural machinery in Africa, which was still below what had been planned. On the other hand, some of the studies showed that Africa remained the region with the least power usage and the lowest level of agricultural machinery, compared to Asia, where it had more tractors in use than Africa (Ashburner & Kienzie 2011; Kienzle and Sims 2014; Economics 2015). Intensively cultivated lands of Asia and Latin America had experienced significant levels of mechanization, while adoption rates in Africa remained low (Ashburner & Kienzie 2011; Kienzle and Sims 2014; Economics 2015).

In short, a number of studies and researches concluded that there was the lowest usage (manual, animal-load and mechanical) and the lowest level of agricultural mechanization in Africa (Clarke 1997; Kienzle and Sims 2013b; Houmy et al. 2013; Sims and Kienzle 2006; FAO and UNIDO 2009; Ahmed and Ariyo 2015; Sims, Hilmi, and Kienzle 2016; Sims 2017).

2.2.4 The agricultural mechanization in South Africa

The deficiency and disadvantage of farm labour remained a series of the serious problem in South Africa, which caused an upswing in labour salary. The scarcity and lack of farmworkers and the increase of labour wage may have accelerated farm machine sales and aided in market growth. According to the survey done by the World Bank, only 5% of employees in the total in SA (South African) were conducting the agricultural activity in 2018. However, inadequate job opportunities and limited access to financial capital in the rural area were leading to the farmers or labours moving from rural areas to urban centres in a bid to search for a better job. In addition, the World Bank reported Sub-Saharan Africa went through an annual urban population growth rate of 4.1% in 2016 due to urban industrialization. This (urban industrialization makes more people leave the rural area) leads to a labour shortage in the agriculture sector in a rural area in Sub Saharan Africa, so does South Africa.

The tractors market was one of the most critical segments in the industry of SA (South African) agricultural equipment. Tractors, being necessary farm equipment, occupied the central part of agricultural machinery in terms of units sold. However, continued growth in tractor sales volume was noticed for the last few years. Moreover, the average number of tractors used per thousand hectares in SA (South Africa) was 3.8 ha (hectares) in 2018, which was 2.8 ha in 2016 and 3.2 ha in 2017, respectively. The tractor sales seem to have been fuelled by increasing government subsidies and accommodative financing (Durczak et al., 2020). However, it can also be increased in the agricultural industry by raising awareness of farm machine mechanization.

From Figure 2.2, South Africa had the most amounts of tractors in the whole continent, according to Mrema, Kienzle, and Mpagalile (2018). In South Africa, there were commercial farmers whose agricultural mechanization rate was higher than small-holder farmers who got land as the demise of apartheid in 1994. Because the emerging farmers were poor and did not have enough money to obtain land, the government offered land to them or the demise of land from their ancestors. Consequently, this was also one of the reasons which led to them not having enough money to purchase farm equipment to achieve agri-mechanization. However, this phenomenon was common in South Africa.

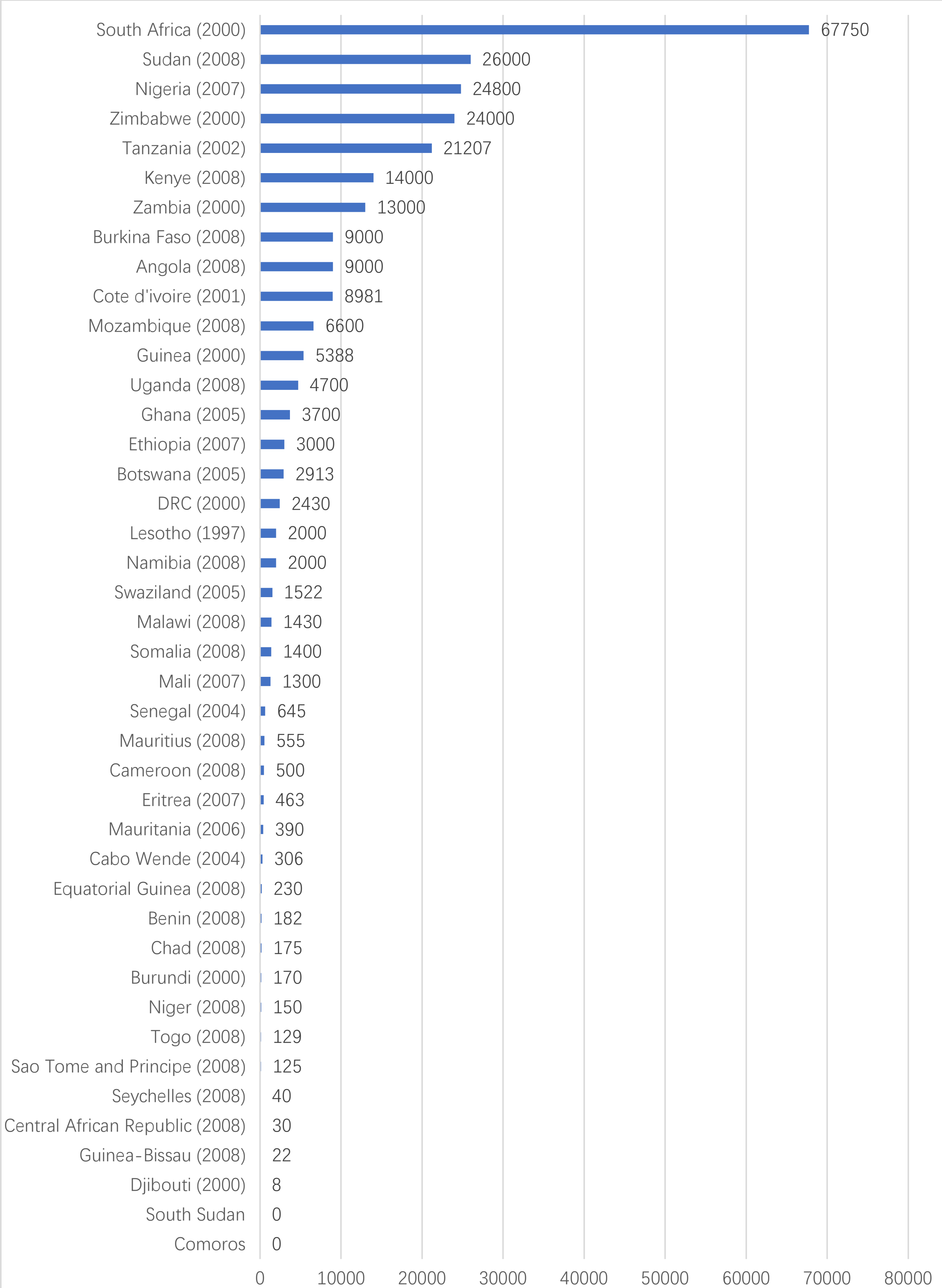

Figure 2.2: Number of tractors [4WT] owned by distinct African countries (Mrema et al., 2018)

2.2.5 Conclusion

In this section, the situation of arable land and the agricultural mechanization in Africa and South Africa have been discussed in context. In the following part, the discussion and explanation of agricultural machinery will be stated, followed by the process of Chinese agricultural machinery. Soon afterwards, the status quo of Chinese agricultural machinery export as well as the Chinese agricultural machinery in Africa and South Africa will be shown.

2.3 Agricultural machinery

The information regarding agricultural machinery, the development of Chinese agricultural machines, the export of Chinese agri-mechanical and the Chinese farm equipment in Africa will be demonstrated in this section. As this research focuses on the establishment of a risk-reduction model of agricultural machinery, it is necessary to explain the relevant information in this section.

2.3.1 The definition of agricultural machinery

According to the Chinese Encyclopaedia, agricultural machines referred to a variety of machines in crop cultivation, the husbandry production process, agricultural procedure and livestock productions processing in the initial work and process. In other words, the definition given by Li and Ma (2017) and Lang et al. (2018) of agricultural machinery was that agricultural machinery was machinery used in farming or other agricultural activities. Moreover, Li and Ma (2017) and Lang et al. (2018) further stated that due to the industrial revolution, the development of agricultural machinery had three stages in the farming history: initial hand farm equipment, steam power, and internal combustion engines.

According to Singh's (2009) opinion, agricultural machinery was that of hand tools or the animal-drawn types of equipment and power-operated implements used to carry out and perform various field operations in the production of crops. As mentioned by Fong (2011), farm machines included any mechanical unit utilized principally and directly for the objective and intention of yielding agricultural products. Lastly, James (2014) identified that agricultural machinery, also called “farm equipment”, was a tangible personal property that was used to plant, sow, harvest, collect or process agricultural production on the farm.

2.3.2 The development process of Chinese agricultural machinery

The development of China’s agriculture had a history of thousands of years when the utilization of traditional agricultural machinery had five stages: namely, the foundation of stone agricultural machinery, bronze farm tools; the application of iron farm equipment, the invention of the plough, rake; the seeding machine and the latest traditional agrarian machinery were the plough, sowing and planting machinery, seeding tool and harvesting and threshing equipment.

According to Yuan (2005), Liu (2013) and Yang et al. (2016), the modern history of China's agricultural machinery can be divided into five stages. All of them thought the first stage was from 1949, when it was the foundation of China, to roughly 1958. In the 1950s, China initiated its agricultural machinery industry; furthermore, by the end of 1957, the number of agricultural machine factories reached 276 in China(Yuan, 2005). Liu (2013) and Yang et al. (2016) considered the second stage was between 1958 and 1965, called the phase of adjustment and innovation. Moreover, the number of medium and largest tractors is from 14.7 thousand to 72.6 thousand. Meanwhile, the amount of multi-harvesting machines rises from 1,789 to 6,704. On the other hand, Yuan (2005) had a different view in which he thought the second phase should be from 1960 to 1980. In the third stage (1966-1980) proposed by Liu (2013) and Yang et al. (2016), the development and amount of China's agricultural machinery were extraordinarily remarkable, comparing to the previous development of agricultural machines. However, the fourth stage of the development of agricultural machinery was considered a stable development in history (Yang et al., 2016). The number of medium and largest tractors and multi-harvest machines was 813.5 thousand and 38.7 thousand, respectively, by the end of the 1980s (Yang et al., 2016). Moreover, Yang et al. (2016) identified that the final stage was from 1990 to 2014, the so-called high-speed development period of China's agri-machinery. In that period, the number of tractors was more than two million, and the multi-harvesting machine's number was more than 1.4 million.

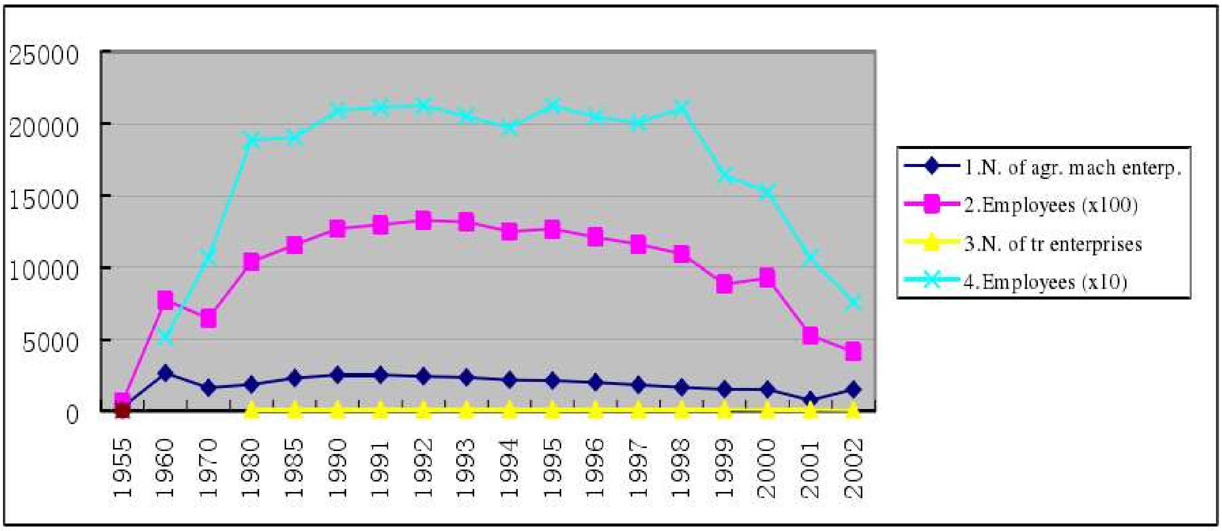

Figure 2.3: Quantity of agri-machinery factories and employees between 1955 and 2002
Source: (Yuan 2005)

As elaborated in Figure 2.3 and Figure 2.4, in the 1970s, the quantity of agricultural mechanical companies and employees rose fast in China. After 1979, the yield of medium- and large-sized tractors declined at high speed; however, the yield of small-sized tractors largely raised because farmers required small-scale tractors for their small-sized farms. In Figure 2.4, it's inferred that the production of tractors declined, then rose and subsequently declined to the lowest level in 2002 (Yuan 2005).

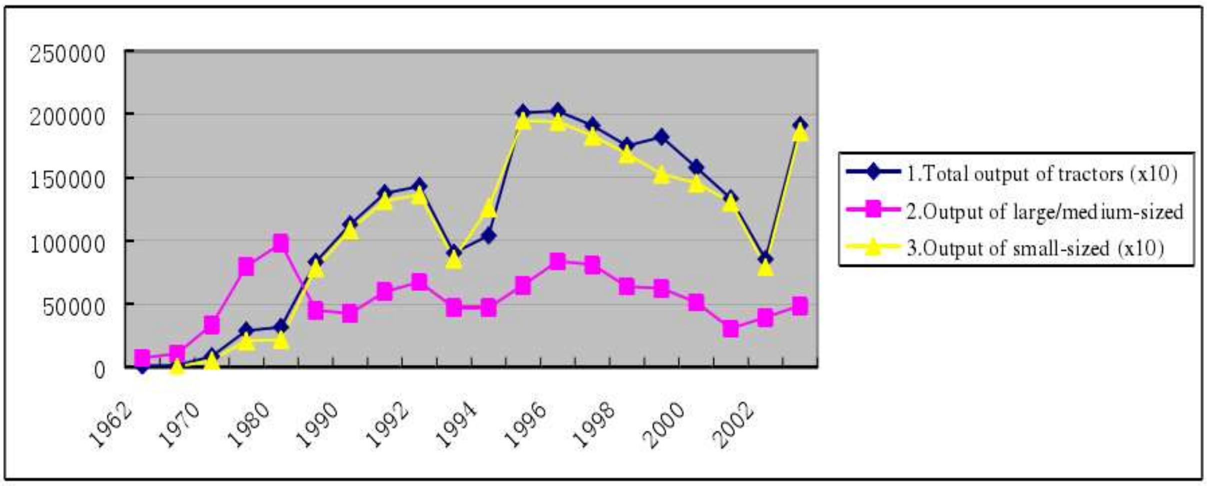

Figure 2.4: Output of tractors (1962-2003)
Source: (Yuan 2005)

According to the view of Li (2005) and Huang & Peng (2008), they concluded the development of China's agricultural machinery as three stages, namely managerial promotion stage (1949 – 1980), market-oriented and system-reform stage (1980 – 2000) and internationalized stage (2000 – Present).

Furthermore, Gao (2012) indicated that since 2002, the annual growth rate in the yield of the agricultural machine and sales amount surpassed 20 percent. In Figure 2.5, Yuan (2005) stated explicitly that, according to the information of the Chinese Statistics Bureau, there were 1,468 agricultural machine companies with large-scale volume (more than 100 employees) in 2003 (total was 8,000 companies in China at that time). Furthermore, in the context of enterprises where employees were more than 100,480 were state-owned, accounted for 32.7% of the total amount (Yuan 2005). Meanwhile, 918 were privates (non-state-owned) (62.5%) and 70 were foreign-invested, that accounted for 4.8% (Yuan 2005).

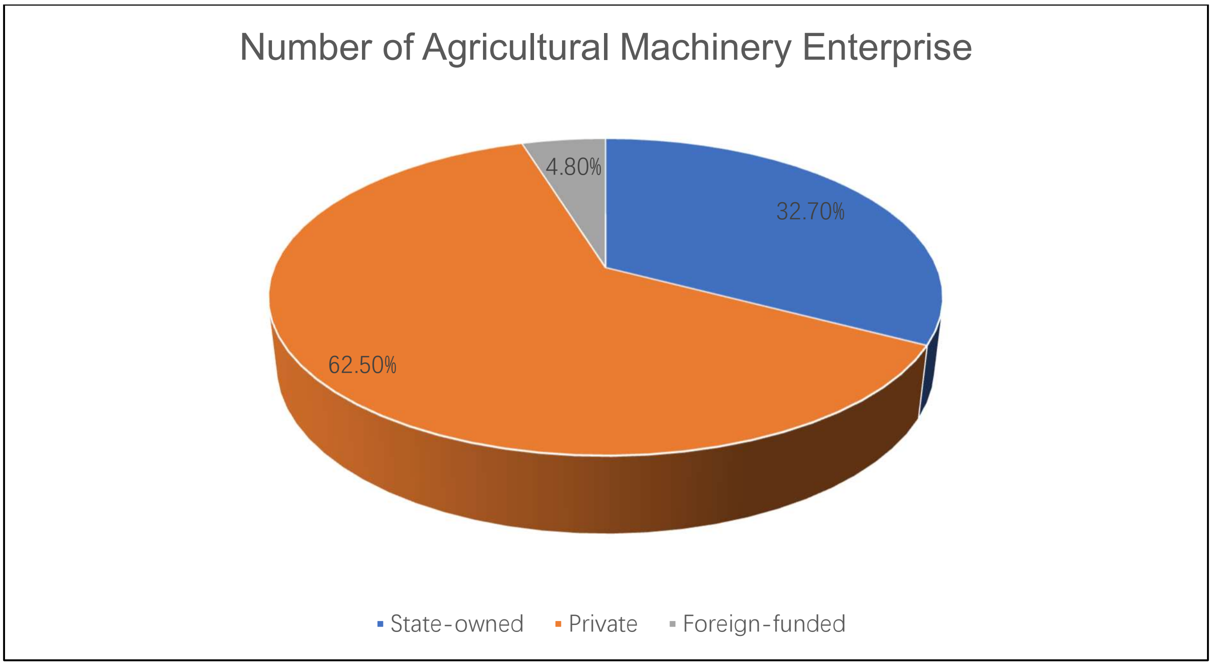

Figure 2.5: Number of agricultural machinery enterprises in 2003
Source: (Yuan, 2005)

According to Gao (2012), the total yield value and sales revenue of AM for the entire fiscal year of 2006 would be more than RMB 130 billion. In 2013, the total industrial yield of Chinese agricultural machines was CNY 357.1 billion (Fonton Lovol, 2015).

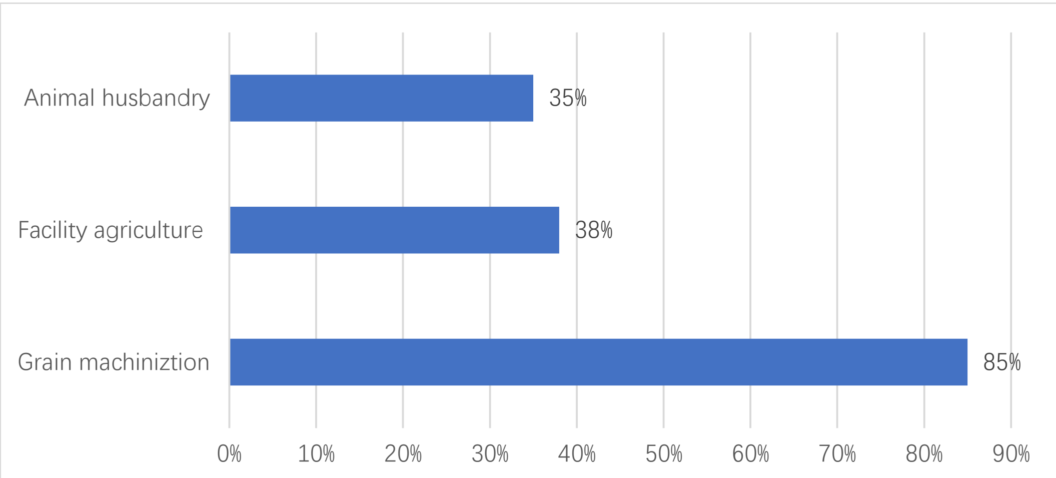

Figure 2.6: The agricultural machination in areas of grain, facility agriculture and animal husbandry
Source: (Li 2021)

Since 2015, with the deepening of the supply-side reform of the agricultural planting structure, the principal topic of the development of the agri-machinery industry in China has shifted from scale growth to quality growth, entering a novel stage of development (Li 2021). In 2020, traditional products, such as large and medium tractors, grain combine harvesters, rice transplanters etc., have increasingly reflected the characteristics of inventory competition by means of demand upgrades and renewal. The market for emerging products, such as livestock machinery, cash crop machinery and aquaculture machinery, has risen sharply. As of now, the comprehensive mechanization of the three staple food crops (corn, wheat and rice) has exceeded 85% in China (Yong Li, 2021); furthermore, the mechanization has basically been realized. However, the degree of comprehensive mechanization of facility agriculture and the primary agri-processing products was only 38% (Yong Li, 2021), as shown in Figure 2.6. The degree of comprehensive mechanization of animal husbandry was less than 35% (Yong Li, 2021). The AM level in facility agriculture and animal husbandry needs to be improved in China in the future.

2.3.3 The status quo of Chinese agricultural machinery export

The governments of China and African countries focused intensely on exchanges and cooperation in the agricultural field (Lu, 2018). They have achieved good results in the context of farming products results as well. Furthermore, the collaboration between the two parties in the agricultural area has expanded and covered various aspects such as AM business, agricultural machinery assistance, agricultural investment and agrarian product trade etc.

China had a long history of farming, but the entire agricultural machinery industry only emerged after the 1950s (Chen et al. 2020). Through continuous and uninterrupted exploration and practice, the Chinese agricultural machinery industry has achieved rapid development and promotion. Especially since 2000, when China officially entered a stage of the rapid development of medium- and large-scale agricultural machinery, the export volume of Chinese agricultural machinery products kept increasing rapidly and fast.

In Figure 2.7, Chen et al. (2020) demonstrated that the import and export trade of agricultural machinery products in China had developed rapidly. The overall development trend of export on Chinese AM was increasing, from USD 2.769 billion in 2000 to USD 43.126 billion in 2017, an increase of 1 457.46% (N. Chen et al., 2020), as shown in Figure 2.7.

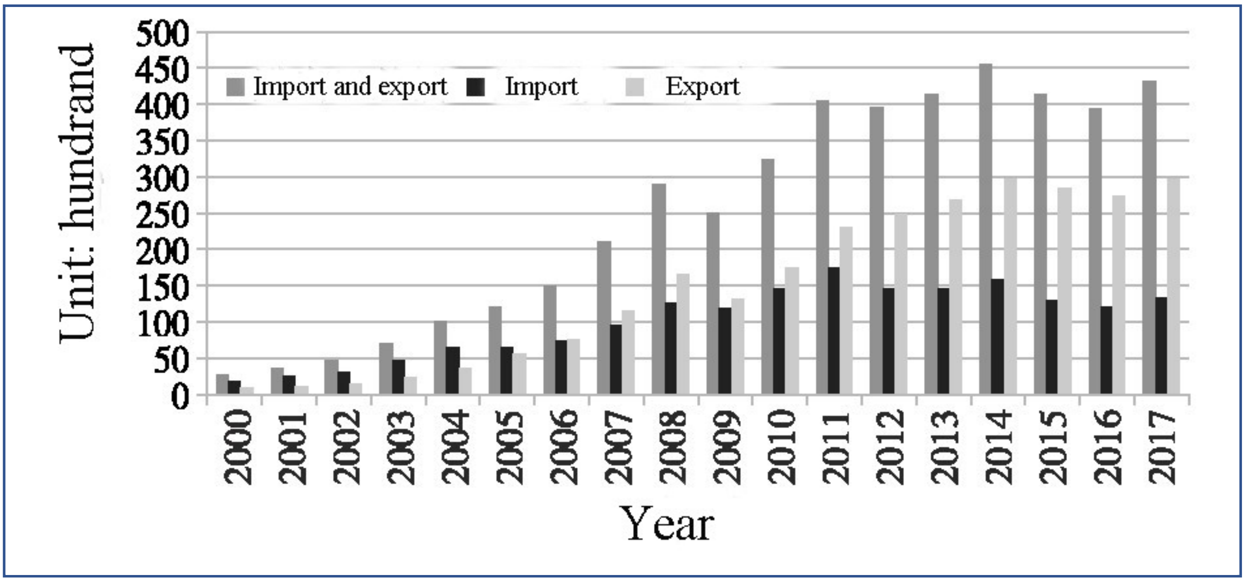

Figure 2.7: Import and export situation of Chinese agricultural machinery products during 2000~2017 (Chen et al. 2020)

According to Lu (2018), the export market of Chinese agricultural machinery products was mainly concentrated in Southeast Asia, Latin America and Africa. Among the major export countries and regions of agricultural machine products in 2017, Chinese agricultural equipment exports to Africa accounted for approximately 6% of China's total agricultural machinery exports (Lu, 2018). In 2012, China exported 1.53 billion dollars of agricultural machinery to Africa. In 2017, Chinese agricultural machinery exports to Africa rose to 2.24 billion dollars, a growth rate of 46% (Lu, 2018). Among African countries that imported agricultural machinery products, imports of agricultural machinery from China accounted for about 10% of all import AM products on the continent (Lu, 2018).

On the other hand, although Japanese and Korean 2WTs (two-wheeled tractors) may be superior to Chinese 2WTs, their price was more than double. Due to the demand for relatively cheap and 'good enough' 2WTs, the market of two-wheel tractors in Bangladesh was primarily dominated by Chinese two-wheel tractors (Baudron et al., 2015).

Based on the import and export situation of Chinese agricultural machinery products from 2016 to 2018, Chen et al. (2020) analyzed the competitiveness of the Chinese agricultural machinery products trade, as shown in Table 2.2. It showed that all items were above value 0, which meant positive results in terms of export competitiveness of Chinese AM.

Table 2.2: Trade competitiveness (TC) of Chinese agricultural machinery products (Chen et al. 2020)

Item	Products	TC		
		2016	2017	2018
Tillage machinery	Plough, disc harrow, roller, other tillage machinery	0.84	0.86	0.88
Planting and fertilizing machinery	Planting machine, transplanting machine, fertilizer applicator, spare parts	0.65	0.47	0.71
Field management machinery	Spraying machinery for agriculture or horticulture	0.29	0.07	0.11
Harvesting machinery	Lawnmower, harvest machine, picker, spare parts	0.68	0.47	0.72
Post-harvest processing machinery	Thresher, dryer; cleaner; spare parts	0.79	0.86	0.77
Primary processing machinery for agricultural products	Classifiers, mill machine, dry-bean milling processing machine, processing machinery for the food and beverage industry, spare parts	0.50	0.56	0.53
Agricultural transport machinery	Agricultural self-loading or dump trailers and semi-trailers	0.93	0.95	0.90
Livestock machinery	Cream separator, milking machine, dairy processing machine, feed preparation machine, incubator, etc., spare parts	0.64	0.68	0.70
Power Machinery	Tractor, motor tractor	0.83	0.82	0.92
Other machinery	Knives and blades for machines, other machines, spare parts	0.38	0.49	0.50
Total		0.68	0.67	0.72

Through comparison, it can be seen that from 2016 to 2018, the overall trade competitiveness index of Chinese agricultural machinery products was 0.68, 0.67 and 0.72, respectively, which remained stable and slightly increased, as shown in Table 2.2: Trade competitiveness (TC) of Chinese agricultural machinery products (Chen et al. 2020). The competitiveness index could stay within a range of 0.5 to 0.8 separately, indicating a strong export competitive advantage.

In the first half of 2020, because of the outbreak and impact of the Covid-19, the world economy has severely declined, and the agricultural machinery industry chain and supply chain cycle have been affected as well (Zhang 2020). According to Zhang (2020), the total export delivery value of agricultural machinery in China was 11.473 billion yuan in the first four months of 2020, a year-on-year decrease of 5.11%. From the analysis of the 11 sub-sectors of the agricultural machinery industry, the agricultural and garden metal tool manufacturing industry stood out with a total export delivery value of 3.276 billion yuan, a significant year-on-year increase of 33.01%, accounting for 28.55% of the total export amount in first four months of 2020. It was a substantial increase of 8.18%, compared to the same period in 2019.

According to Zhang (2020), the Chinese agricultural machinery export trend from 2003 to 2019 was ascendant and increasing. In 2020, the Chinese agricultural machinery export market was facing a complicated international economic environment due to the outbreak of Covid-19. The decline of Chinese agricultural machinery exports in 2020 was a foregone conclusion, and the downward slip was expected to exceed 10%, as demonstrated in Figure 2.8.

Figure 2.8: Trend of the export delivery value of Chinese agricultural machinery (Zhang 2020)

2.3.4 The Chinese agricultural machinery in Africa and South Africa

In the previous section, more focus has been on the development of China's agricultural machinery. In this section, the primary attention can be on the Chinese agricultural machinery in Africa.

According to Nian (1994), the production of agricultural machinery in African countries can't satisfy the needs of local governments. By the end of the 1990s, Africa needed small agricultural machinery numbers around 0.15-0.2 billion, approximately 500-800 thousand tractors and irrigation equipment of 1 billion sets. In recent years, Xiao (2016) further stated that now the potential African agricultural machinery reached approximately $300 billion.

Due to China's policy of "Going out" (Zhang & Cao, 2016), more and more Chinese agricultural enterprises invested in African and sold agrarian machinery to African countries by means of cross-border e-commerce.

Since 1992, YTO Group (an agri-machinery enterprise based in Henan province in China) has entered the African market (Zhang, 2009; Qu, 2014), where YTO has established assembly factories and after-sales service centers in seven African countries, namely Egypt, Kenya, Ethiopia, Angola, Nigeria, Algeria and South Africa (Qu, 2014). Only in 2009, Egypt imported more than 1000 tractors from YTO (Zhang, 2009). From 2007 to 2009, the total sales of tractors of YTO exported to Zimbabwe have accumulated to more than 2400 (Zhang, 2009). In March 2013, after more than two years of unremitting efforts, YTO finally reached a tractor contract of the total amount of 1,480 medium- and large units, worth $100 million successfully (Tao & Liu, 2013:23).

By means of China's policy of "Going Out", Foton Lovol (an agri-machinery enterprise based in Shandong province in China) has accumulated to export hundred thousand of agricultural machinery to different countries and districts including Africa, Asia-Pacific, EU and America etc. (Song, 2015). After getting the offer of 200 tractors from African countries in 2015, Lovol has obtained another order which covers 1 000 sets of medium- and large-tractors, 2 800 sets of agricultural machinery and other production equipment, the total value of up to CNY 100 million (Song, 2015). Except for this, in Angola in 2012, Angola's government had a one-time procurement of 250 Lovol TD904 (a type of tractor) tractors for the integrated agricultural development demonstration project (Song, 2014).

According to the "Into Africa" strategy, Chery Heavy (an agri-machinery enterprise based in Anhui province in China) planned to invest $260 million in seven African countries to build up a modern agricultural machinery operation centre (Qu, 2014). In 2011, the company transported five batches of agricultural machinery, irrigation tools and other farm equipment, the total amount of 120 units (Xiao, 2012). It significantly improves the farm machinery operation capacity, simultaneously achieving the whole mechanization from planting to cultivating (Xiao, 2012). Chery Heavy Co., Ltd. would establish sales and after-sales service outlets in Zimbabwe and actively introduce products to adapt to the African market farming environment, fully contributing to the development of modern agriculture in Africa (Xiao, 2012).

After obtaining the order from Ghana, Wu Zheng Group (an agri-machinery enterprise based in Shandong province in China) expressly set up an "African export car" project team to prepare and design (Qu, 2014). On the other hand, since 2011, Egyptian customers have ordered more than 650 units, and follow-up orders were still in negotiations in 2011(Xu & Zheng, 2011).

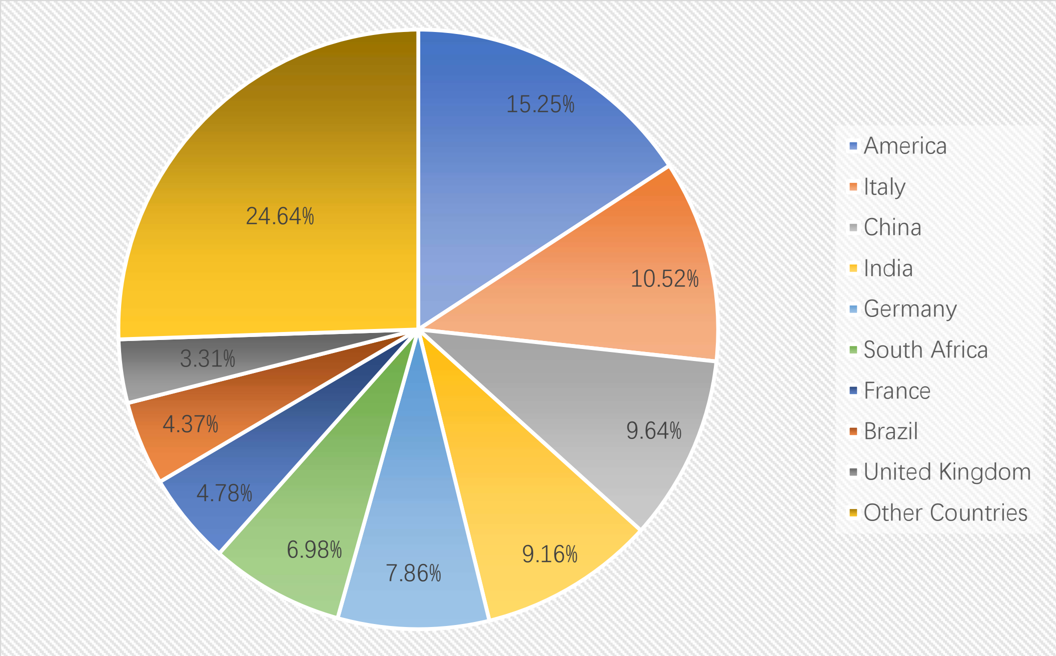

Figure 2.9: Agricultural machinery production import Source in Africa in 2012
Source: (Zhang & Cao, 2016)

As illustrated in Figure 2.9, according to the agricultural machinery import source countries in 2012, China was the top 3 in all the nations, accounting for 9.64%. Nevertheless, from the long-term perspective, China's exports of agricultural machinery in Africa still had more room for improvement (Zhang & Cao, 2016).

2.3.5 Conclusion

In this section, the discussion and explanation of agricultural machinery have been presented. The process of Chinese agricultural machinery has also been explored. In addition, the status quo of Chinese agricultural machinery export as well as the Chinese agricultural machinery in Africa and South Africa have been displayed. In the following segment, the definition of after-sales service, maintenance and logistics will be explained. And, the comparison of after-sales service between automatic and agricultural machinery, after-sales use of Chinese agrarian machinery, factors that affect the after-sales service of agricultural machines will be presented in the forthcoming section. Finally, the situation of ASS (after-sales service) of AM (agricultural machinery) in Africa and South Africa will also be discussed in more detail in Section 2.4.

2.4 After-sales service of agricultural machine

In the previous section, most attention has been paid to agricultural machinery, the development of China's agricultural equipment and China's agricultural machinery in Africa. In this section, the paramount focus will be on after-sales service and the after-sales service of China's agricultural machinery.

2.4.1 The definition of after-sales service

Lele and Karmarkar, as quoted by Mohd et al. (2009), Rigopoulou et al. (2008) and Alireza et al. (2011), stated that "after-sales services" were frequently referred to as "product support activities", which meant the product-centric transaction was the key focus of all activities. In the literature of Cohen and Lee in 1990, Ehinlanwo and Zairi in 1996, Loomba in 1996, Asugman et al. in 1997, Boyt and Harvey in 1997, Urbaniak in 2001 and Johansson and Olhager in 2004 (in Saccani et al. (2007)), a handful of definitions and concepts of ASS can be discovered. In addition, on the basis of these concepts and keeping a comprehensive and general perspective, it's concluded that the after-sales services incorporated a series of activities occurring following the purchase of the product in a bid to support customers regarding the application and distribution of products (Saccani et al., 2007).

Armistead and Clark in 1992 and Goffin in 1999, as quoted by Saccani et al. (2006), defined the after-sales service as a potential origin of rival merit and advantage for the enterprises. Uise and Baumgartner, in 1997, as quoted by OKO and Onuoha (2013), indicated that after-sales service was believed as a major source of enterprise's profitability as well as the principal index of organization performance evaluation. In 1998, Loomba (in Mohd et al., (2009)) further defined after-sale service as "customer support" factors where all activities ensured that a product was available to customers "over its useful lifespan for trouble-free use".

However, Verstrepen et al. (1999) pointed out that on the whole, the ASS process incorporated all doings and activities associated with enabling existing customers to quickly locate, contact and activate the supplier's resources. Furthermore, this was needed in a bid to create product-related services satisfaction and provide answers to inquiries or explanations to problems.

After-sales service as a term was explained in the study of Goffin and New in 2001, Agnihothri et al. in 2002 and Vitasek in 2005 (in Rigopoulou et al. (2008)). It was also called "field service", as well as "technical support" or even just "services". Besides, it has been utilized significantly to recount services that were offered to the customer following the products had been sold (Rigopoulou et al. 2008).

Furthermore, after-sales service was defined as happening following the product purchase and concentrated on supporting users in the utilization and ASS of goods (Gaiardelli et al., 2007). As defined by Murali et al. (2015), after-sale service referred to an increasing and significant definition and concept in a number of industries in order to establish favourable customer relationships that conduced to improve the performance of the sustainable enterprise.

2.4.2 After-sales service, customer satisfaction, maintenance and logistics

In this section, the information on ASS, customer satisfaction will be described. And then, the introduction and comparison of maintenances and logistics will be expounded as well.

2.4.2.1 After-sales service

After-sale service (ASS) (Shahrouzi Fard and Hosseini 2015; Murali, Pugazhendhi, and Muralidharan 2015; Hanim Saidin et al. 2015; CM 2016; Van Friderici, Ravesteyn, and De Waal 2016; Shahrouzifard and Faraji 2016; Sands et al. 2016; Dombrowski and Malorny 2016; Nordin et al. 2016; Dombrowski and Malorny 2017; Dombrowski and Fochler 2017; Saidin et al. 2018; Giri and Thapa 2018; Ashfaq 2019; Baskara et al. 2019; Kundu and Ramdas 2019; Sani et al. 2019 ; Shokouhyar, Shokoohyar, and Safari 2020; Chiguvi 2020) was regarded as an essential and increasing concept in the context of multiple of industries in a bid to establish excellent customer and seller's relationships that promote the wonderful performance for a sustainable enterprise (Murali et al., 2015).

ASS was a novel concept in each industry, and organizations had to provide better ASS in order to maintain, satisfy and make the customer be loyal to them (Chiguvi, 2020). Meanwhile, CM (2016) indicated that after-sales service referred to numerous procedures that made sure customers were satisfied with the organization's goods and services. In addition, after-sales service guaranteed goods and services to satisfy or surpass the expectations of the customers (CM, 2016). On the other hand, it included multiple activities or doings to ascertain whether the customer was satisfied with the products provided by the relevant enterprises (CM, 2016). Moreover, according to CM (2016), it was a collective procedure for attention to a business deal that generally took place after the sale (and often after delivery) between sellers and buyers was accomplished.

As one of the unique features of ASS, the loyal customer was the life or baseline for a business organization; furthermore, without the loyal customer and clientele, it was impossible for any business, trade, and enterprise to succeed (Saidin et al., 2018). However, the unique features of ASS have made it hard for the salesmen and marketers to satisfy the customers and make them return, especially under a stringent competition environment and the high expectation on the maximum value for profit (Saidin et al., 2018).

After-sales service has become an essential source for the sustainability of all enterprises and organizations nowadays. Meanwhile, enterprises and organizations were integrating several markets in different respects and ways to improve customer satisfaction and loyalty (Ashfaq, 2019). On the other hand, after-sales service was regarded as an essential factor that impacts establishing good relationships with customers (Baskara et al., 2019). Enterprises and organizations attempt to supply outstanding ASS to customers. Furthermore, they should use several techniques, tactics, and strategies to retain the customers as loyal ones (Ashfaq, 2019). Also, Ashfaq (2019) reported that after-sales service quality had a positive influence on behaviour intention, perceived value, and customer satisfaction and loyalty. Simultaneously, offering adequate after-sales service to customers has become a significant generator of profit, revenue, and competitive advantage in modern society and industries (Shahrouzi Fard and Hosseini 2015; Baskara et al. 2019).

In addition, after-sales services accounted for a large part of enterprise profits (Giri & Thapa, 2018). According to a research report published by AMR in 1999, although business accounted for only 24% of company revenues, it earned 45% of gross profits from the ASS (Giri & Thapa, 2018). However, the cost to attract a new customer was gauged to be five times the cost to retain an already-existing customer. Hence, businesses were conducting customer satisfaction surveys to understand the customer's needs and requirements (Giri & Thapa, 2018). On the other hand, Dombrowski and Malorny (2017) argued that this was because after-sales services of the primary producers were responsible for 75-80 % of the enterprise profit (Dombrowski & Malorny, 2016). Consequently, it was essential to assure the profits obtained by means of the after-sales service (Dombrowski & Malorny, 2017).

In a bid to illustrate the discrepancies between respectively product sales or production and after-sale service, a comparison between the after-sale service and the product sales was given in Figure 2.10 (Dombrowski and Malorny 2017).

	Product Sales	After Sales Service
Independency of economic situation	Low	Very high
Margin	Low	High
Behavior in times of crisis	Profit and sales collapse	Stable or growth
Forecast horizon	Short product life cycles	Long service intervals / contracts
Contact to customer	Singular customer contact	Intensive, long lasting contact
Gathering customers needs	Limited	Good, due to intensive contact with the customer
Growth and innovation potential	Often already limited	High

Figure 2.10: Comparison between sales and service (Dombrowski & Malorny, 2017)

According to Dombrowski and Malorny (2016), ASS can be usually classified into three organizational subdivisions, namely the customer service, the spare parts service and the accessories business, as shown in Figure 2.11.

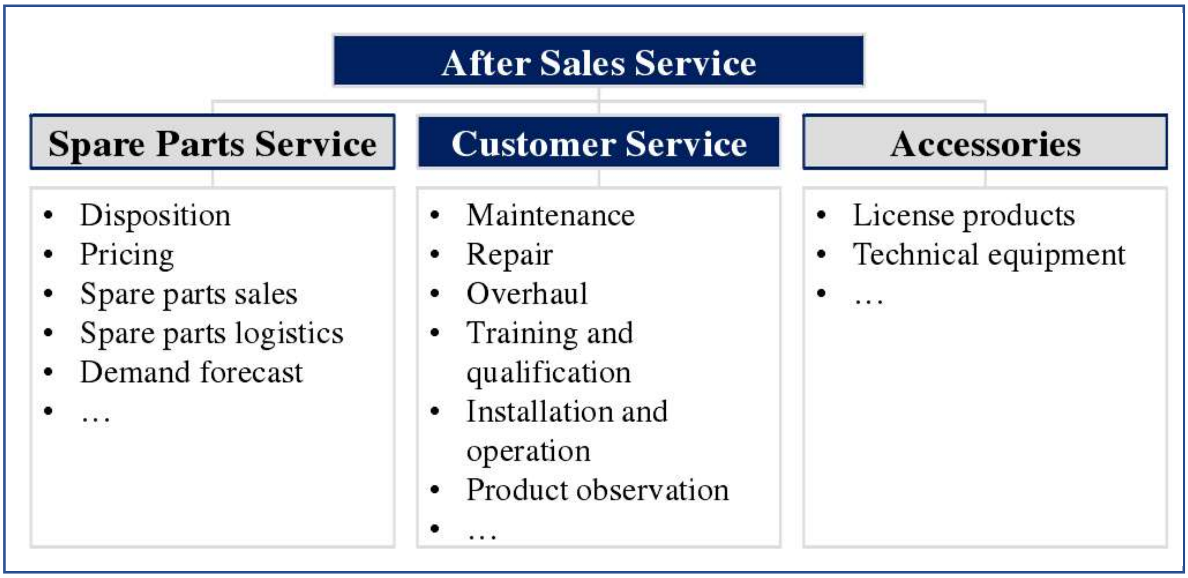

Figure 2.11: Three subdivisions of the after-sales service (Dombrowski & Malorny, 2017)

Furthermore, Dombrowski and Malorny (2016) formulated the methodological approach for procedure identification in a customer service flow diagram, as shown in Figure 2.12, by means of their study and arrangement. The after-sales service flow chart illustrated explicitly and unambiguously the process of customer service.

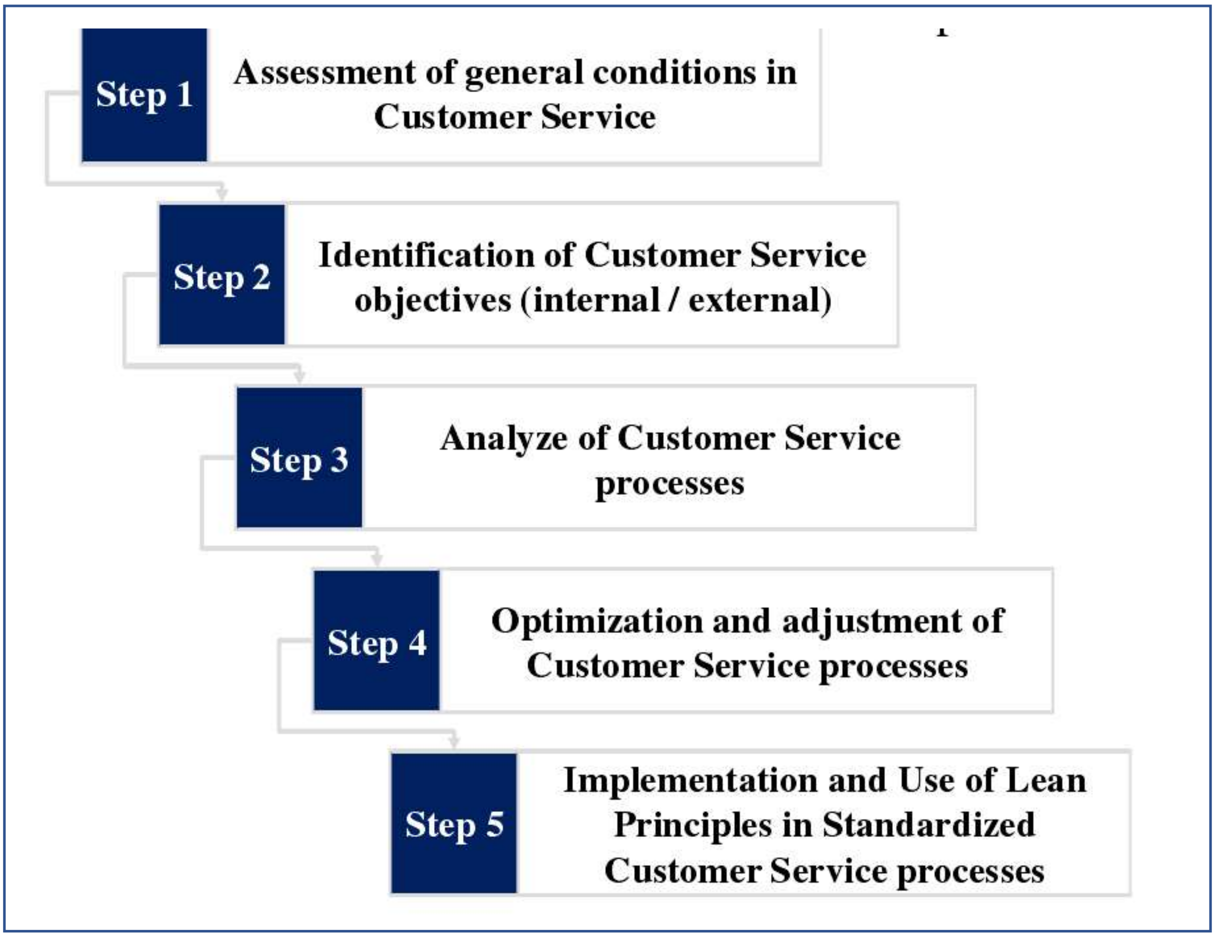

Figure 2.12: The methodological steps in the process of customer service identification (Dombrowski & Malorny, 2017)

2.4.2.2 Customer satisfaction and loyalty

Customer Satisfaction (Nasri 2013; Suchánek, Richter, and Králová 2014; Kim, Vogt, and Knutson 2015; Saeidi et al. 2015; Mouwen 2015; Pan and Nguyen 2015; Chung et al. 2015; Izogo and Ogba 2015; Izogo and Ogba 2015; Hussain, Al Nasser, and Hussain 2015; Kaura, Prasad, and Sharma 2015; Al-Tit 2015; Radojevic, Stanisic, and Stanic 2015; Dahlgaard-Park et al. 2015; Sarkar Sengupta, Balaji, and Krishnan 2015; Ling et al. 2016; Ngo and Nguyen 2016; Paul, Mittal, and Srivastav 2016; Agnihotri et al. 2016; Zehrer and Raich 2016; Razak, Nirwanto, and Triatmanto 2016; Oh and Kim 2017; Pham and Ahammad 2017; Ali and Raza 2017; Kasiri et al. 2017; Wongleedee 2017; Leninkumar 2017; Ramanathan, Subramanian, and Parrott 2017; Kanten and Darma 2017; Mahmoud, Hinson, and Anim 2018; Mahmoud, Hinson, and Anim 2018; El-Adly 2019) was a measure or magnanimity of how goods and services offered by an enterprise satisfy or surpass customer anticipation (Giri & Thapa, 2018). Furthermore, customer satisfaction was a business philosophy that emphasized the significance of creating value for customers, managing and accomplishing the expectations, and illustrating the responsibility and ability to meet their requirements (Radojevic et al., 2015). Accordingly, customer satisfaction mainly depended on how customers were treated by the company or agent, following the sales was done and completed (Giri & Thapa, 2018).

After-sales service played a crucial role in meeting the issues of customer satisfaction and customers' purchase decisions (Giri and Thapa 2018; Baskara et al. 2019). According to Baskara et al. (2019), customer satisfaction hugely hinged on product brand, price, features and ASS (Giri & Thapa, 2018). However, satisfying the customers with excellent services and high-quality products was one of the most crucial landmarks of any sustainable enterprise and business, as customers were the principal fountainhead of any trade and commerce (Chiguvi, 2020). Meanwhile, according to the study of Giri and Thapa (2018), the relationship between customer satisfaction and after-sales service was vigorous and positive ($r=0.463$, $p \leqslant 0.001$), and there was an active and positive correlation between the variables of intent to repurchase and after-sales service.

However, customer satisfaction referred to the customers' overall judgment of the product or service provided after customers purchased it (Pham & Ahammad, 2017). Customer satisfaction was the outcome and effect of the customer's experiences during and after the buying process and played a significant role in directly impacting customers' future behaviour (Pham & Ahammad, 2017). Ali and Raza (2017) argued that customer satisfaction was a satisfied degree following a service or product having been utilized. The chances of further purchase increased by means of repeat purchase of that product or service. Furthermore, they examined that the satisfied customer shared their active and positive experience with other customers, and this became a source of word-of-mouth advertisement (Ali & Raza, 2017). On the contrary, a dissatisfied customer would provide negative and passive word-of-mouth advertising and was more likely to switch the brand or product (Ali & Raza, 2017). Although customer loyalty and customer satisfaction were distinct constructs, there was a positive and active relationship between them (M. V. Ngo & Nguyen, 2016). However, customer loyalty can be affected by customer satisfaction because customers tend to be reasonable and risk-averse so that they might be prone to decrease risk and stay with the service providers, which they already have an excellent experience of service (M. V. Ngo & Nguyen, 2016).

The definition and explanation of customer satisfaction and customer loyalty/customer retention from distinct researchers and academics are discussed in the following section, as illustrated in Table 2.3.

Table 2.3: The comparison between customer loyalty and customer satisfaction (Ismail and Yunan 2015; Chung et al. 2015; Al-Tit 2015; Kaura, Prasad, and Sharma 2015; Leninkumar 2017; Ngo and Nguyen 2016; Kasiri et al. 2017)

Authors or researchers	Customer satisfaction	Customer loyalty/customer retention
Ismail and Yunan (2015)	Customer satisfaction was widely defined as a divergence between customers' expectations and experience	Customer loyalty was often associated with the customer's willingness to repeatedly buy the products or service that was followed by a psychological adhesion and

	after using the product and service.	maintain beneficial attitudes toward the products and service these enterprises provided.
Chung et al. (2015)	Customer satisfaction consisted of the consumer's viewpoints on this product or service the enterprise offered. Furthermore, this was a significant impetus for the company's sustained market value and profitability.	Customer loyalty was believed a key aim to a firm's growth and survival. On the other hand, building a faithful customer foundation had not only become a crucial marketing target but was also an essential base for developing a competitive and sustainable advantage
Al-Tit (2015)	Customer satisfaction was an assessable judgment of customers who judged the products they bought and the service company offered.	Customer retention was a method or measure of how enterprises can keep the customers being loyal to the service provider.
Leninkumar (2017)	Customer satisfaction, as an approach, is shaped on the basis of experience after clients obtained a product or utilized a service.	Customer loyalty was a crucial factor that led to rival merit over other companies in a thoroughly dynamic and competitive circumstance. However, it was a multidimensional construct that was set up on two elements, namely, attitude and behaviour.
Ngo and Nguyen (2016)	Customer loyalty has always been related to as an outcome of all the customer's experiences with a service/product provider.	Customer satisfaction was one of the indispensable purposes which many companies sought for a long-term relationship with clients as their top priority.
Kasiri et al. (2017)	Customer satisfaction was defined as the feelings of customers that resulted from comparing the firm performance of providing products or outcomes with the clients' expectations.	Customer loyalty was referred to as a commitment to re-patronize or rebought a preferable product or service consistently. Although situational impacts and marketing intention had the potential to lead to swop behaviour, these clients were still loyal to this product or service.
Kaura, Prasad, and Sharma (2015)	Customer satisfaction was the customers' satisfaction degree resulting from comparing a product's performance to the customer's expectations.	Customer loyalty sometimes had been recognized as a behavioural estimation or judgement or as an attitude towards the service or goods. On the one hand, behavioural loyalty was the intense promise of clients to buy the goods or service in spite of the alternatives of these products in the market. On the other hand, attitudinal loyalty was clients' beneficial tendency towards a service associated with other

		enterprises supplying the same service.

In addition, Leninkumar (2017) drew the conceptual model among customer trust, customer satisfaction and customer loyalty, as shown in Figure 2.13: Conceptual model among customer trust, client's satisfaction and its loyalty (Leninkumar, 2017). However, the results and outcome revealed a crucially positive correlation between customer trust and loyalty (Leninkumar, 2017). The relationships of customer satisfaction and loyalty, as well as customer satisfaction and trust, were also illustrated in Figure 2.13: Conceptual model among customer trust, client's satisfaction and its loyalty (Leninkumar, 2017) (Leninkumar, 2017). In addition, customer satisfaction has been determined as an important influencing factor on customer loyalty; furthermore, customer trust is affected by customer satisfaction which certified that client's satisfaction was an antecedent of client's trust (Leninkumar, 2017).

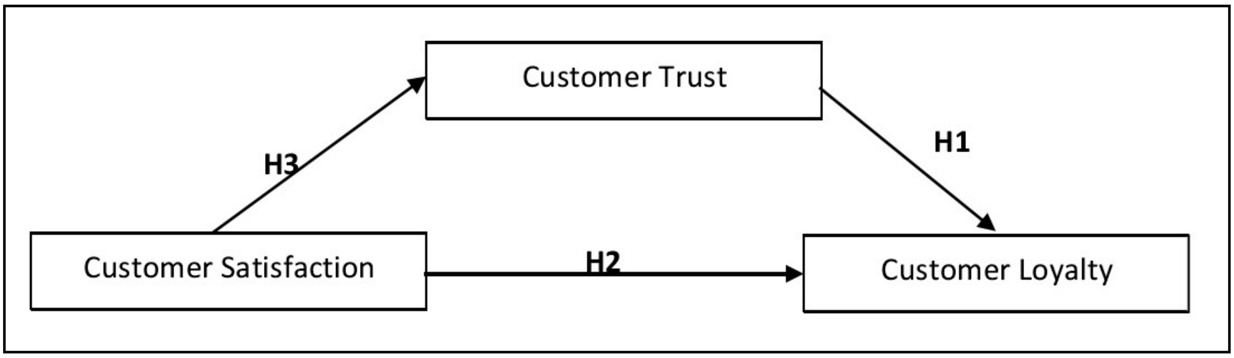

Figure 2.13: Conceptual model among customer trust, client's satisfaction and its loyalty (Leninkumar, 2017)

Although client's satisfaction and client's loyalty were different constructs, they were positively correlated (M. V. Ngo & Nguyen, 2016). Ngo and Nguyen (2016) developed an empirical conceptual model showing the mutual relationships between service quality, client's satisfaction and client's loyalty in the context of retail banking, as indicated in Figure 2.14. The findings suggested that there were non-linear relationships between client's satisfaction and client's loyalty (M. V. Ngo & Nguyen, 2016). Moreover, they were distinct constructs and underlined the demands to treat client's loyalty management as a process that included a large number of factors interrelating.

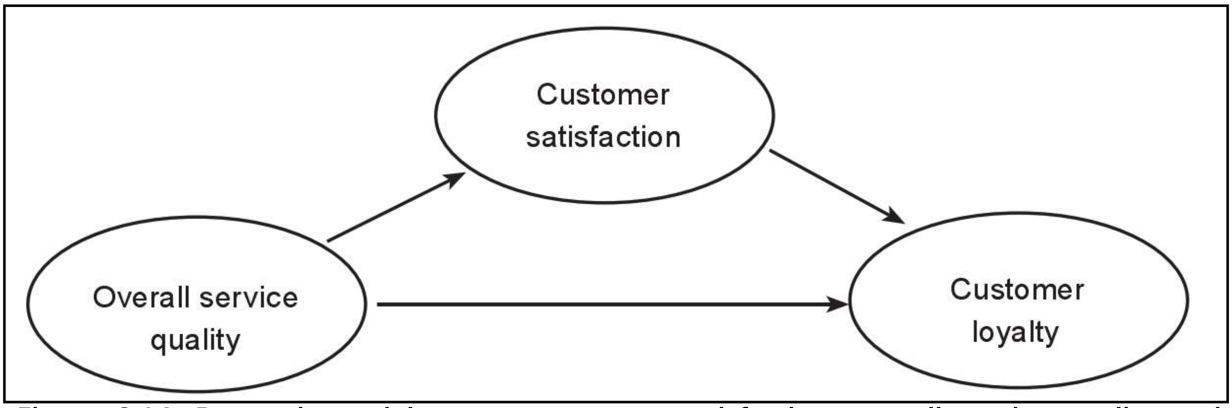

Figure 2.14: Research model among customer satisfaction, overall service quality and customer loyalty (M. V. Ngo & Nguyen, 2016)

On the other hand, ASS has been an often-debated subject in the area of marketing and has been directly linked to client's satisfaction and client's retention (Sani et al., 2019). Sani et al. (2019) argued that ASS effectiveness also had a direct and positive connection with customers' satisfaction rate. Subsequently, Sani et al. (2019) demonstrated that after-sales services vigorously and positively affected the perception of quality loyalty by customers. Meanwhile, the activities of after-sales service were often dedicated to customer satisfaction. Furthermore, it was given to the purchasers by the sale managers after selling the goods or providing the service (Ashfaq, 2019). The linchpin to set up a long-term relationship and strengthen the client's loyalty was to produce superior worth for customers (Ashfaq, 2019). Meanwhile, problem-solving, after-sales service and assistance activities had an active and positive relationship with client's satisfaction and loyalty (Ashfaq, 2019). Forasmuch, client's satisfaction was believed one of the essential and indispensable factors to reinforce customer repurchase purpose and set up a long-term relationship with the clients in the context of marketing (Ashfaq, 2019). Moreover, after-sales service also helped to establish a long-time relationship in order to meet the customer and receive loyalty (Ashfaq, 2019).

Oliver, cited by Ashfaq (2019), has interpreted loyalty as "*an extremely assurance of a liked product or service to be re-purchased, re-patronized, or continuously bought in the future*." If an organization or enterprise would like to strengthen its profits, clientele retention and loyalty, it should specifically be concentrated on satisfying its patrons (Ashfaq, 2019). Additionally, plentiful of researchers or academic consent that service quality, client's satisfaction, and client's loyalty were different but extremely interrelated (Ismail & Yunan, 2015). For example, service providers' ability to properly carry out service quality in executing daily work may bring about clientele greater client's satisfaction and customer loyalty (Ismail & Yunan, 2015).

Ismail and Yunan (2015) demonstrated a theoretical framework between service quality and customer satisfaction, and client's loyalty, as illustrated in Figure 2.15.

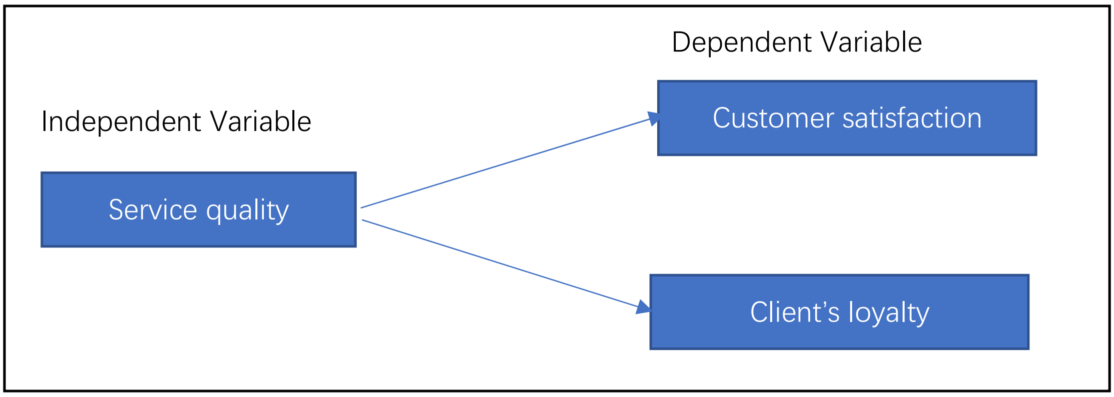

Figure 2.15: The theoretical framework for service quality and client's satisfaction and client's loyalty (Ismail & Yunan, 2015)

Based on this framework, two hypotheses formulated by Ismail and Yunan (2015) were explained as follows:

H1: There was a positive and active relationship between service quality (i.e., reliability, tangible, assurance, responsiveness and empathy) and client's satisfaction.

H2: There was a positive and active relationship between service quality (i.e., reliability, tangible, assurance, responsiveness and empathy) and client's loyalty.

In addition, Chung et al. (2015) demonstrated the influences of the company's social responsibility (CSR) on client's satisfaction and loyalty in China, as shown in Figure 2.16. The findings ad outcomes showed that CSR (company's social responsibility) positively affected customer loyalty and satisfaction; meanwhile, client's satisfaction actively impacted customer loyalty (Chung et al., 2015).

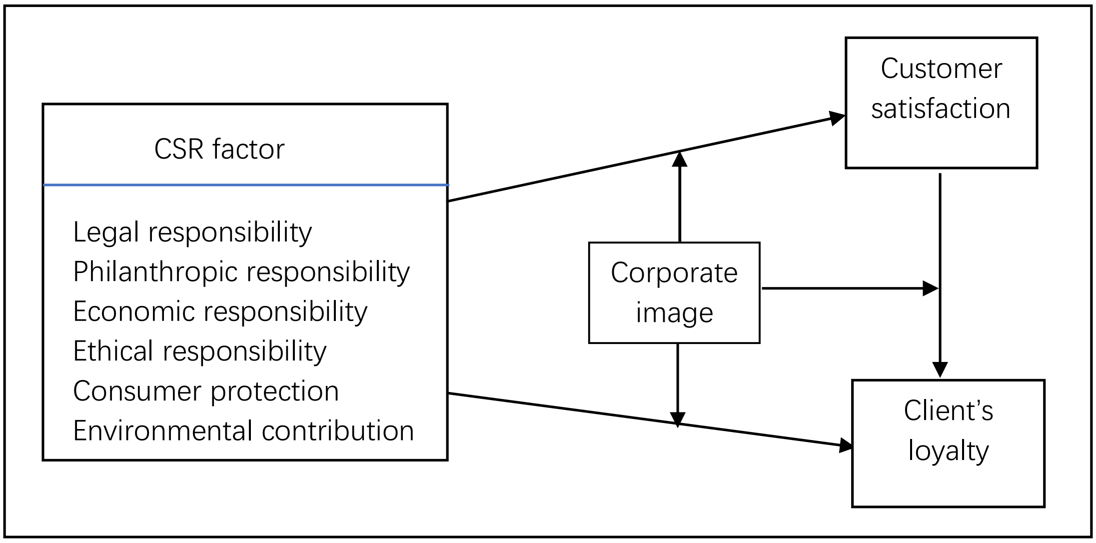

Figure 2.16: The proposed model of corporate social responsibility (CSR) factors influences client's satisfaction and loyalty (Chung et al., 2015)

In conclusion, ASS had an active, positive and direct relationship with the satisfaction rate of customers and client's loyalty. Meanwhile, there was an active and positive relationship between client's satisfaction and customer loyalty. Finally, client's satisfaction could give rise to client's loyalty and retention.

2.4.2.3 Maintenance

In general, maintenance (Shin and Jun 2015; Bastidas-Arteaga and Schoefs 2015; Seyr and Muskulus 2016; Vieira and Loures 2016; Wits, García, and Becker 2016; Hegde, Utne, and Schjølberg 2016; Rastegari and Mobin 2016; Carr 2017; Goncalves and Kokkolaras 2017; Alaswad and Xiang 2017; Li et al. 2018; Goncalves and Kokkolaras 2018; Palmarini et al. 2018; Baptista 2019; Hong, Kim and Oh 2020; Ge 2020; Shi 2020; Li 2020; Shang 2020; Wang 2020) was defined as all managerial and technical actions or activities happened during the utilized period to restore or maintain the requested functionality of a product or service (Shin & Jun, 2015). In their research, the maintenance policy and approach were classified into three categories: preventive maintenance, breakdown maintenance (corrective maintenance), and condition-based maintenance (CBM) (Shin & Jun, 2015).

On the basis of the understanding of Shin and Jun (2015) and Rastegari and Mobin (2016), maintenance might be conducted through numerous actions or activities; meanwhile, there were multiple categories of maintenance types in which maintenance was classified into two major categories, namely, corrective maintenance and preventive maintenance. On the one hand, corrective maintenance was also popular as reactive or run-to-failure maintenance and was a tactic that was utilized to restore (replace or repair) apparatus to its indispensable function (Rastegari & Mobin, 2016). On the other hand, preventive maintenance might be or predetermined (regular) maintenance, in which preventative maintenance is conducted in the light of the requirements of periodic inspection or interval check, such as scheduled maintenance, but without previous item situation examination or inspection (Rastegari & Mobin, 2016).

Moreover, Rastegari and Mobin (2016) explained the numerous classifications of maintenance types, as shown in Table 2.4.

Table 2.4: Distinctive classifications of maintenance types (Rastegari & Mobin, 2016)

Species of maintenance	**Explanation**
Breakdown Maintenance (BM), Failure-Based Maintenance (FBM)	Reactive maintenance or run-to-failure was a master plan utilized to resume (substitute or repair) equipment to its essential function following it was broken.
Condition-Based Maintenance (CBM), Time-Based Maintenance (TBM), Fixed-Time Maintenance	Preventive maintenance was conducted in the light of the established intervals of time, such as scheduled maintenance, but without preceding item situation inspection.

(FTM)	
Design-Out Maintenance (DOM)	To be believed as another maintenance strategy in which the concentration should be on enhancing the production design in a bid to make maintenance more achievable or even extirpate it.
Skill-Level Upgrade (SLU)	To be used to improve the competence of operators.
Reliability-centred Maintenance (RCM)	This was a process employed to decide what must be completed properly to make sure that any physical asset continued to do the right thing. Furthermore, it should do what its customers wanted in the context of the present operation.
Total Productive Maintenance (TPM).	Productive maintenance involving total participation

According to Baptista (2019), some researchers have focused on the work of repair and infrastructure maintenance after catastrophic failures and breakdowns, particularly as a result of external reasons. Graham and Thrift, cited by Baptista (2019), argued that primary maintenance and repair made its bid for significance somewhere in the space between restoration and breakdown of the pragmatic balance. Furthermore, infrastructures demanded consistent maintenance conducting and repair undertaking in order to avoid malfunction, decay or reconfiguration (Baptista, 2019).

Ge (2020) claimed that equipment maintenance consists of daily equipment maintenance and regular equipment maintenance. In addition, daily equipment maintenance also implied that the steps of cleaning and wiping, adjusting and lubricating of equipment were mainly used to protect and maintain the technical and production performance of the equipment. On the other hand, regular equipment maintenance meant that fixed-point inspection and disassembly maintenance, cleaning, system maintenance etc. In addition, regular equipment maintenance of the equipment should be carried out in a bid to keep all parts of the equipment fastened in place at any time. Shi (2020) described farm machinery maintenance in three regimes, namely:

- **Maintenance during the idle period**
  Most agricultural machinery would be idle for a long time throughout the whole year. Furthermore, if maintenance was not done for an extended period, it would cause problems in terms of the electronics and mechanical systems of the agricultural machinery. Therefore, the maintenance of the farming machinery during the idle period for field operations was exceptionally crucial and essential.
- **Change engine oil timely**
  Engine oil was a critical composite to operate and drive agricultural machinery and equipment systems. In the case of long-term use of agricultural machinery, there would be a large amount of metal scrap and oxides in the oil. Meanwhile, long-term non-replacement of engine oil would affect the system's mechanical performance. Consequently, it was necessary to regularly check and replace the engine oil of agricultural machinery as well as pay attention to the use of qualified oil products.
- **Replacement of vulnerable parts**
  In accordance with scientific methods, it was necessary to check and maintain these vulnerable

parts and replace them in time.

Li (2020) presented the problems in the maintenance process of agricultural machinery, such as insufficient preparation, no cut-off before commissioning and maintenance, and unskilled maintenance experts or technicians. Shang (2020) demonstrated that the care of agricultural machinery consisted of maintenance after commissioning, daily maintenance, regular maintenance, storage maintenance as well as extraordinary maintenance. Wang (2020) discussed agricultural machinery maintenance's status quo, namely inadequate implementation of maintenance work, lack of mechanical maintenance skills, insufficient investment in daily maintenance costs, and lack of professional and technical personnel on agricultural maintenance.

Maintenance was meant all the activities or actions in which the focus was on reinstating or repairing any function or breakdown of the product within their lifecycle (Palmarini et al., 2018). In addition, when the product was industrial equipment, it was usually related to industrial or manufacturing maintenance (Palmarini et al., 2018). The actions or activities that can be undertaken to repair or restore products' functions can be administrative, technical and managerial (Palmarini et al., 2018). Meanwhile, Palmarini et al. (2018) indicated that the characteristics of maintenance operation consisted of the maintenance missions that had been divided into four main categories, as shown below:

- Assembly
- Repair
- Diagnosis
- Training

According to Shin and Jun (2015), the advantages of maintenance were as follows:

- Maintenance can provide a preceding warning of forthcoming failure and increased accuracy in failure forecasting.
- This led to the improvement of customer satisfaction due to high-quality assurance
- It allowed end-users to conduct better planning, decrease or eradicate useless and unnecessary check-ups or inspections.
- It can accomplish the optimization of the production process; meanwhile, it can promote productivity.

Yet, maintenance and repair offered a critical foundation for re-valuing the skills and dispositions (Carr, 2017). In addition, repair and maintenance were the essential factors that influenced the after-sales service (Ashfaq, 2019). Maintenance issues should be met prior to any fault or malfunction occurred (Ashfaq, 2019).

In conclusion, maintenance was exceptionally significant to the long-term normal operation of equipment. However, the regular maintenance helped to improve the application effectiveness and efficiency of equipment and further expanded the service life of the device or machine.

2.4.2.4 Logistics

As the growth and expansion of e-commerce, logistics (Christopher 2011; McKinnon et al. 2015; Barreto, Amaral, and Pereira 2017; Hackius and Petersen 2017; Rodrigue, Slack and Comtois 2017; Grazia Speranza 2018; Gao 2019; Cui 2019) has gradually become the main link in which it takes cost reduction as the core of management, uses information technology as a support at the same time, and continuously evolved into an essential core of enterprise management.

Gao (2019) indicated that the concept of logistics originated in the U.S. military logistics department in the 1930s when it used "Physical Distribution" to represent objects' circulation. After continued understanding and development of logistics, the proper noun "*Logistics*" was used to describe the physical distribution.

According to Cui (2019), the definition and development of logistics are demonstrated and interpreted during the distinct time, as illustrated in Table 2.5.

Table 2.5: The definition of logistics (Cui 2019)

Year	Definition institution	The definition of Logistics
1981	Japanese Nittsu Institution "Logistics Manual"	Logistics was a physical movement of physical materials from the supplier to the demander in which this economic activity creates the value of timeliness and spatiality. It can be seen from the field of logistics that it included processes such as packaging, loading and unloading, storage, inventory management, circulation processing, transportation, and distribution etc.
1994	European Logistics Association	Logistics was planning, execution and control within a system. Furthermore, logistics achieved the expected purpose through the transportation, arrangement and related activities of personnel or commodities.
1996	Taiwan Logistics Management Association	Logistics was the flow of physical materials. In the flow process, through management procedures, it effectively combined transportation, warehousing, loading and unloading, packaging, circulation processing, information and other related logistics functional activities in a bid to create value to meet the needs of consumers and society.
2001	National Standard "Logistics Terminology" GB/T18354-2001	Logistics was the actual logistics process of goods from the supplier to the demander. According to trade needs, logistics can effectively integrate basic circulation processes such as transportation, storage, handling, packaging, circulation processing, and information processing to achieve customer requirements.
2006	National Standard "Logistics	Logistics was the physical flow of goods from the supply to the demand side. According to transaction needs, the fundamental processes of transporting, storing, handling, packaging, loading

	Terminology" GB/T18354-2006	and unloading, packaging, circulation processing, distribution, recycling, and information processing were organized organically.

Rodrigue, Slack and Comtois (2017) argued that logistics was an essential function of modern transport systems. However, logistics was also the term widely employed to interpret the storage, transport, processing and treatment of products as they moved from the original process (through the production system) to their final point of sale and consumption (McKinnon et al., 2015). Logistics was essentially a framework and planning orientation that sought to produce a unitary plan or program for the flow of information, goods and product by means of a business or trade activity (Christopher, 2011). He further provided the model of logistics and competitive advantage, as illustrated in Figure 2.17.

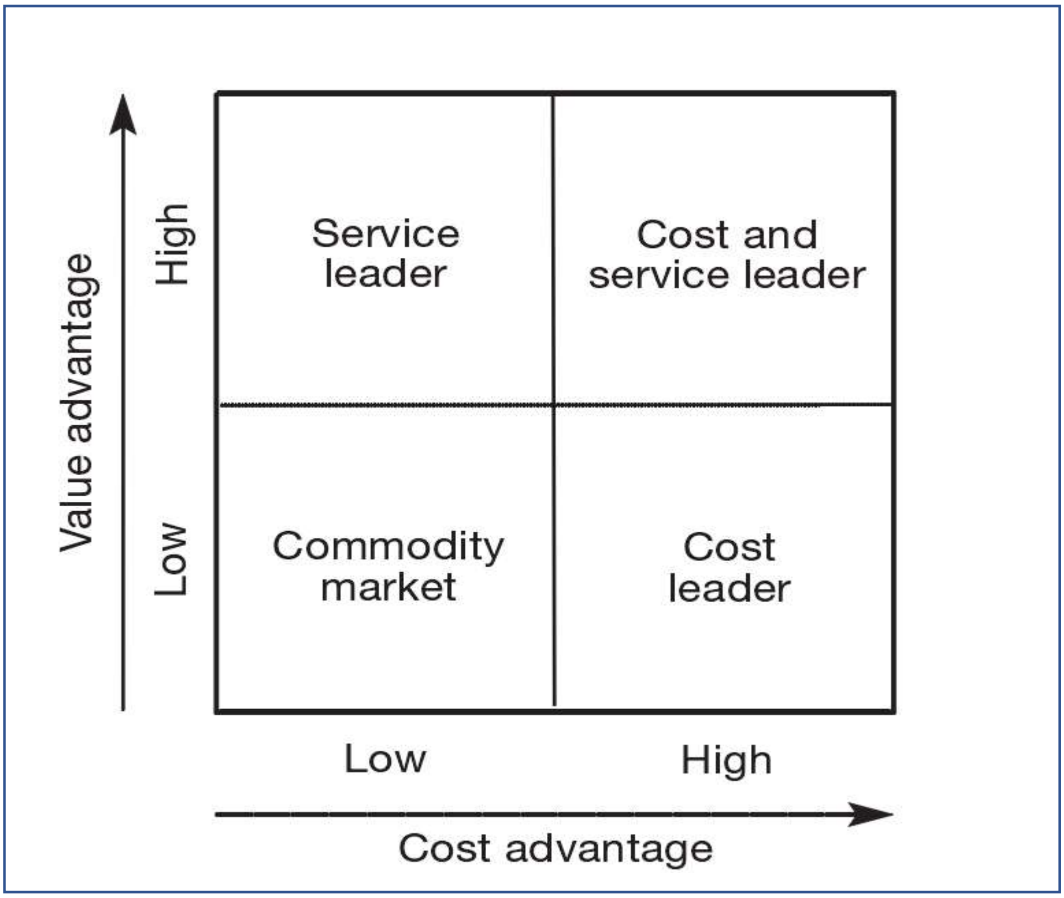

Figure 2.17: Logistics and competitive advantage (Christopher, 2011)

Furthermore, Rodrigue, Slack and Comtois (2017) analysed the essential characteristics of logistical systems, as shown below:

- The objective of logistics was to decrease costs, especially transport expenses.
- Logistics provided door-to-door services, mostly associated with just-in-time (JIT) strategies.
- The sticking point of logistics was the overriding significance of service reliability.

- Modern logistics systems economies were based on reducing inventories, as the speed, quickness and reliability of deliveries might remove the necessity of storage and stockpile. Therefore, a decrease in warehousing demands was one of the odds of logistics.

Barreto, Amaral and Pereira (2017) brought the concept of “Smart Logistic”, a system of logistics that can improve flexibility, adjust to the market changes, and encourage the company to meet the customer demands. Furthermore, this would make it probable to promote the degree of customer satisfaction as well as facilitate the optimization of the production (Barreto et al., 2017).

Logistics was also critical to the after-sales service of agricultural machinery. The transport or delivery of spare parts was a significant issue to technicians and dealers in South Africa and Africa. The majority of Chinese entrepreneurs are worried about this issue. However, the timely provision of spare parts can guarantee seasonable repairing and avoid the long-term breakdown of the machine, especially during busy seasons. On the other hand, logistics can ensure the availability, reliability and adequacy of spare parts in a bid to reduce the risk of after-sales service of AM.

2.4.3 After-sales service of agricultural machinery

After more than fifty years’ development and growth, China’s agricultural industry has formed a complete industrial system including tractors, internal combustion engines, farming machines, plant protection equipment, harvesting machines, irrigation and drainage equipment, transport trucks, animal husbandry machines, agricultural and sideline products processing machinery and feed processing tools etc. in 13 small industries (Liu, 2009). Moreover, it can produce 16 categories, more than 3200 kinds of products; furthermore, it has improved the continuous level of agricultural mechanization in China (Liu, 2009).

As stated by Xie (1996), the after-sales service of the agricultural machine referred to the installation and commissioning of agrarian machinery, technical training and consulting, product quality Three Guarantees (Sanbao: contract repairing, contract changing and contract to return), spare parts supply, use and operating organization form, the collecting of users’ views and market research forecast, repairing and maintenance, precautions of storage and so on.

On the other hand, Han (2005) and Fu & Cheng (2010) explained that the after-sales service of agricultural machinery was all the technical services offered by the sales department as well as the after-sales division. Moreover, Zhang (2010) defined after-sales services as agricultural machinery debugging, maintenance, repairing, troubleshooting, technical support, technical support providing, production sending, offering information, technology upgrading, access to the customer response and comments in terms of agricultural machine and the relevant services.

All in all, as elaborated by the authors mentioned above and summarized by other scholars, the after-sales service of China’s agricultural machinery may be considered in seven aspects of content, namely:

- Three Guarantees (Xie, 1996; Luo, 2012 and Fu, 2016): namely contract repairing, contract changing and contract returning
- The spare parts (Xie, 1996; Zhang, 2010 and Fu, 2016): the establishment of spare parts storage, the supply chain of spare parts and the timely supply of spare parts
- Experts (Liu, 2009; Fu, 2016 and Li & Ma, 2017): the experienced specialists, who are sufficient masters
- The timely repairing(Fu, 2016): especially in the busy farm season
- Repairing centre (Liu, 2009; Han, 2005; Fu &Cheng, 2010 and Li & Ma, 2017): sufficient repairing centres, the advanced repairing centres with a set of adequate repairing equipment
- After-sale service training (Xie, 1996; Liu, 2009; Luo, 2012; Fu, 2016 and Li & Ma, 2017): including the practice of agricultural machinery use, maintenance and repair
- The establishment of a customer information database and feedback (Zhang, 2010)

Regarding the after-sales of China's agricultural machinery, most of the researchers, academics and experts' attention has been focussed on the after-sales inside China, as concluded from the above article. Very few researchers focused on the after-sales service of China's agricultural machine in Africa. The different academics provided a distinct explanation of the ASS of agricultural equipment, as shown in Table 2.6.

Table 2.6: The content of after-sales service of agricultural machine

Author	Focus on ASS of agricultural machine
Fu (2016)	1, Installation and debugging on agricultural machinery for users 2, To instruct the usage of agricultural machinery according to the demands of users 3, To guarantee the provision of spare parts on agricultural machinery 4, To implement "Sanbao" (Three Warranties), namely ensure repairing, guarantee changing as well as guarantee refunding 5, To deal with the timely inquiry from users
Han et al. (2016)	1, The net of after-sales service of AM 2, Spare parts 3, Expert or technician, skilled man of after-sales service of AM 4, On-time provision of service on AM 5, Training course of after-sales service of AM 6, Information construction of after-sales service of AM
Zhao (2015)	1, Package service 2, Delivery service 3, Installation and debugging service 4, "Sanbao" (Three Warranties), namely guarantee to repair, guarantee returning as well as guarantee refunding 5, Technical troubleshooting 6, Training course 7, Establish a database of customers 8, Keep in touch with users 9, Knowing the usage situation of AM timely

	10, Collecting feedbacks from users of AM

2.4.4 Some elements of after-sales service of agricultural machinery

This study focuses on the ASS of AM, so some factors that influence the ASS of AM will be extracted from the literature review in this section in a bid to determine the relationship between the elements of ASS of AM and risk reduction.

2.4.4.1 Technician

In the context of after-sales service on agricultural machinery, the technician (K. Liu, 2015; X. Fu, 2016b; Z. Han et al., 2016; Wu, 2015; Daum, 2016; Wanyama et al., 2016; Daum and Birner, 2017) played a largely significant role to undertake detection of malfunction on farm equipment, repairing of machinery, a training course, as well as maintenance for tractor, seeder, plough and combine harvester etc.

Wu (2015), Jin (2016) and Zhang (2017) focused on the agricultural enterprise that should enhance the training of technicians and improve their level of knowledge and theory. This can keep them advanced, lead in their domain and ensure the quality of repair and operation on agricultural machinery.

According to Daum and Birner (2017), many agricultural programs, such as machinery imports, AM services hiring and farmwork conducting, were unsuccessful because of challenges, for instance, insufficiency and scarcity of qualified experts and technicians. In addition, some scholars argued that technicians were an indispensable part of mechanization in many agricultural programs (Daum 2016; Daum and Birner 2017).

While it was the downtime of farm equipment or encountering frequent breaking on agricultural machinery, it can reduce the end-users complaints if it was easy to obtain better-trained technicians. Furthermore, the after-service problem on agricultural machinery would have deteriorated because it was very difficult to access technicians; on the other hand, it took days or occasionally weeks to fix even very easy and uncomplicated problem of agri-equipment (Daum 2016; Daum and Birner 2017).

Moreover, the absence of skilled experts and technicians and hard access to maintenance have resulted in prolonged and frequent breakdowns, which were reflected in the sharp slump of quality of after-sales service of agriculture machinery (Daum, 2016; Daum and Birner 2017). For instance, it would be fascinating to quantify the influences of limited skills and knowledge of experts and technicians. These positive effects were not only on personal service providers but also on the entire agri-sector and the regained rate on broader stakeholders (Daum & Birner, 2017).

On the other hand, Wanyama et al. (2016) indicated that technicians were a vital linkage to the farmers to relay holistic knowledge about getting the skill of usage of agricultural machinery and the best farming practices. Farmers may have insufficient knowledge about the principles and application of mechanization, which technicians should provide. This can result in long-term breakdown time, which is detrimental for the agricultural undertaking, especially in the busy farming season.

In short, the technician was vital for after-sales service on agricultural machinery. Furthermore, lack of technicians for farm equipment or poor-quality of the technician, especially in break-down time, would result in farmers' dissatisfaction, which may lead to increase the opportunities for choosing another brand of agricultural machinery.

2.4.4.2 Spare parts

Managing reserves of spare parts (Wang 2015 and Jin 2016) for farm machinery in agricultural production activities represented one of the most critical doings and activities in guaranteeing smooth functioning, especially bearing in mind the urgency of the continuous nature of agri-production (Mirčevski et al. 2018).

It was significant for this machine not to be malfunctioning in order to ensure continuity in agri-work. However, in order to reduce the time of drawback of these devices, it can be implemented by the probability of faster repairs (Fu 2016b) to be returned in a functioning status. Furthermore, the successful realization of this issue was met by means of the sufficient stock of assemblies (Mirčevski et al. 2018; Fu 2016b).

Furthermore, Mirčevski et al. (2018) indicated that stocks or warehouses of spare parts located at proper locations could preclude long-term downtimes of farm machinery used in the primary agricultural processes of farmers. Obviously, numerous spare parts preserving was crucial for after-sales service on agricultural equipment in farm activities (Fu 2016b and Wu 2015).

On the other hand, Daum and Birner (2017) pointed out that according to the tractor-owners and other stakeholders interviewed, and there were ample opportunities for an unmet requirement for spare parts in the activity of agriculture. In addition, this was a legitimate conjecture that breakdown times were diminishing due to the improving access to spare parts (Daum and Birner 2017). Nevertheless, Lozano et al. (2017) argued that the optimization of spare parts management integrated into the supply chain and after-sales service through the design of a work methodology was unusually significant to obtain an improvement both in financial and organizational results of the companies that have applied it.

Based on Diao, Silver, Takeshima (2016b) and Wu (2015), timely and high-quality repair services, along with a trustworthy supply of spare parts, were imperative to keep machines functioning during peak agricultural seasons. Frequently broken-down tractors during the peak agricultural seasons have been seen as a most considerable constraint (Diao et al., 2016b). Notwithstanding this, the sufficient provision of spare parts should help them deal with more serious repairs, prevent further breakdowns as well as reduce the time machines remained in downtime (Diao et al., 2016b).

2.4.4.3 Timely repair

Agricultural machinery was an essential and primary element of the farming process, success and development, in which agricultural machinery management dealt with the optimization of the machinery phase of agricultural production, which was concerned with efficient operation, repair and maintenance (Shoaei et al. 2019 and Chervenchuk et al. 2020).

Timely repairing and repair cost (Shoaei et al. 2019 and Chervenchuk et al. 2020) was one of the most crucial elements of analysis of customer or user's satisfaction. According to Addisu Tadege Animaw et al. (2016), on-time repair service can be provided by after-sales service with warranties in the early stage of ownership after their purchase. Nevertheless, Liu (2015) explained that timely repair meant a technician provides seasonable service and repair when the agricultural machinery was broken or in downtime, especially in a busy agricultural season. Moreover, a timely repair can operate to cope with the malfunction of farm machinery in standard time.

Furthermore, Gauchan and Shrestha (2017) indicated that traditionally the technician had played an important role in repairing agricultural machinery. However, they may lack experience and technical knowledge related to agricultural machinery development services. Consequently, private sector manufacturing or repairing centres and repair workshops in different regions and locations were to be promoted and supported with experience and technical knowledge or know-how of repair and maintenance (Gauchan and Shrestha 2017).

On the other hand, Mirčevski et al. (2018) elaborated that it was essential for agricultural equipment not to be faulty to ensure continuity in work, reducing the time of defectiveness of farm machinery achieved by the possibility of faster repairs. Repairing can be achieved both in the repairing workshop/centre (Pei 2015; Liu 2015; Gauchan and Shrestha 2017; Addisu Tadege Animaw et al. 2016; Jin 2016) and in the field/on the spot (Liu 2015; Mohamed, Kheiry, and Ahmed 2016).0

2.4.4.4 Maintenance

Low maintenance of machinery which tended to be unreliable and also required frequent repairs compared with sufficiently maintained machinery, was a risk factor (Jadhav, Achutan, Haynatzki and Rajaram 2016).

Ahmad et al. (2017) reported that it was essential for the farm machinery to work for maximum time with regular maintenance. Maintenance was required for agricultural machinery to keep it updated in perfect working order, in spite of the consequences of the age of the machine. Nevertheless, improper maintenance of farm machines (Ahmad et al. 2017) may result in perennial break-down time, especially in the peak busy agricultural season. This was significant for farmers who were urgently wanting to use agricultural machinery during the busy agri-season. However, the technician/expert of the agricultural machinery workshop was responsible for providing information regarding the skill of operation of farm equipment and maintenance of knowledge/know-how on agricultural machinery (Pei, 2015).

In their article, Daum and Birner (2017) indicated that tractors required regular maintenance and careful operation, as tractor-owners who always used this kind of agricultural equipment in their farm acknowledge the importance of maintenance. Furthermore, a lack of proper and suitable maintenance in both the regular season and busy agri-season has resulted in frequent and long-term break-downs. On the other hand, ignoring maintenance may increase income in the short term (Daum & Birner, 2017). Following maintenance rules, on the other hand, may ensure payment and dividends in the long term (Daum & Birner, 2017).

While performing maintenance tasks, the technicians' prominent role was to investigate the problem immediately and quickly using their senses, experience, relevant knowledge on agricultural equipment. In addition, know-how, as a set of repairing equipment as well as electronic gauges, was also utilized by technicians (Ahmad et al. 2016; Pei 2015).

2.4.4.5 Training Course

As mentioned by Man et al. (2016:2), training was one of the most useful businesses and industry tools to bring the best of employees. It was designed to help the employees and users to familiarize themselves with the work, to develop the skills of customers, to maintain a high standard of services as well as to prepare for the work advancement with greater responsibilities (Man et al. 2016; Pei 2015; Liu 2015 and Han et al. 2016).

In the agricultural domain, the training course may bring farmers and end-users information regarding the maintenance of agricultural machinery, know-how or expertise (Pei, 2015). This information included how to repair the essential malfunction as well as the preliminary operation of farm tractors.

According to Liu (2015), Wang (2015) and Fu (2016b), the training course should include knowing the structure of agricultural machinery, understanding the working theory of machinery, comprehending the flow of operation of machinery, knowing how to operate the farm equipment, being familiar with simple repairing and maintenance as well as knowing how to troubleshoot the agricultural machinery.

Notwithstanding this, Man et al. (2016) reported that the weakness or absence of training agricultural workers after employment in planning and instructional program might negatively affect the success of agricultural work. In a bid to implement and improve the quality and skill of farmers/end-users who use agricultural machinery, the training course was one of the essential requirements (Kwesiga, 2018). Training and information, which must be easily and simply understandable for farmers and users, must allow them to obtain all the relevant knowledge that usually plays an essential role (Cecchini et al., 2018) in the progress of agricultural machinery field operations.

It has been reported as a harmful way of adding higher chances of injury in farmers who used unsafe and high-risk practices and agri-activities. However, this situation would be improved when they attend a safety training course or high-quality management lessons (Jadhav et al. 2016). These unsafe practices included not regularly turning off the machine, occasional splash of acids on the skin, frequently wrong-operation during farming (Jadhav et al. 2016) due to lack of training course on how to use machinery correctly and adequately. The employer or agricultural machinery enterprises must ensure that each worker and farmer receive sufficient information and training (Jadhav et al. 2016). Furthermore, this was also significant in the domain of agricultural machinery.

Moreover, in accordance with Cecchini et al. (2018), training should not be one-way delivery of AM knowledge or know-how from the technician to the farmers. On the other hand, it should improve the experiences of the farmers and facilitate their personal decision-making technology and skills in the practice of near-future farm equipment production activities.

Notwithstanding this, in the light of Cividino et al. (2018), a professional training course in the context of machinery use has been reported and implemented as compulsory. On the other hand, many farmers were not provided with information services and adequate training, which can lead to misfunction and injury in the operation of agricultural machinery.

2.4.4.6 Farm equipment information management system

The database or information system for users was crucial to the ASS of AM. The entrepreneurs or salesmen can communicate or remind customers to operate the AM or do maintenance regularly in a bid to increase the competitiveness of their brand and decrease the risk of ASS.

- **Enquiry from farmers**

According to Tourdonnet et al. (2018), the feasibility of collecting the required information in a short period of time was typically through farmers' enquiries (Zhao 2014). When the tractor or other agricultural machinery was broken down or malfunctions, farmers always phone or call the repair centre or service centre at first in order to obtain assistance or help (Zhao 2014).

- **Prompt response to farmer enquiry** (Zhang 2017 and Zhao 2014)

Prompt response to farmer enquiry was extremely significant, especially when users were urgent and desired fast repairing on agricultural machinery during the break-down time. However, it was also very important for service staff at the service centre to arrange for the repair technician to go to the field in a bid to provide essential and urgent assistance.

- **Establishing a database for users** (Zhang 2017 and Zhao 2014)

A database of agricultural machinery users, also named as agricultural machinery users' information management system (Fountas et al., 2015), included general information of farmer, such as name, contact number, email, farm address etc. Moreover, the date of purchasing farm machinery, type and kind of agricultural machinery and so on were also in the domain of user information management system (Kaishun Liu, 2015).

The main aims of the database were as follows:

1) To store the general and fundamental data and information (Nunes, Abi-Saab, and Ralisch 2017; Liu 2015) of the user for further communication on the issue of after-sales service in the upcoming future.
2) To provide interactive information and useful guidelines in real-time for tractor or other farm equipment operators (Fountas et al., 2015).
3) To inform users to come to repair workshops for timely maintenance (Daum & Birner, 2017).
4) To phone or interview farmers who purchased and used the agricultural machinery to make sure whether they are satisfied (Nunes et al., 2017) with the farm equipment or not. And why.

- **Regular phone interview of satisfaction of after-sales service on farm equipment**

According to Zhao (2015), after-sales service on farm machinery in the process of usage consisted of not only repairing of agricultural machinery, maintenance, provision of spare parts, but also users' database, phone interview of the customer, collection of feedback information as well as the establishment of users' information management system which was another type of after-sales service on agricultural equipment.

On the other hand, regular phone or call interviews with the customer can make sure and know the solution to agricultural machinery's problem (Zhao 2015; Han et al. 2016). The issues were whether they could provide timely repairing or not. On the other hand, it can provide information including the project or plan of AM product, updating of farm equipment, as well as other relevant information that farmers need (Zhao 2015; Han et al. 2016). This can increase enterprise confidence and meet their satisfaction with agricultural machinery (Zhao 2015; Han et al. 2016).

Relevant data were collected regarding service needs, habits of use and possibilities of agricultural machinery management through interviews and questionnaires (Carroquino et al., 2017).

In short, Liu (2015) and Han et al. (2016) stated that establishing the user information management system was to get the information on the usage of farm machinery quickly and timely. This can provide prompt service, technical advice and support via which farmers would be satisfied with the agricultural machinery enterprises (Fu 2016b; Wu 2015 and Zhao 2014).

2.4.5 Comparison of after-sales service between automotive and agricultural machinery

After-sales service of the automotive industry was first developed in the early 1930s (Luo 2020). It was first popular in western countries and then began to develop globally (Luo 2020). Furthermore, the service quality of automobiles is the extent to which the service, service organization and service process can meet the expectations of the consumer (Kesh, 2017). The service quality of automobiles formed an essential aspect in the perception of services that can be used as a tool for differentiation and can provide a competitive edge in the automotive industry (Kesh, 2017).

Ahmed and Sanatullah (2011) argued that the after-sales service of automobiles considered installation, delivery, spare parts, expert, customer satisfaction as well as re-buy purpose and word of mouth as the variable of after-sales service in the auto or car industry. Moreover, Adusei and Tweneboah-Koduah (2019) suggested that the after-sales service of automobiles consisted of warranty (Guajardo et al., 2016), product-, technical- or service- support to the customer, user information system, service contract, knowledge of the service staff, prices for assistance, the transportation time of the vehicle, automobile 4s (sale, spare-part, service and survey) workshop, service technician, spare parts, warehouse, repairing as well as qualified and experienced engineers to handle significant tasks. Adusei and Tweneboah-Koduah (2019) further indicated that after-sales service strategies were one of the driving forces in the automobile industry that must make a conscious effort of meeting customer requirements.

Moreover, Lande and Abramovici (2017) stated that after-sales service was a strategic activity for authorized automobile dealers and repairers by providing the service such as maintenance scheduling, personnel responsible for customers and repairing advice, technicians, useful customer scripts for the customer, a relationship-building between the customer and the authorized dealer or repairer. Furthermore, Lande and Abramovici (2017) illustrated the four stages of ASS of the automobiles clearly and explicitly using the standard process in the after-sales service of the automobile:

Stage 1: Making an appointment in after-sales service of the automobiles (Lande & Abramovici, 2017)

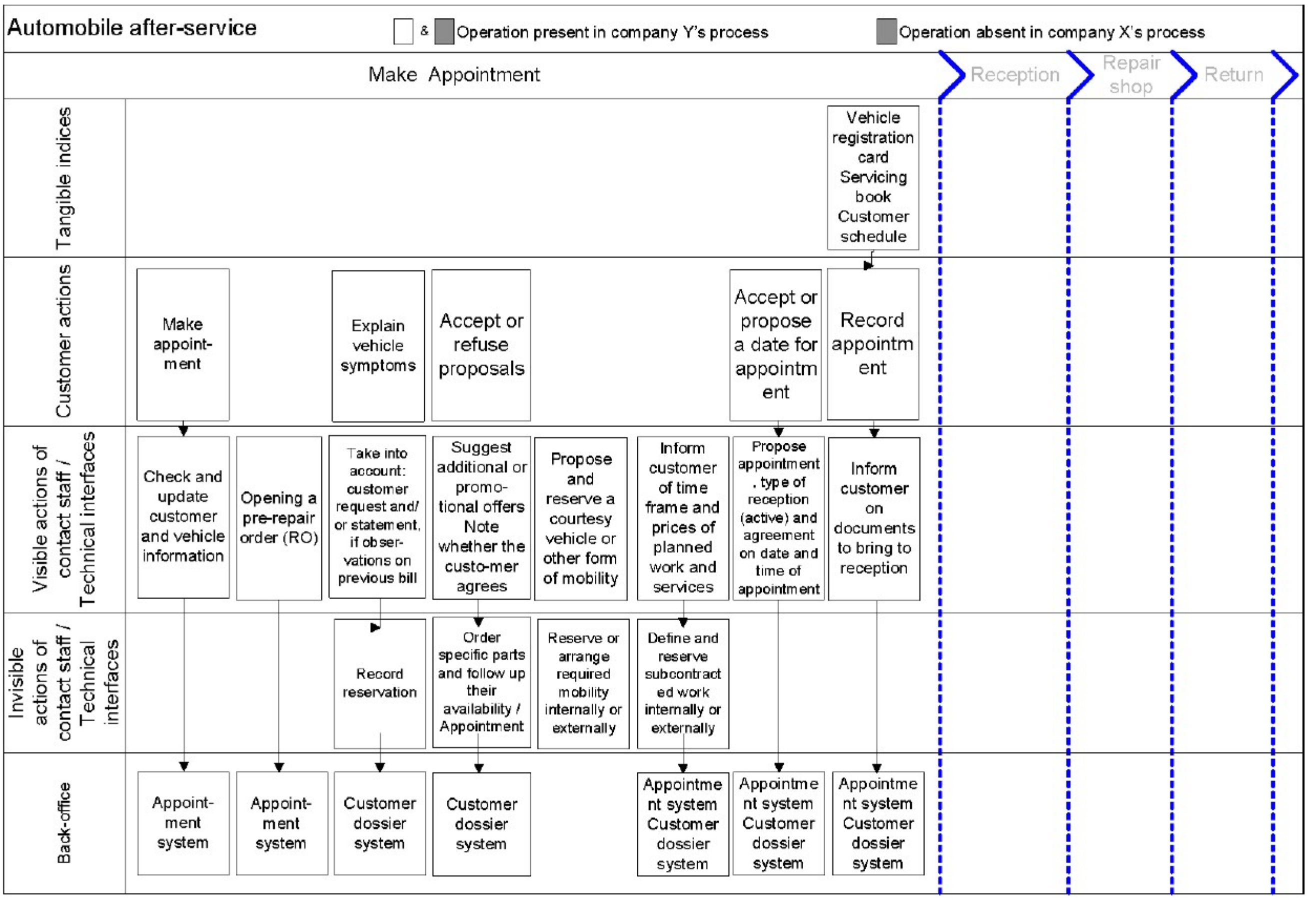

Figure 2.18: Blueprint of arranging an appointment in after-sales service of the automobile (Lande & Abramovici, 2017)

- Stage 2: Receiving the customer and his vehicle in after-sales service of the automobile (Lande & Abramovici, 2017)

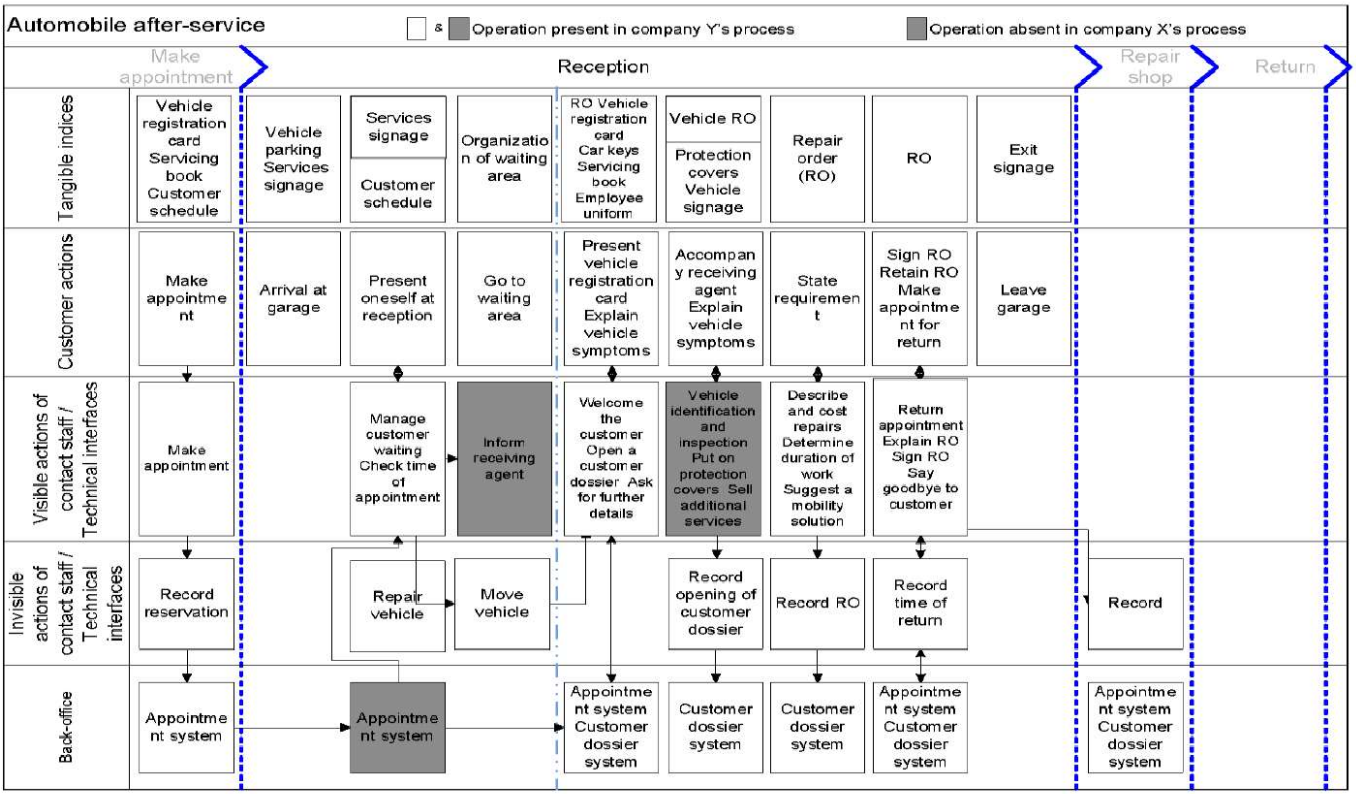

Figure 2.19: Blueprint of reception in after-sales service of the automobile (Lande & Abramovici, 2017)

- Stage 3: Carrying out the work required of the automobile after-sales service (Lande & Abramovici, 2017)

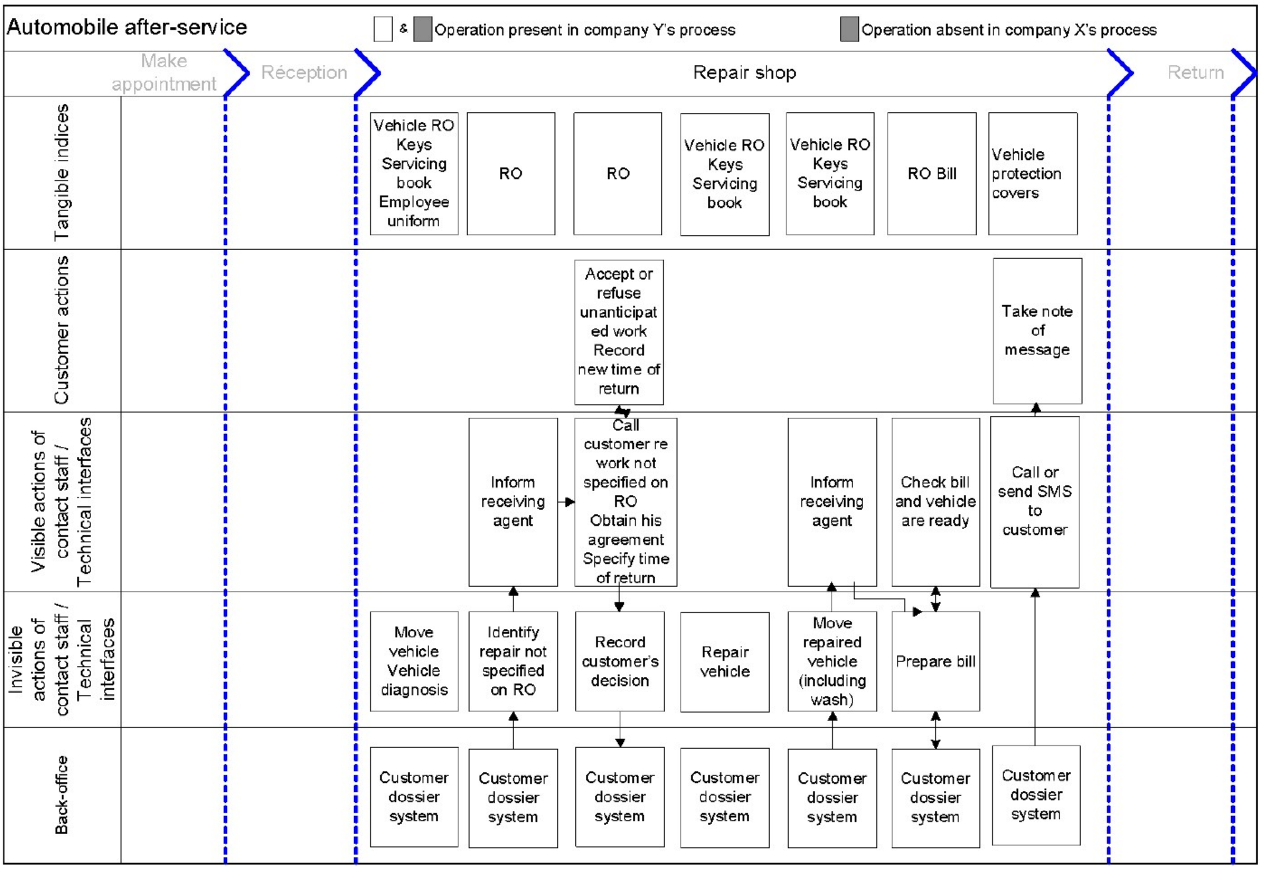

Figure 2.20: Blueprint of the repair shop stage in after-sales service of the automobile (Lande & Abramovici, 2017)

- Stage 4: Returning the vehicle (Lande & Abramovici, 2017)

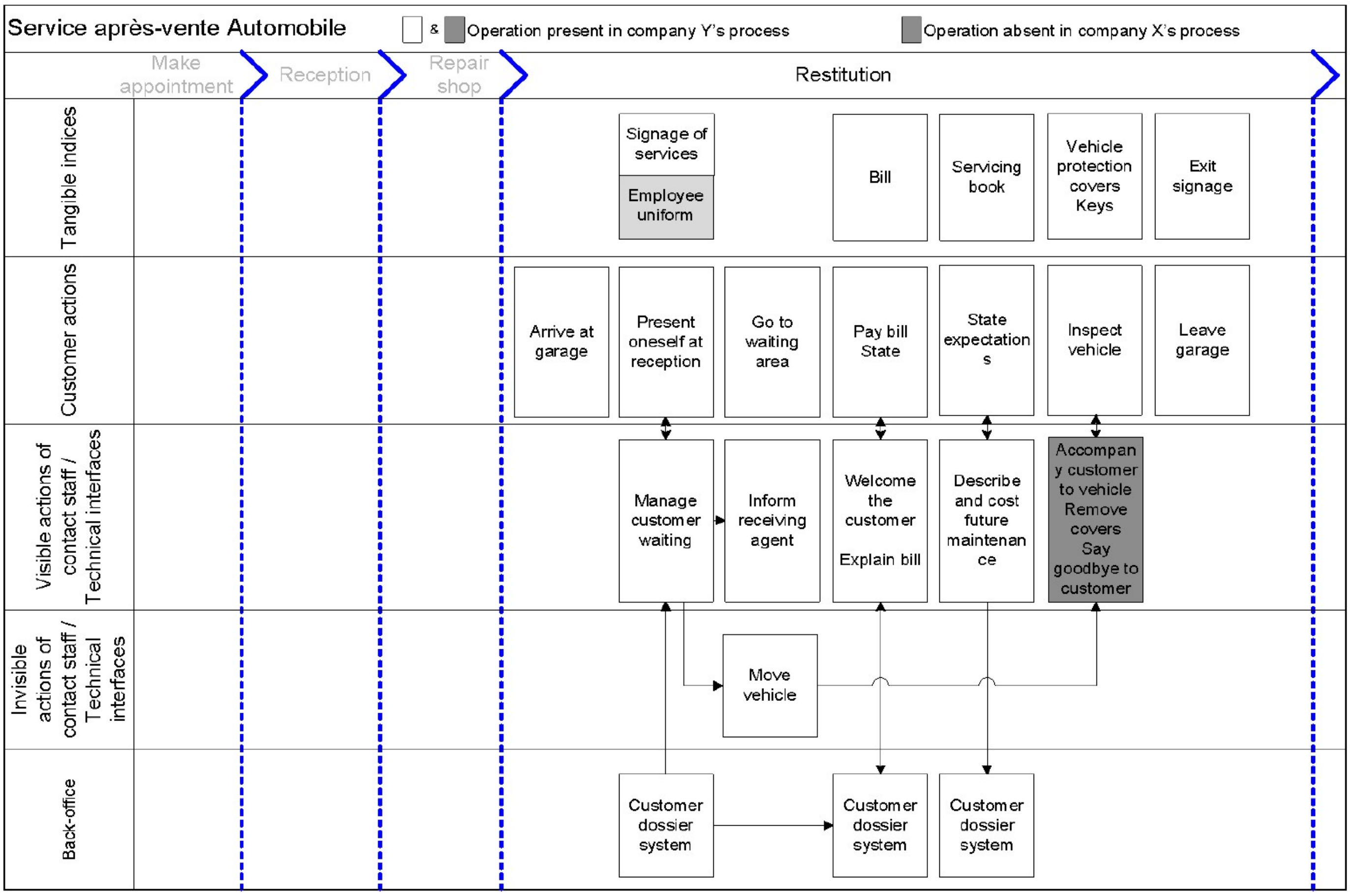

Figure 2.21: Blueprint of the vehicle return of after-sales service of the automobile (Lande & Abramovici, 2017)

On the other hand, Albors-Garrigos et al. (2017) presented the successful chains of client's behaviour and the automobile's after-sales service. Furthermore, they indicated that the critical constructs of the research model regarding ASS were: (a) perceived service quality, (b) workshop faithfulness, (c) after-sales service satisfaction and (d) brand fidelity (Albors-Garrigos et al., 2017). Furthermore, this successful chain within service departments can be associated with the auto ASS business, as shown in Figure 2.21 (Albors-Garrigos et al., 2017).

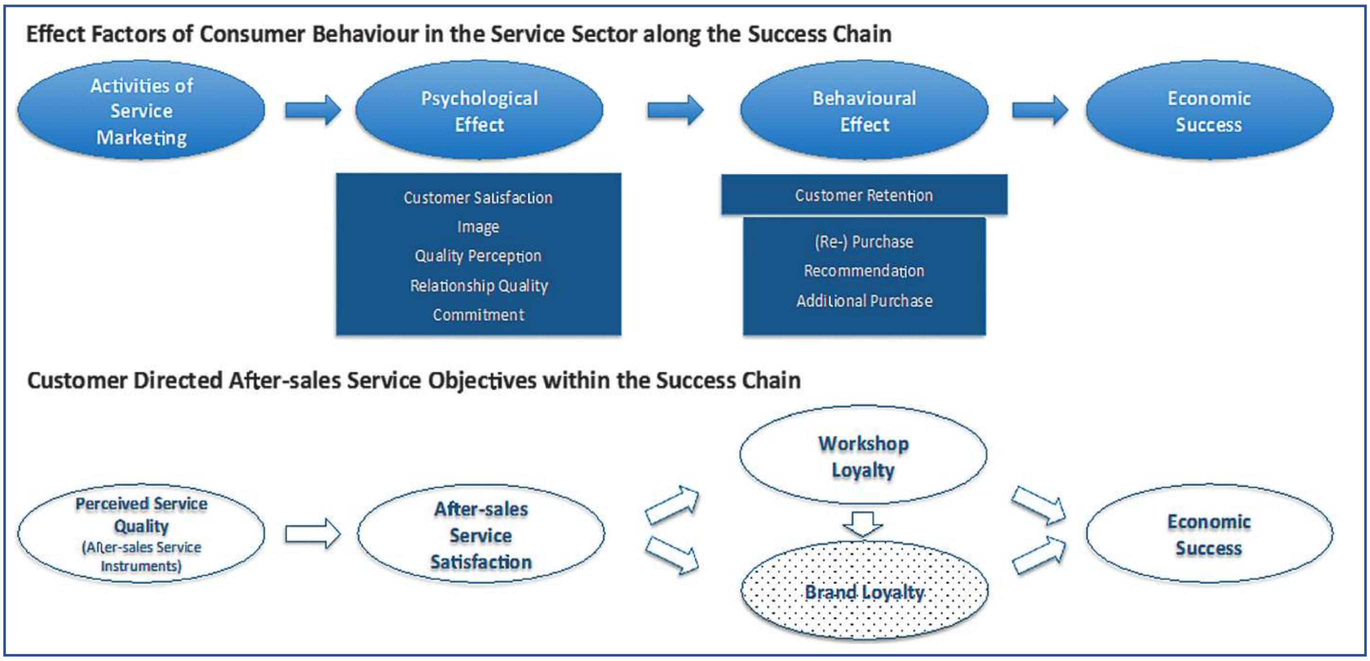

Figure 2.22: Success chains of consumer behaviour and automotive after-sales service

Wang (2020) argued that the after-sales service in the automotive industry not only involved repair and maintenance operations on a superficial level but also incorporated quality assurance, compensation and customer relationship establishment after the car has been sold. He further elaborated the automotive service operation mode includes 1) 4s, mainly refers to car sales, maintenance (service), data feedback (survey) and provision of accessories (spare part); 2) franchise management; 3) particular service station; and 4) self-management (Wang 2020). At the same time, he proposed some advice on how to improve the after-sales service of the automobile, including 1) improving auto after-sales service supervision mechanism; 2) building modern automobile service thinking and accumulating excellent and outstanding after-sales service experience; 3) introducing advanced after-sales technology in a bid to enhance the quality of automotive after-sales service, and 4) strengthening the comprehensive ability of after-sales personnel (Wang 2020).

Zhao (2020) claimed that the solutions of the after-sales service problem incorporated innovating the after-sales service project, improving the after-sales service process, strengthening the training of technicians and experts, and intensifying customer feedback and management, establishing impeccable employee management and incentive system as well as handling complaints properly. Furthermore, Zhang (2020) argued that the automobile after-sales service model consists of after-sales service personnel training, the after-sales service talent management system and the establishment of the customer feedback system as well as user database.

As discussed in the previous section, the after-sales service of agricultural machinery, refined from the literature review, included technician, spare parts, timing repairing, maintenance, training course as well as farm machine user information management system and service centre, as shown in Table 2.7.

Table 2.7: The factors that affect the after-sales service of the agricultural machines (Qin, Pretorius, and Jiang 2019)

Item	The factors that affect the after-sales service of agricultural machine
B-1	Technician
B-2	Spare parts
B-3	Timing repairing
B-4	Maintenance
B-5	Training course
B-6	Farm equipment user information management system and service center

The system of after-sales service of automobiles is more mature, systematic and comprehensive than the ASS of AM. As mentioned previously, the ASS of automobiles not only includes the 4s but also incorporates spare parts, technicians, maintenance, training, installation, customer satisfaction, repair, personal response to customers, brand loyalty, customer information system, feedback to users and handling complaints etc. However, the ASS of automobiles and agri-machinery is a little bit similar to some extent; for instance, they have the same elements or factors, containing technicians, spare parts, repair, maintenance, training and user system. Subsequently, the ASS of automotive has an extremely large influence on the ASS of AM. The experience and lessons from ASS of automobiles can be borrowed from the ASS of AM. For instance, agri-machinery enterprises and dealers would like to arrange and distribute 4s AM centers in different districts in a bid to serve their customers and users better and conveniently.

2.4.6 The situation of after-sales service of agricultural equipment in Africa and South Africa

Africa was the continent with the most developing countries in the world (Liu and Ma 2011). The current level of agricultural development in Africa was still relatively low, which meant that its development in agricultural mechanization was slow as well (Liu and Ma 2011).

In Sub-Saharan Africa, only about 5% of the land was cultivated with tractors, compared with 85% of the farmland in Central Africa depending on human production (Chen and Wang 2018). In West Africa, the workforce accounts for 70%, comparing to the usage of AM (Chen and Wang 2018). Meanwhile, Southern Africa and Eastern Africa's situation was better, but the proportion of the workforce had reached 54% and 50%, respectively (Chen and Wang 2018), which meant only 46% and 50% usage of AM.

After-sale service of agricultural machinery meant the provision of services to customers like provision of spare parts, timely repairing, training course and customer feedback during and after a purchase of tractors (Lwesha, 2015). The market for after-sales services was underdeveloped in African countries, with unbalanced supply across locations (Takeshima et al., 2013). Meantime, most repairs of farm tractors were performed by local mechanics in Africa, which can ensure the long-term sustainability of tractors and agricultural machinery utilization on the continent (Lwesha, 2015). The current status of agricultural mechanization in Africa may be tremendously limited by the lack of supply and the after-sales service, leading to the potential demand unmet for the majority of smallholder farmers (Takeshima et al., 2013).

Compared with European and American countries, the price of agricultural machinery of the same model from China was only 1/6 - 1/5 (from one sixth to one fifth) of those countries; nevertheless, the after-sales service of the agricultural machine in Africa was much more difficult to guarantee than those countries (Ke Liu & Ma, 2011). It was more significant to do better after-sales service for Chinese agricultural machines in Africa.

Lwesha (2015) explained that after-sale service was provided to customers through its service workshops and established dealer workshops and to train customers and dealers so as to ensure adequate support and maintenance of tractors being provided.

However, Lwesha (2015) indicated that the lack of well-trained operators of farm machinery was extremely apparent in the whole of Africa. At the same time, many of the operators who handled agricultural machinery were not well-trained despite operating expensive machines. In most cases, this led to poor quality of work, costly breakdowns of agrarian machinery and economic life-span of the machinery reducing (Lwesha, 2015). On the other hand, service providers, including manufacturers, importers, dealers and after-sale services, were inadequate in terms of repair knowledge and having poor technical expertise in relation to agricultural machinery (Lwesha, 2015). Meanwhile, they had poor working tools, equipment and underutilized capacity, which led to poor commercialization of development technologies and insufficient after-sales service of agricultural equipment (Lwesha, 2015).

When discussing the after-sales service of the agricultural machine in Africa, Hou and Qian (2018), in their study, discussed the status quo of it under the following points:

- Too few machinery repair service centres available nationwide
- Lack of strong state support for manufacturers, distributors, sellers
- Lack of agents with after-sales service expertise at rural extension centres
- Affordable prices for after-sales service
- Lack of policy supporting agricultural mechanization and the relevant after-sales service in some of the African countries.

According to Chen and Wang (2018), there were many agricultural machinery brands in the immature African market. Furthermore, the supply of agricultural machinery maintenance and spare parts has become a bottleneck, which seriously affects agricultural machinery's efficiency and brand promotion. There was a shortage of technicians for agricultural machinery in Africa, and smallholder farmers' educational level was relatively low (Chen and Wang 2018). It was challenging to obtain maintenance on this continent (Chen and Wang, 2018). In Africa, agricultural machinery was often damaged due to small-holder farmers' ignorance of know-how or improper operation, and even appropriate agrarian machinery has been left unused because they cannot use it (Chen and Wang 2018).

In conclusion, there were numbers of research focusing on agricultural mechanization (Buckley 2013; Takeshima, Pratt, and Diao 2013; Diao et al. 2014; Baudron et al. 2015; Lwesha 2015; Sims and Kienzle 2016; B. Sims and Kienzle 2017; Kergna 2018; Adu-Baffour, Daum, and Birner 2019), especially mechanization in Africa (Ke Liu and Ma 2011; Buckley 2013; Hou and Qian 2018; Chen and Wang 2018), Western African (Mrema et al., 2018), Sub-Sahara Africa (Cousins 2010; Takeshima, Pratt, and Diao 2013; Baudron et al. 2015; Sims and Kienzle 2016; Mrema, Kienzle, and Mpagalile 2018), Eastern African (Akinyemi & Mushunje, 2019), Southern Africa (Baudron et al., 2015). Very few studies concentrated on the after-sales service of the agricultural machine in Africa, which was extremely important for sustainable agricultural enterprise development and agri-economy growth.

2.4.7 Conclusion

In this part, the relevant information of after-sales service, including the definition, the distinctive factors of after-sales service, have been interpreted. Meanwhile, the pieces of knowledge of maintenance and logistics have also been discussed in this part. Moreover, a comparison of after-sales service between automotive and agricultural machinery was illustrated. The after-sales service of Chinese agricultural machines, factors affecting after-sales service of agricultural equipment, as well as the situation of after-sales service of agricultural equipment in Africa and South Africa, have been discussed in detail in this part as well. In the following section, the relevant detail regarding project management, the definition of risk, risk management as well as the risk of after-sales service of agriculture machinery will be illustrated.

2.5 Risk management

The main research objective in this thesis is to facilitate the risk reduction model of ASS of AM, so it is significant to introduce the information regarding risk management via literature review to have a primary understanding of risk management. Because risk management is part of project management also in the agriculture sector, it is better to introduce project management at first briefly.

2.5.1 Project management

Before discussing risk management, it is crucial to briefly explain what project management is, so it might be very crucial to present the relevant information in the following context.

Hall (2012) demonstrated that project management (PM) emerged to be exceptionally different from both theoretical and pragmatic perspectives, compared to numerous business processes. From a pragmatic and realistic viewpoint, the two standard purposes in PM were referred to be the completion and success of the project on time (Hall 2012).

In order to better demonstrate and display the history and development of modern project management, Kwak identified four periods in the history and development of modern project management: prior to 1958, 1958 – 1979, 1980 – 1994, and 1995 to present, as shown in Table 2.8 (Seymour & Hussein, 2014).

Table 2.8: The four periods of modern project management (Seymour & Hussein, 2014)

Periods	
Prior to 1958	During this phase, project management converted from a crafting system to human relations administration. Meanwhile, better telecommunication and transportation systems empowered speedy communication and higher mobility.
1958 – 1979	During this period, it focused on the application of management science. On the professional side, project management's process of institutionalization started with the emergence of the global first PM institution, now known as IPMA (the International Project Management Association).
1980 – 1994	Multitasking PC (Personal Computer) influenced many respects and fields of business and work, including project management etc.
1995 to present	In this period, technology continued to be an impetus and momentum for change and hugely impacted what project managers did. During this era, both the ANSI (American National Standards Institute) and the IEEE (Institute of Electrical and Electronics Engineers) acknowledged PMBOK as a criterion and standard.

Heagney (2016) indicated that project management was the design, scheduling and control of project doings and activities in a bid to meet project aims. However, the primary purposes of project management that must be met include cost, performance and time targets while controlling or maintaining the area of the project at the proper level (Tips & Search, 2013).

According to Heagney (2016), the steps of project management in a project are shown in Table 2.9.

Table 2.9: The steps in managing a project (Tips and Search 2013)

The steps in managing a project	
Step 1	Develop solution options
Step 2	Design the project
Step 3	Implement the plan
Step 4	Supervise and control the progress
Step 5	Complete the project

Project management, on the other hand, also involved five steps or processed which was identified in the PMBOK Guide, as shown in Table 2.10 (Kerzner, 2009), namely:

Table 2.10: Five process group of project management (Kerzner 2009)

Process groups	Content
Project commencement	• Selection of the scope of the project • Acknowledging the project benefits • Preparing the documents regarding the project • assignment of the project administrators and managers
Project design	• To define the work requirements • To describe the quality and quantity of this project • To constrain the resources demanded • To schedule the project activities • To evaluate the various and numerous risks
Project implementation	• To negotiate with the program team members • To guide and manage the work • To work with the team members to execute the project
Project supervising and control	• To track progress • To compare the real outcome to predicted results • To analyze the variances and influences • To adjust the results
Project completion	• To verify whether all of the work has been completed • To close the contract • To closer down the finance of this project • To summarized the paperwork of this program

Successful and superior project management can further be explained to have accomplished the project aims and purposes (Kerzner, 2009):

- Before the deadline
- Under the cost
- At the level or stage of the desired performance or technology
- Through employing the allocated resources effectively and efficiently
- Accepted by the clients

According to Kerzner (2009), project management was the plan or design, organizing, management, monitoring and controlling company resources in a bid to meet a comparatively short-term goal or objective. Meanwhile, this has been set up to complete concrete and particular objectives, aims and goals. Additionally, project management employed the system methods to manage the project through assigning functional staff (the vertical hierarchy) to a particular program (the horizontal hierarchy) (Kerzner, 2009).

The process of project management has been obtaining a growing amount of attention as a method to promote a company's competitive role and position (Mathur et al., 2013). Furthermore, Mathur, Jugdev, and Shing Fung (2013) stated that project management was a set of procedures that incorporated the measures, techniques, and knowledge-based implementations utilized to projects in order to deliver products or services and bring about organizational targets that involved both tangible and intangible assets.

On the other hand, Radujković and Sjekavica (2017) demonstrated that project management was design, organization, supervising, controlling and consummation of all aspects of the project. They further explained that the motivation of all project aspects was incorporated to meet the project objectives in a safe manner, to comply with the planned budget, premeditated schedule and performance criteria. In addition, it can be understood from the definition of project management that it concentrated on project undertaking and performance, as well as adherence to standards and criteria of time, cost and quality (Radujković & Sjekavica, 2017).

Silvius and Schipper (2014) explained clearly that the project person-in-charge should take liability for more sustainable prospects and facilitate the impact of project management on sustainable development. Meanwhile, project management was an effective impetus to present a more overwhelming change, not only to the construction of industry’s practice but also, more significantly, to the industrial culture (Silvius & Schipper, 2014). Additionally, several opportunities and chances for introducing sustainability of PM guidelines into all PM processes or procedures can be identified by mapping the sustainable PM development in the process of PM and its knowledge areas (Silvius & Schipper, 2014).

At its kernel, project management targets were associated with bringing out a circumstance where the human being can work together to realize a reciprocal aim to convey successful projects on a budget and on time (Seymour & Hussein, 2014). In addition, some researchers disputed that future project management positions would be the past tense, and there would no longer be a particular role of project administrator in the PM process (Seymour & Hussein, 2014). However, a project manager's work should be broken apart and become technical workability that was part of the basic requirement of work responsibilities (Seymour & Hussein, 2014). On the contrary, others debated that project management had been shown to the advantage of professionalization and required a particular skill type of effective and efficient project management (Seymour & Hussein, 2014). In a nutshell, Nicholas and Steyn (2020) indicate that project management aims to manage a system of tasks, people, resources and organizations to achieve the project target. Meanwhile, they interpret that project management resembles the novel venture management, a type of management used in consumer-oriented enterprises for developing new products or markets (Nicholas & Steyn, 2020).

ASS of AM was closely related to project management. Furthermore, the after-sales service started after the AM products being sold. The ASS staff should plan how to provide wonderful service after customer’s purchases. Additionally, the management of spare parts, training course and repair are involved in the process of project management. The communication between ASS staff and customers was also part of project management. Moreover, the project monitoring and control of ASS should be conducted by ASS managers, operators in the information center and technicians. However, the project would be ended or closed by definition until the ASS of AM is complete following the specific life or duration.

2.5.2 Risk

The objective of this research is to establish the risk reduction model of ASS of AM, so the risk is a hot topic to discuss in this section. The introduction of risk in this section to understand the role and function of risk as part of this research.

Valsamakis et al., in the study "The Theory and Principles of Risk Management" and the book "Risk Management 2nd Edition" in 1996 and 2000 separately, as cited by Smit (2012), defined risk as to the variation of the actual outcome from the expected outcome. Meanwhile, Sitkin and Pablo, in the article "Reconceptualizing the determinants of risk behaviour", as cited by Smit (2012), defined the risk as "the extent to which there was uncertainty about whether potentially significant and/or disappointing outcomes of decisions would be realized".

Moreover, the Collins English Dictionary cited by Smit (2012), defined risk as "to be in peril". On the other hand, Briers (Smit, 2012) stated risk as a human behaviour with imperfect knowledge about the future outcome.

According to Miller (1992), risk refers to variation in enterprise outputs or functions that cannot be predicted previously. Furthermore, risk refers to uncertain environmental variables that reduce property predictability, as well as the lack of predictability in company outcomes itself, can be confusing (Miller, 1992). Chapman and Ward (2003), on the one hand, identified risk as an uncertain event or condition; or, it was an uncertain event or set of environments.

On the basis of Manuj and Mentzer (2008), the finance literature viewed risk as probabilities of expected outcomes or risk of default. In the context of strategy literature, the risk was defined as utilizing the adjusted ratio of return on financial investment. Furthermore, marketing looked at risk as to the failure of meeting psychological or performance goals. In the light of view, as stated by Manuj and Mentzer (2008b), risks were all those items that kept people away from the perfect outcomes or perfect path; otherwise, unintended outcomes were the risk, including potential losses and the likelihood of losses.

2.5.3 Risk management

Steinherr, as quoted by Mcneil, Frey, and Embrechts (2005), indicated that risk management was described as one of the most significant innovations in the 20th century. However, Dionne (2013) explained that risk management's purpose and objective were to produce a relevant framework that would permit enterprises or companies to deal with uncertainty and risk. At the same time, different researchers gave a distinct definition of risk management as follows.

Dionne (2013) indicated that risk management was defined as a set of operational or financial doings and activities that maximize a company's portfolio or value by decreasing the costs related to cash flow uncertainty and volatility.

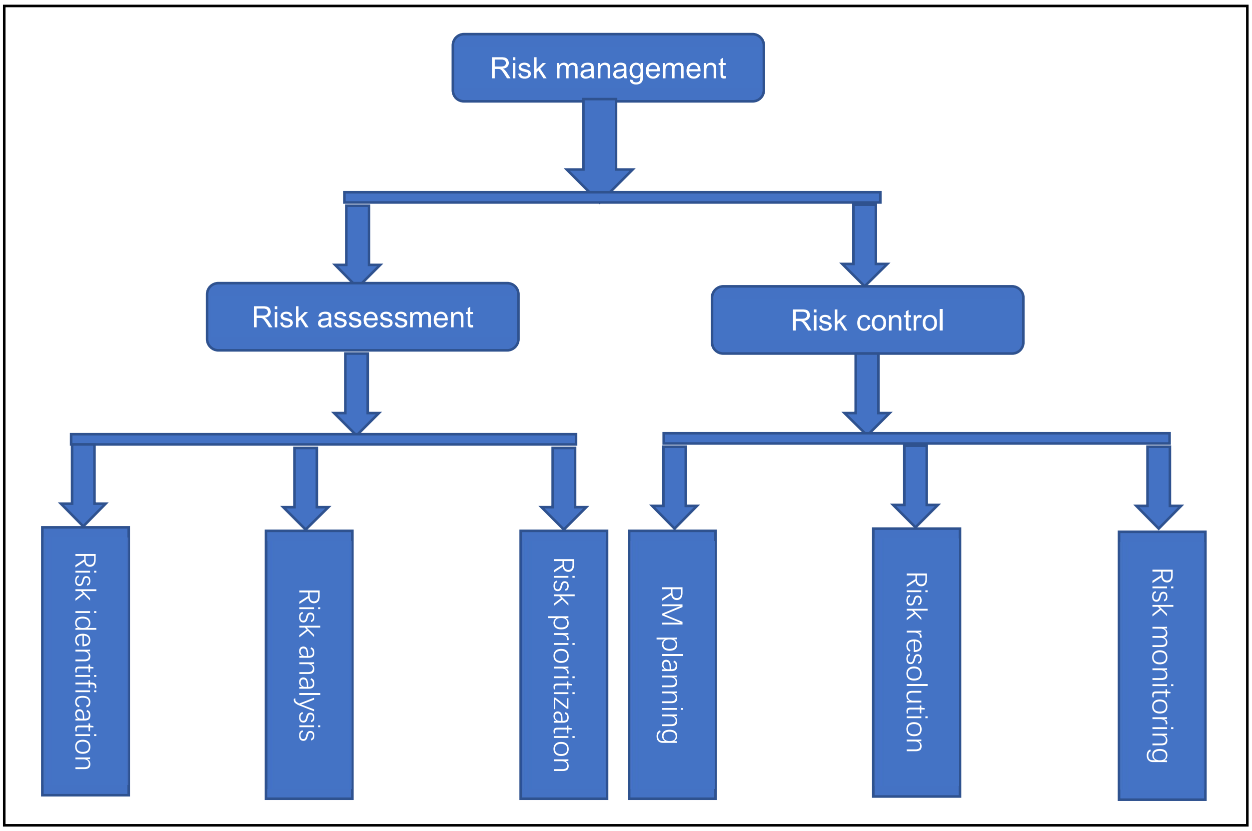

Figure 2.23: Constitution of risk management (Boehm, 1991)

As shown in Figure 2.23, Boehm (1991) explained that risk management included two principal and primary components, risk assessment and risk control, which were composited by six subsidiary parts, namely risk identification, risk management planning, risk prioritization, risk analysis, risk monitoring as well as risk resolution respectively.

Table 2.11: The five-step risk management procedure and crucial information in each step (Smith and Merritt 2002)

Step	Content	Crucial information
Step 1	Identifying risks	Risk events, classifications and impacts
Step 2	Analyzing risks	Drivers, probabilities, and total loss
Step 3	To prioritize risks	The subset of risks to be managed
Step 4	Resolving the targeted risks	Types of action plans: dodge, transfer, hedging, contingency, reduction and prevention
Step 5	Monitoring risks	Assess the status quo and closedown of targeted risks

On the other hand, as shown in Table 2.11, Smith and Merritt (2002) explained that risk management includes five steps, namely identifying risk aspects; analyzing risks for determining what drove them, how significant their influence might be, as well as how likely they were; prioritizing and mapping risks so that the most significant and primary factor would be resolved; planning resolution of targeted threats via targeting risks, furthermore planning to meet the risks; monitoring risks means that assessing the status of risks, monitoring procedure on the action plans, terminating action plans of risks that have been sufficiently solved and finally seeking for novel risks.

2.5.3.1 Identify risk

The first step was to determine risks (Zhang et al. 2016) that the business or management was disclosed to in its operational circumstance. However, there were numerous distinct types of risks, such as legitimate risks, market risks, environmental risks, regulatory risks and so on. It was extremely crucial to determine as many of these risk factors as possible.

Risk identification referred to identifying potential problems that might lead to cost overruns, schedule delays, or performance degradation and further analyzing qualitatively their consequences. Meanwhile, the work to be done at this step was to analyze the technical weaknesses and uncertainties of the system and project, obtain the risk sources of the system, and combine these risk sources into a format file for future analysis and reference. In conclusion, this belonged to the scope of qualitative analysis.

However, the agricultural risk is a significant public health problem all over the world (Jadhav et al., 2016). Jadhav et al. (2016) identified emerging risk factors for agricultural injury and calculated pooled estimates for factors that were assessed in their studies. Risk management usually utilizes templates or formulas to narrow down and identify risk. However, some general risk identification methods include the flowchart method, SWOT analysis, brainstorming, risk surveys, and risk questionnaires.

2.5.3.2 Analyze risk

Risk analysis (Dziadosz & Rejment, 2015) aimed to find out the uncertain factors (subjectively uncontrollable) of the action plan or project, analyze its environmental conditions and sensitivity to the project. Moreover, risk analysis was to evaluate and estimate the impact and consequences of risks, including qualitative risk analysis and quantitative risk analysis.

Once a risk (Dziadosz & Rejment, 2015) has been determined, it was necessary to be analyzed. Among them, qualitative risk analysis was the process of evaluating the impact and possibility of risks identified and sorting the risks according to the possible impact of risks on project objectives. However, its role and purpose were to identify specific risks and guide risk response; sort the risks according to the potential impact of each risk on the project objectives and; determine the overall risk ranking of the project (overall risk ranking for the project) by comparing the risk scores (risk scores). On the other hand, quantitative risk analysis was to quantify the probability of each risk and its consequences to the project goals and also analyze the overall risk of the project. Its role and purpose were to determine the probability of achieving a specific project goal; identify the risks by quantifying the impact extent of each risk to the project goal; determine the realistic and achievable cost, schedule and scope goals.

2.5.3.3 Evaluate or rank risk

Risk assessment was to analyze the possibility and influence of failure in the state of the hazard and then determine whether this possibility and impact can be tolerated in the project process. On the other hand, risk evaluation referred to the assessment of the possibility of major misstatements and the severity of consequences. Meanwhile, it was crucial to rank and classify risks (Guo et al., 2016) as it permitted the organization or enterprises to obtain a comprehensive view of the overall organization or enterprise's risk disclosure. According to the possibility of the threat and the possible impact of the threat, an assessment result was obtained, namely the risk level or rank. Furthermore, the intolerable risk level was determined based on the result of risk evaluation. The main purpose of risk rating was to rank the listed threats, list which ones need to be considered first, which ones can be considered later, as well as which ones cannot be considered under current technical conditions.

One can rank or evaluate the risk by means of examining the risk size and magnitude (Norhayati et al., 2015), which was the amalgamation of consequence and likelihood. Then decisions can be made regarding whether the risk was accredited and acceptable or whether it was severe enough to guarantee treatment. In a nutshell, risk evaluation was the prerequisite and foundation of safety management, and an excellent risk assessment was of great significance.

2.5.3.4 Treat risk

Risk treatment (Lonial et al., 2015) referred to the relevant prevention plan for avoiding, accepting, reducing or sharing risks based on the nature of the risk and the decision-making subject's tolerance for risks. Furthermore, this is based on the determination of the risks in the business activities of the main body of the decision and analysis of the risk probability and the degree of risk impact. Moreover, the formulation of risk response strategies mainly considers four factors: avoidability, transferability, mitigation, and acceptability.

On the other hand, risk treatment referred to minimize the impact of risk losses on the production and business activities of the enterprise by means of taking corresponding countermeasures, measures or methods for risks of different types, different scales and different probabilities. Meanwhile, risk treatment was an economic operation process to achieve maximum safety guarantee with the smallest cost through employing different measures and means. The common method of risk treatment was avoidance, retainment, prevention, restrain and transfer.

2.5.3.5 Monitor and control risk

Not every risk can be eliminated – some risks were continuously existing. Meanwhile, there were always things that cannot be controlled, and risks were always presented. For instance, environmental risks and market risks were exactly two risk cases that always need to be kept an eye on.

As a risk manager or controller, various measures should be taken to reduce the possibility of risk events or to control possible losses within a certain range in order to avoid unbearable losses when risk events occurred. If an organization or enterprise gradually formed its risk management procedure and facilitated its risk system or culture, it meant that this enterprise or organization could create a more robust bottom line to monitor or control risk over the long-term development (Cărăuşu, 2015), based on an integrated picture of the enterprise's risk operating circumstance.

In a nutshell, risk monitoring and control were the procedure of tracking the identified risks, supervising the remaining risks and determining the novel risks. This should ensure the implementation of risk plans and assess their effectiveness of risk reduction. Risk monitoring and control were a continuous process in the project life.

2.5.4 Corporate risk management and the theory

Nocco & Stulz (2006) demonstrated corporate risk management at the level of macro benefits and micro benefits. Meanwhile, they further introduced the theory of corporate risk management, including the inventory of risks, aggregating risks, measuring risks, using economic capital to make decisions, and the governance of corporate risk management. Compared with traditional risk management, corporate risk management believes the company's whole risk portfolio in a holistic and integrated manner (Gatzert & Martin, 2015). Gatzert & Martin (2015) interpreted that in the context of the company's whole risk portfolio in a holistic process, corporate risk management is said to contribute to stock price volatility, reduced earnings volatility, higher capital efficiency and external capital costs. The consideration of risk dependencies further allowed enterprises to take advantage of synergy influence in the process of risk management. In addition, establishing a powerful risk management culture and the development of sufficient and adequate incentive systems in an enterprise was needed for the successful implementation of corporate risk management.

Zwaan Laura et al. (2011) employed an experimental research design (2 x 2 between-subjects) in which they manipulated the internal auditor's involvement in the corporate risk management and the relationship strength between audit the committee and internal audit. The study demonstrates that high involvement in the context of corporate risk management influenced the perceptions of internal auditors' willingness to report a breakdown in risk procedures to the audit committee. In addition, Xiaofang & Huili (2016) built the internal risk control framework (three dimensions including 19 items) of small and medium manufacturing enterprises in China based on comprehensive risk management in a bid to increase the internal control systems theory and provide reference to those manufacturing enterprises. On the other hand, Altuntas et al. (2011) developed a conceptual framework of corporate risk management along the lines of the risk management process in order to meet this significant question of how insurance companies actually implement risk management in their context. Gatzert & Martin (2015) proposed that the development of the enterprise risk management project encouraged enterprises to run their corporate risks in a holistic way as contrasting with the silo-based perspective in traditional frameworks of corporate risk management. Furthermore, they presented that corporate risk management generally had a crucial and positive influence on an enterprise's value and performance to a different extent by means of empirical study.

MacKay & Moeller (2007) evaluated the value of corporate risk management through the theoretical and practical model using quarterly operating data in the context of oil refiners. They validated this approach by regressing firm value on the risk management values and discovered economically and statistically important relations that were robust to the inclusion of proxies for alternative risk management techniques such as vertical integration, real optionality, and diversification (MacKay & Moeller, 2007). Moreover, Bodnar et al. (2019) offered a brief overview of the risk management theories that direct their study in the empirical analysis. They indicated that hedging alleviated the influence of credit rationing by lowering the volatility of cash flows that can be employed to attract investments. In their study, they expected that financially constrained firms with low collateral capacity to be less likely to hedge relative to financially constrained companies with high collateral capacity (Bodnar et al., 2019). Their analysis advised that risk-averse executives were more likely to work at firms with a risk management program (Bodnar et al., 2019). Furthermore, they demonstrated that risk-averse executives were more likely to be dependent on conservative fat-tailed distributions to make an estimate of risk exposure (Bodnar et al., 2019).

As mentioned above, multitudinous researchers and academics have been focused on risk management and enterprise risk management in the context of finance, economics, audit, and management, etc. Furthermore, distinctive research methods were also employed to examine or evaluate the risk management and enterprise risk management, such as questionnaires, surveys, company data as well as different data analysis tools. However, few researchers concentrated on formulating the risk reduction model of after-sales service of agricultural machines. This study will use quantitative data and qualitative data to examine the relationship between risk reduction of after-sales service of agricultural machines and sustainable agri-enterprise and the growth of agri-economy. The factors of after-sales service and financial resources impacting the ASS of AM were also determined via the regression analysis. Meanwhile, the theories of risk management and enterprise risk management will also be employed in this study.

2.6 Summary

In this chapter, the researcher has demonstrated the arable land and status quo of agricultural mechanization in Africa and South Africa. Meanwhile, the researcher stated the relevant information pertaining to agricultural machinery, after-sales service of agricultural machinery as well as risk management. Numerous researches were focusing on agricultural mechanization, and few academics focused on the novel risk reduction model of ASS of AM. In addition, six factors of after-sales service, including technician, spare parts, timely repairing, maintenance, training course, agri-machinery user information management system, have been extracted and refined from the literature review. Furthermore, the comparison between after-sales service, customer satisfaction, maintenance and logistics has been explained explicitly in this chapter. The five steps of risk management were discussed in appropriate detail as well because ASS of AM is closely related to project management.

In the following chapter, the theory of risk management, as well as the theoretical framework, will be demonstrated and formed respectively. All practices are from theory, and the theory will support this argument. Furthermore, the conceptual framework is an analytical instrument and basis to illustrate what you expect to work out through your study. More detail will be illustrated in Chapter 3.

PART 2: THE THEORETICAL FRAMEWORK, RESEARCH DESIGN AND METHODOLOGY

Chapter 3: Theoretical framework

3.1 The theory: introduction

Sutherland, cited by Wacker (1998), explains that the theory is an ordered set of propositions regarding a general structure or behaviour presumed to hold throughout an outstandingly broad extent to special instances. Meanwhile, theory can be defined as an explanation of relationships between units approximated or observed in the context of the real world. On the other hand, theory (Wacker, 1998) is the logical system in which humans understand and grasp the world through the logical deduction process of concept-judgment-reasoning and thesis-argument-argument. Theories include the theory in the stage of cognition knowledge and the theory in the stage of rational knowledge.

A theory is a well-founded statement of regard of the natural world and others that can incorporate laws, hypotheses and facts etc. In this study, the theory of risk management is a foundation to conduct the research regarding the establishment of a risk-reduction model of after-sales service of AM.

3.2 The theory of risk management

Close and Bidek (2018) summarize that there are four theories on the evolution of risk management, namely: Darwinian Theory of Risk Management Evolution, Great Man Theory, Historical Dissatisfaction Theory as well as Environmental Complexity Theory. The Darwinian Theory of Risk Management Evolution is the evolvement development of risk management. The term of the risk manager has experienced four steps in the evolution, viz the insurance clerk, the insurance buyer, the insurance manager, and the risk manager. The Great Man Theory emphasizes that strongly competent people could make their position more significant, especially for the enterprise. The "Historical Dissatisfaction Theory" states that, antithetically, a poor department, relying mainly on insurance agents and brokers, has created risk programs with resulting high costs and uncovered losses. Thus, a rational search for more acceptable alternatives has resulted in a risk department with more complex functions. The "Environmental Complexity Theory" suggests that the development of the Risk Management Department was a function of the degree to which the environment facing the firm is heterogeneous and shifting (dynamic) (Close & Bidek, 2018).

Klimczak (2007) discusses contemporary corporate risk management theories in which these theories are agency theory, financial theory, stakeholder’s theory and novel institutional economics. The contemporary corporate risk management theories are the embodiment of risk management theory in the new era.

Stulz (1996) utilizes the modern risk management theory as proposing that enterprises might decrease the variation of cash flow by means of hedging risks. Furthermore, the theory implies whereas risk management is not only the management of a single risk of a single business in the past but also the comprehensive management of all risks from the perspective of the entire system. Woods (2009) demonstrates at Birmingham City Council that the risk management control system expands existing theory by exploiting a contingency theory for the public department through using a case study in his study.

The risk management theories will be explained more comprehensively from the studies having been done by other researchers (Eling and Schmeiser 2010 and Brodin and Kl¨uppelberg 2014). In the following section, the distinct kinds of risk management theories will be demonstrated, as these introductions of risk management theories will bring a brief understanding to them. This will make it much easier to decide which risk management theories are appropriate and acceptable to this study. After that, the proper risk management employed in this research will be explained in more detail in this section.

3.2.1 The distinct types of risk management theories

The distinct types of risk management theories will be demonstrated in a bid to provide a preliminary understanding of risk management theories. The details will be demonstrated as follows:

3.2.1.1 Portfolio theory

Financial investors widely utilize portfolio analysis to produce sturdy portfolios that generate effective and efficient results amid a variety of economic circumstances (Awerbuch & Berger, 2003). In principle, an effective and efficient portfolio doesn't take the necessary risk with regard to its expected outcomes. On the other hand, effective and efficient portfolios are associated with the following characteristics: they maximized the prospective outcomes for any specific risk standard or minimized the expected risk under a given level of expected return. (Awerbuch & Berger, 2003).

Harry Markowitz, cited by (Awerbuch & Berger, 2003), states that portfolio selection is generally facilitated on the basis of mean-variance portfolio theory. In addition, they indicate that it causes the formation of minimum-variance portfolios in the context of any given level of expected (mean) return. Meanwhile, they explain further that such efficient portfolios minimized risk, as measured by the SD (standard deviation) of periodic returns. The point of view is that while investments are risky and unpredictable, the main intention of portfolio theory managers is to build an effective portfolio as much as possible in order to obtain the highest return per unit risk level or the lowest risk per unit return level (Awerbuch & Berger, 2003).

Roques, Newbery, and Nuttall (2008) indicate that financial portfolio theory was initially initiated by Markowitz in 1952 in which it did not present a unitary optimal portfolio combination but a series of efficient choices. Furthermore, these include portfolio return, portfolio standard deviation to mix together in a bid to maximize the expected return at a given scheduled risk level or to minimize the expected risk at a given desired return level. Moreover, a risk-return amalgamation would be chosen by investors or portfolio managers based on their own risk aversion priority and preferences in the light of optimal portfolio theory (Roques et al., 2008).

Furthermore, Roques, Newbery, and Nuttall (2008) explained that optimisation procedures were proved to be also practical and available by Berger and Awerbuch in 2003. In such an optimisation process, they cited Kwan's view of the point that the program calculated all probable portfolio amalgamations and found the effective and efficient frontier employing an iterative channel.

The following example can be employed in this section. Two assets can be used in this example. Furthermore, the computation of the risks of the portfolio and returns is undertaken by employing the following mathematical procedure. Meanwhile, the assets A (expected return r_A, standard deviation σ_A) and B (expected return r_B, standard deviation σ_B) are included in the expected return E(rp) of portfolio p, as shown in Equation 3.1. Accordingly, X_A and X_B are unambiguously the weighted averages of expected returns in these two assets (Roques et al., 2008):

$$E(r_p)= X_A\ E(r_A)+ X_B\ E(r_B) \tag{3.1}$$

The portfolio standard deviation σ_p is explained by the following equation, as illustrated in Equation 3.2 (Roques et al., 2008):

$$\sigma_p=\sqrt{X_A^2\sigma_A^2 + X_B^2\sigma_B^2 + 2X_AX_B\rho_{AB}\sigma_A\sigma_B} \tag{3.2}$$

Where ρ_{AB} indicates the correlation between the two assets returns.

According to the above mentioned and illustrated, investment portfolio theory explains how "rational investors" choose to optimize investment portfolios. Rational investors prefer to maximization of the expected return at a given expected risk level or minimization of the expected risk at a given expected return level by means of using the mean-variance theory.

On the other hand, in terms of finance and stock, investors employ portfolio theory to minimise the risk and maximise their portfolio's income by diversification of stocks matching (Rodoulis, 2010). He comments that the perfectly diversified portfolio should cast aside the idiosyncratic or stand-alone risk of each stock while maximising the overall income. This idea was first proposed and introduced by Harry Markowitz (Nobel Laureate) in 1952 and was well known as Mean-Variance Portfolio Theory (Markowitz 1991; Awerbuch and Berger 2003; Roques, Newbery, and Nuttall 2008; Rodoulis 2010). In layman's study, this theory supports the phrase as follows: "Never place all the eggs in one basket"(Rodoulis, 2010).

3.2.1.2 Extreme value theory

The extreme value theory (EVT) stemming from statistics has been utilized in many areas, such as oceanography, structural engineering, pollution studies, meteorology, hydrology, highway traffic, material strength and many others (Gencßay & Selcßuk, 2004). On the other hand, extreme value theory (Gencßay & Selcßuk, 2004) pays attention to the tail characteristics of the risk loss distribution. It is usually used to analyze rare events with probability. It can rely on a small amount of sample data to obtain the change of extreme values in the overall distribution when the overall distribution is unknown. It possesses estimation ability beyond sample data. In addition, EVT is also an accustomed framework of a distribution tail which allows for asymmetry. Meanwhile, considering the fact that most financial return series are asymmetric, the EVT approach is advantageous over models which assume symmetric distributions such as t-distributions, normal distributions, autoregressive conditional heteroskedasticity (ARCH), generalized autoregressive conditional heteroscedasticity (GARCH). On the contrary, E-GARCH (generalized autoregressive conditional heteroscedasticity) allows for asymmetry (Gencßay & Selcßuk, 2004).

As mentioned above, EVT is a formidable and yet reasonably strong framework to research the tail behaviour of a distribution. Although revolutionary EVT has previously been found to be applied in the context of hydrology and climatology, there have also been plentiful of researches on extreme value theory in the context of finance recently. Embrechts, Resnick, and Samorodnitsky (1999) stated that the catastrophic losses are to an increasing extent disclosed in the circumstance of the financial industry in recent years. Furthermore, the asset securitization of risk and risk transfer underlines the convergence of insurance and finance. At the same time, extreme value theory plays an essential methodological role in the scope of finance, insurance, and reinsurance (Embrechts et al., 1999). This is also in the context of risk management.

Extreme events take place when the risk obtains values from the end of its distribution. EVT is an instrument that attempted to offer the best probable estimation of the distribution's tail district. Moreover, EVT supplies direction on the distribution that would be selected to handle extreme risks conservatively (Mcneil, 1999). Broadly speaking, Mcneil (1999) stated that there are two essential types of models for extreme values. On the one hand, the ancient set of models are the BM (block maxima) models. The block maximum is to select the maximum value in each time block (segment) as a sample and then estimates the operational risk according to the time series composed of all samples. For instance, if it can be recorded hourly or daily profits and losses through using the special devices or instruments, the method of block maxima offers a novel model which might be proper or suitable to provide the quarterly or annual maximum values. On the other hand, a more modern and fashionable set of models are the POT (peaks-over-threshold model) models in which were models for all large and huge observations which exceeded a high value of the threshold. However, the POT model is generally believed to be the most proper and appropriate utilization of EVT as a result of their more effective and efficient application of the (often finite or limited) data on extreme values (Mcneil 1999; Brodin and Kl¨uppelberg 2014) in a bid to improve the accuracy of loss estimation.

3.2.1.3 Agency theory

Anggraeni (2016) stated that agency theory (principal-agency theory) was proposed in the 1970s by accountants and academics in the United States. This theory was one of the most significant contract theories in the past nearly 50 years. It is based on asymmetric information game theory. Furthermore, its core is to study how the principal can design the optimal contract to incentivize the agent in the environment of conflicting interests and asymmetric information. Anggraeni (2016) further indicates that the information asymmetry between agents and principal makes agents often provide null and void information to obtain expected advantages, which can lead to the agency problem. Meanwhile, this moral risk urges the principals to employ the controlling system (Anggraeni, 2016) to reduce the loss of principals and align the agent and the principal's interests.

Agency theory determines the relationship between two transaction sides in which the principal delegate worked with the agent who conducted the work on behalf of the principal (Whipple and Roh 2010; Mitchell and Meacheam 2011). Logically speaking, professional managers should make decisions based on the principle of maximizing shareholder benefits (Mitchell & Meacheam, 2011), but this is not the case. The interests of professional managers are often inconsistent with the interests of shareholders (Mitchell & Meacheam, 2011). For instance, shareholders always pursue the long-term development of the enterprise; however, professional managers prefer to choose to take care of the company's immediate development for their own reputation, advantage and future. Therefore, if professional managers (agents) conflict between the two sides when making decisions, they would give priority to making decisions that are beneficial to themselves rather than those principals. In addition, professional managers (agents) may be lazy and neglect corporate governance, which may damage the interests of principals or shareholders.

On the other hand, Whipple and Roh (2010) employ buyer company-supplier company relationships as another form of principal-agent theory to explain and present this relationship. They explain further that a buying firm, in this case, represents the principals who have collaborated or transacted with the supplier’s company (agents). In comparison, the supplier enterprises represent the agents who have worked for the buyers (principals). Moreover, Whipple and Roh (2010) argue that agency theory is employed to buyer company-supplier company relationships because the buying company is eventually in charge of its whole product/service quality. However, supplier enterprises (agents) outsource portions of the product and service in this process. In another sense, the supplier corporation works in the name of the buying enterprise (principals).

On the other hand, Whipple and Roh (2010) indicate that the focus of agency theory is on examining the most effective and efficient agent-principal type or relationship that can satisfactorily run and be managed. Furthermore, contract issues propose between an agent and a principal while two factors co-exist as illustrated in the forthcoming equation (Whipple & Roh, 2010):

$$\textit{Agency problem} = \textit{Goal conflict} + \textit{Information asymmetry} \tag{3.3}$$

In Equation 3.3, these two conditions (information asymmetry and goal conflict) bring about a contractual issue because of latent opportunism, in which agency theory is attached labels to as shirking, moral hazard or covert action (Whipple & Roh, 2010).

In a bid to safeguard the principal's interests and minimize unfavourable effects on their benefit and profit of principal, some specific measures or methods are suggested to be taken to protect the benefit of agents typically (Mitchell & Meacheam, 2011). Meanwhile, these measures are measured and monitored typically (Mitchell & Meacheam, 2011). In addition, Whipple and Roh (2010) elaborate that the agent must be encouraged to conduct in a manner in line with the interests of the principals in order to reduce/perish the motivation of the agent to cheat.

In the context of the corporate governance solutions of principal-agency theory, the three greatest impacts on corporate governance are equity incentives, independent directors, and separation of two positions of chairperson and CEO. Firstly, it is to grant part of the equity to professional managers or CEO (agents). Once professional managers (agents) have equity, they are also shareholders of this enterprise. Therefore, they would consider their own interests as shareholders when making decisions, rather than just being a professional manager (agents). Furthermore, this is also the theoretical basis for many companies to engage in option incentive systems. The second is to design a supervision mechanism. The board of directors is not only the company's decision-making body but also has supervisory functions. For instance, the most important function of independent directors is to supervise high-level decisions. The third method employed is to appoint the chairman and the general manager/CEO separately in a bid to prevent abuse of power caused by one person (not only chairman but also CEO) being overpowered.

3.2.1.4 Hedging theory

The theoretical basis of hedging is that under perfect conditions, both the spot and futures markets are affected by the same supply and demand relationship in which the prices of the two markets rose or fell at the same time. Because the hedgers operate entirely in these two markets, on the contrary, the surplus or loss in the final spot market can be offset by the loss or profit in the futures market (Liu, Jian, and Wang 2010; Chang, McAleer, and Tansuchat 2011; Fan, Li, and Park 2016; Billio, Casarin, and Osuntuyi 2018; Cong 2019; Xiao Wang 2019; Huang 2020; Mu 2020). On the other hand, Cong (2019) annotates that hedging, also known as offset, refers to the purchase or sale of commodities or financial instruments while selling or buying the same amount of contracts with the same quantity of the entities or financial instruments as the target in the futures market. It aims to achieve circumvention of the risk, which is the main function of the futures market. Meanwhile, Chang, McAleer and Tansuchat (2011) report that hedging theory also means that simultaneous buying and selling activities of the same quantity but opposite directions are carried out for the same type of commodity in the spot market and the futures market at a certain time. That is to sell or buy the same number of futures in the futures market while buying or selling physical goods. After a period of time, when price changes cause profits and losses in spot trading, the losses and profits in futures trading can be offset or remedy accordingly. Consequently, a hedging mechanism is established between "present" and "future", between the short-term and the long-term so as to minimize the price risk.

According to the literature review of hedging theory, three-stage hedging theory will be elaborated in this study as follow:

Traditional hedging theory:

Keynes and Hicks first explain the traditional hedging theory from an economic perspective (Cong 2019; Xiao Wang 2019). The general viewpoint is to establish equal but opposite positions in the same period and current market to achieve the risk-offset attribute of hedging theory (Xiao Wang, 2019). According to this theory, investors need to conduct the same number of transactions in the futures market as opposed to the spot market. The influencing factors of commodity futures price and spot price are basically the same, so their trend is basically the same (Cong, 2019). Meanwhile, as the expired date of the futures contract approaches, the futures price and spot price are converging (Cong, 2019). If transaction costs are neglected, the losses and surpluses of the two markets could offset each other to achieve a perfect hedging status (Cong, 2019).

Additionally, the traditional hedging theory emphasizes the risk aversion function of the futures market and believes that reducing risk is the only motivation for hedgers to engage in futures trading (Liu, Jian, and Wang 2010). The hedger's position in the futures market and its position in the spot market (whether it is related to financial instruments or the value of the transaction) must be exactly the same; meanwhile, the direction is exactly the opposite. In addition, earnings or losses in the futures market would be offset by earnings or losses in the spot market (Liu, Jian, and Wang 2010). They also use the optimal hedging ratio to balance the futures market and spot market. Furthermore, this optimal hedging ratio can be reckoned with by means of ordinary least squares (OLS) regression (Liu, Jian, and Wang 2010; Huang 2020; Wang 2019). However, this method of OLS is critiqued by numerous researchers because nearly all financial commodities and assets (Liu, Jian, and Wang 2010) changed at time-varying moments.

Basis-for-profit hedging theory:

Typically, the trend of futures prices and spot prices are not consistent in the market. The basis, which is the discrepancy between the spot price and the futures price, is variable. Consequently, there is a basic risk in the real world. Moreover, ideal hedging that the losses and surpluses of the sports market and future market can offset each other to achieve a perfect state of hedging was a challenge to achieve. In response to this matter, Cong proposes a basis-based-for-profit hedging theory in the 1960s (Cong, 2019). This theory believes that the purpose of hedging is not to transfer all risks; instead, through the futures market, hedgers can choose to withstand smaller risks of changes in basis by means of avoiding the risk of massive changes in spot prices (Xiao Wang, 2019). On the other hand, Cong (2019) narrates that the basis-for-profit hedging refers to the agreement reached by both parties in commodity transactions. The delivery price of the commodity is equal to the sum of the agreement basis and the futures price of the selected date. Meanwhile, the hedger determines the basis of the agreement. Furthermore, the selection date of the futures price is selected by the spot market trader from a period specified by the hedger. And, the transaction price is the delivery price, not the spot or futures price on the day of the transaction. This type of trading is basis trading. It essentially means that hedgers fix the agreement basis to achieve the purpose of hedging.

Modern hedging theory (volatility dynamics model):

Cong (2019) mentions that Johnson and Ederington first describe modern hedging theory based on Markowitz's portfolio theory. Meanwhile, this theory believes that hedging is to invest in the spot market and the futures market in the form of asset portfolios. At the same time, a hedging person determines the trading positions held by the spot market and the futures market according to the expected return and fluctuation of the asset portfolio in order to achieve the purpose of minimizing the investment risk of the asset portfolio or maximizing the utility (Cong, 2019). Different from the traditional hedging theory, modern hedging theory believes that the hedging ratio is variable. Investors can choose the hedging ratio to optimize the effectiveness of hedging.

As of now, a plentiful of the research on hedge ratios, volatility dynamics and correlations between the assets have employed multivariate GARCH (generalized autoregressive conditional heteroskedasticity) (El Hedi Arouri, Lahiani, and Nguyen 2015; Fan, Li, and Park 2016; Basher and Sadorsky 2016; Billio, Casarin, and Osuntuyi 2018), proposed by Baba, Engle, Kraft, and Kroner in 1990 (Chang, McAleer, and Tansuchat 2011; El Hedi Arouri, Lahiani, and Nguyen 2015). In addition, CCC (the constant conditional correlation model) (Chang, McAleer, and Tansuchat 2011; El Hedi Arouri, Lahiani, and Nguyen 2015; Fan, Li, and Park 2016; Basher and Sadorsky 2016) has been brought forwards by Bollerslev in 1990. Meanwhile, DCC (dynamic conditional correlation) (El Hedi Arouri, Lahiani, and Nguyen 2015; Fan, Li, and Park 2016; Basher and Sadorsky 2016) was raised by Engle in 2002 and VARMA-GARCH (the vector autoregressive moving average model) (Chang et al., 2011) was introduced by Ling and McAleer in 2003 (Basher & Sadorsky, 2016).

However, challenges have been proposed when gauging multivariate GARCH models on huge data sets (Basher & Sadorsky, 2016). For instance, the BEKK (Baba, Engle, Kraft and Kroner) model can make estimation hard, particularly for models which had more than two variables (Basher & Sadorsky, 2016). Furthermore, confined correlation models, such as dynamic conditional correlation (DCC), constant conditional correlation (CCC) or asymmetric DCC (ADCC), were devised to solve some issues when encountering VECH and BEKK type models (Basher & Sadorsky, 2016). One of the maximum challenges in multivariate GARCH modeling is a trade-off between feasibility and generality (Basher & Sadorsky, 2016).

Modern hedging theory believes that hedging by traders is actually a portfolio investment of assets in the spot market and the futures market. The hedger determines the trading positions of the spot market and the futures market according to the expected return and its variance of the portfolio investment so as to minimize the return risk or maximize the utility function. Furthermore, the hedging ratio in the futures market should be selected. The optimal hedging ratio depends on the purpose of the hedging transaction and the correlation between the spot market and the futures market price.

3.2.1.5 Comprehensive risk management

With the development of theory and the advance of society, risk management practice shows that it is difficult to achieve the ultimate enterprise goal by internal control alone (Xiaofang & Huili, 2016). Subsequently, COSO (the Committee of Sponsoring Organizations) promulgated the "COSO Enterprise Comprehensive Risk Management Integration Framework" in 2004, proposing a comprehensive risk management integration framework (Xiaofang & Huili, 2016).

Gatzert and Martin (2015) mention that Enterprise Risk Management (ERM) proposes a procedure of risk management that integrates the corporate's overall risk management doings and activities in a holistic and merged framework to bring about an all-around enterprise perspective. Furthermore, Meulbroek, Nocco and Stulz, Pagach and Warr, Hoyt and Liebenberg, cited by Gatzert and Martin (2015), explain that comprehensive risk management aims to establish a sound RM (risk management) culture and the RM system through the implementation of the basic process of RM in all aspects of corporate management and the operation process. These RM (risk management) system includes RM strategies, RM measures, RM organizational function systems, RM information systems and internal control systems. Furthermore, this aims to provide a reasonable assurance process and method for achieving the overall goal of risk management. Additionally, enterprise comprehensive risk management emphasizes risks in terms of strategic direction selections for management and control at the decision-making level as well as major business decisions through decision analysis supported by quantitative analysis. In contrast, the COSO risk management framework focuses on internal control and emphasizes managing and control risks in the process of the operations and management of enterprises through the means of system, process and finance. In addition, ERM usually contains a chief risk officer who is appointed to serve as a coordinator and supervisor in the process of enterprise risk management. Meanwhile, this position doesn't post in traditional theory, provided by Liebenberg and Hoyt, who was cited by Gatzert and Martin (2015). They further indicate that a chief risk officer's appointment aims to make sure an effective and efficient comprehensive risk management.

3.2.2 Risk management theories utilized in this study

The risk management theory used in this study is the enterprise comprehensive risk management theory and portfolio theory. Enterprise comprehensive risk management theory refers to a process that integrates the corporate's overall risk management doings and activities in one holistic and integrated framework to bring about the entire goal of risk management (Gatzert and Martin 2015). In this study, the agricultural machinery enterprise can set up a comprehensive risk management system of after-sales service, including risk determination, risk analysis, risk evaluation, risk response and risk monitoring in a bid to decrease the risk of after-sales service of farm equipment utilized by South African users and customers. Moreover, this research should employ systematic and scientific methods to identify and analyze various risks of ASS of AM in the context of Chinese agricultural machinery in South Africa in order to assist agricultural machinery enterprises in determining and judging the after-sales service risk factors. Furthermore, the risk response measures of after-sales service of agricultural machinery should be implemented into the organizing, process and functions of the AM corporates. Finally, it can form a corporate risk management strategy to support and enhance the realization of corporate strategic objectives of risk reduction of ASS on AM. This can promote the sustainability of AM enterprise and further enhance the growth of the agricultural economy.

According to Awerbuch and Berger (2003), portfolio analysis is widely utilized by investors to produce robust portfolios in which it generates effective and efficient consequences and outcomes. The AM company uses the portfolio analysis of factors that impacts the ASS of AM in a bid to enhance the influence of risk reduction of after-sales service of AM. The AM enterprise should integrate the factors of influencing the ASS of AM, including expert, timely repair, spare parts, maintenance, training course as well as user information system, to create the optimal risk reduction portfolio of ASS on AM for the purpose of decreasing the risk of ASS of AM and enhancing the competition of agri-machinery firm. Moreover, the proper portfolio of ASS of AM can also strengthen sustainable agricultural equipment survival and development amid the ruthless and brutal competition in modern society. Finally, it can improve the growth and enhancement of the agricultural economy.

3.2.3 Conclusion

In this section, the research theories of risk management, incorporating enterprise risk management, portfolio theory, extreme value theory, agency theory as well as hedging theory, have been discussed explicitly and comprehensively. Furthermore, the risk management theories used in this study, namely the enterprise comprehensive risk management theory and portfolio theory, have been introduced. Those two risk management theories can relate to the after-sales service of AM in a bid to facilitate the establishment of the appropriate risk reduction model. The following section should demonstrate and explain the conceptual framework.

3.3 Conceptual framework

The preliminary and basic conceptual framework of this study will be introduced and formed initially in this section. The factors of ASS of AM have been derived from the literature review in Chater 2. Furthermore, a pilot test method should be employed to choose the proper and suitable factors of ASS of AM used in this study. The aim of this section is to initially form the conceptual framework of ASS of AM. A detailed explanation will be illustrated in the forthcoming section.

3.3.1 Factors that impact the after-sales service of agricultural machinery

Literature review and exploratory/descriptive approach of research were adapted from a review of academic resources pertaining to the after-sales service of agricultural machinery. In Section 2.4.4, the main factors that impacted the after-sales service of farm equipment had been derived from those peer-reviewed journal papers, followed by extracting the relevant views or opinions related to the distinct factors affecting after-sales.

In addition, six factors (Qin, Pretorius and Jiang 2019) that impact the after-sales service on agricultural machinery have been tested through a pilot test and mixed research method, as shown in Chapters 5 and 6. Following the data analysis, the main six factors chosen are technician, spare part, timely repairing, maintenance, training as well as a customer information system and service centre, as shown in Table 3.1.

Item	The factors that influence the after-sales service of agricultural machinery
B-1	Technician
B-2	Spare parts
B-3	Timely repairing
B-4	Maintenance
B-5	Training course
B-6	Farm machinery user database or information management system and service centre

Table 3.1: Factors that influence the after-sales service of agricultural machinery (Qin et al., 2019)

In Section 6.2, quantitative data will be reported via using questionnaires as equipment, followed by results presented by means of focus group discussion. This aims to test whether there are any other elements that affect the ASS on agricultural machinery. In a nutshell, all factors obtained from the literature review are determined as the factors influence the ASS of AM employed in this study.

3.3.2 The financial factors that influence the after-sales service of agricultural machinery

Among the factors that impact the ASS of AM, financial aspects have become among the most significant. Meanwhile, financial resources are also very important to the development and sustainability of farm equipment enterprises. Furthermore, the financial factors affecting ASS of AM in this study include savings (Duguma & Han, 2018), overdraft facilities (Melzer & Morgan, 2015), access to credit (Awotide et al., 2015; Cingano et al., 2016; Heikkilä et al., 2016), sponsorship (Lundh et al., 2017), and grants (Creamer, 2015).

Firstly, many enterprises face the issue of increasing overhead costs and make efforts to reduce these, which is a basis for the use of outsourcing principles to provide and increase savings (Potkány et al., 2016). This core business has become the priority in enterprise development (Potkány et al., 2016). Meanwhile, Wieliczko et al. (2020) demonstrated that savings are a catalyst for capital creation and are the driving force behind economic growth and development. As savings are crucial for the welfare, sustainability increased competitiveness, and development of an agricultural enterprise, an understanding of what makes these more diverse can help identify appropriate support schemes set up by those companies for whom sustainable development projects are important (Wieliczko et al., 2020).

Secondly, some statistics and research show that among the resources most used for finance companies is a bank loan or overdraft (Mladenka et al., 2016). Furthermore, Mladenka et al. (2016) state that the use of overdrafts is most prevalent among large enterprises (with at least 250 employees) and lowest among micro-enterprises (1 to 9 employees). Overdraft facilities are also crucial to the development of enterprises and risk reduction in AM companies.

Thirdly, Mabururu & Student (2020) explain that a major hindrance to entrepreneurship and enterprise development is access to funds. Enterprise development funds have led to enhanced performance of enterprises, and therefore the socio-economic status of their managers shows improvement due to access to loans (Mabururu & Student, 2020). On the other hand, Ogundeji et al. (2018) conclude that adequate access to credit is necessary to promote sustainable agricultural development and the livelihoods of rural farmers in Africa.

Fourthly, Fotiadis et al. (2019) indicate that one way to acquire sponsorship is to access national or local government programs. In addition, the development of sponsorship programs that diversify the economic structure of rural communities businesses makes them less vulnerable to changes in market conditions (Fotiadis et al., 2019). The sponsorship obtained from the government or an association is crucial for the growth and development of agricultural enterprises.

Finally, Dvouletý et al. (2020) elaborate that governments allocate financial resources to support small- and medium-sized enterprises (SMEs) through public subsidies and grants to increase their performance and growth (Dvouletý et al., 2020). However, grants are less cost-efficient when compared to other financial instruments (Dvouletý et al., 2020). There is a long tradition of allocating public grants as a direct form of support to firms and entrepreneurs in a bid to increase their growth and improve their financial performance and efficiency (Dvouletý et al., 2020).

The next section will present the preliminary conceptual framework of risk reduction of ASS of AM, as illustrated in Figure 3.1, in a bid to provide a research blueprint or guidance to lead the undertaking of this study.

3.3.3 The preliminary conceptual framework

Previous studies have concentrated on issues regarding agriculture mechanization as well as small-holder farmers in South Africa. Furthermore, few researchers have explained the different factors that influence the after-sales service of agricultural machinery (Qin et al., 2019). Moreover, very few researchers explained a holistic blueprint or all factors that impact on after-sales service of agricultural machinery, as well as how to formulate an emerging or novel model of ASS of AM (Qin et al., 2019). By means of the factors derived from the literature review as well as being identified further from focus group discussions (please see the details in Section 6.2), a potential conceptual framework of after-sales service on agricultural machinery has been formed. This might fill the gap on how to examine the relationships or test the correlation between the risk reduction of after-sales service on Chinese agricultural machinery in South Africa and sustainable agri-enterprises and agri-economy (Qin et al., 2019).

This section aims to form the original and preliminary conceptual framework of ASS of AM in a bid to provide a research blueprint or guidance to lead the undertaking of the research. In the following chapter, all of the data collection and analysis should be guided by this original conceptual framework. The novel risk reduction model will be presented after the definite and already proven data analysis. Finally, the novel risk reduction model will be shown in Chapter 8.

As shown in Figure 3.1, the factors that affect the risk reduction on after-sales service agricultural machinery include mainly two parts, namely mechanical and customer risk reduction indicators. The first part involves technicians, timely repairing and spare parts, while the second section comprises maintenance, training courses as well as a user information management system (Qin et al., 2019). The relationships between mechanical and customer risk reduction indicators and financial factors and ASS of AM risk reduction will be discussed in the future chapter to address some research questions and objectives. In Figure 3.1, the framework illustrates the primary rationale of the whole process, which also, to some extent, demonstrates the explicit structure of the study. The aim of this original conceptual framework is also to guide the operation and conducting of the whole research.

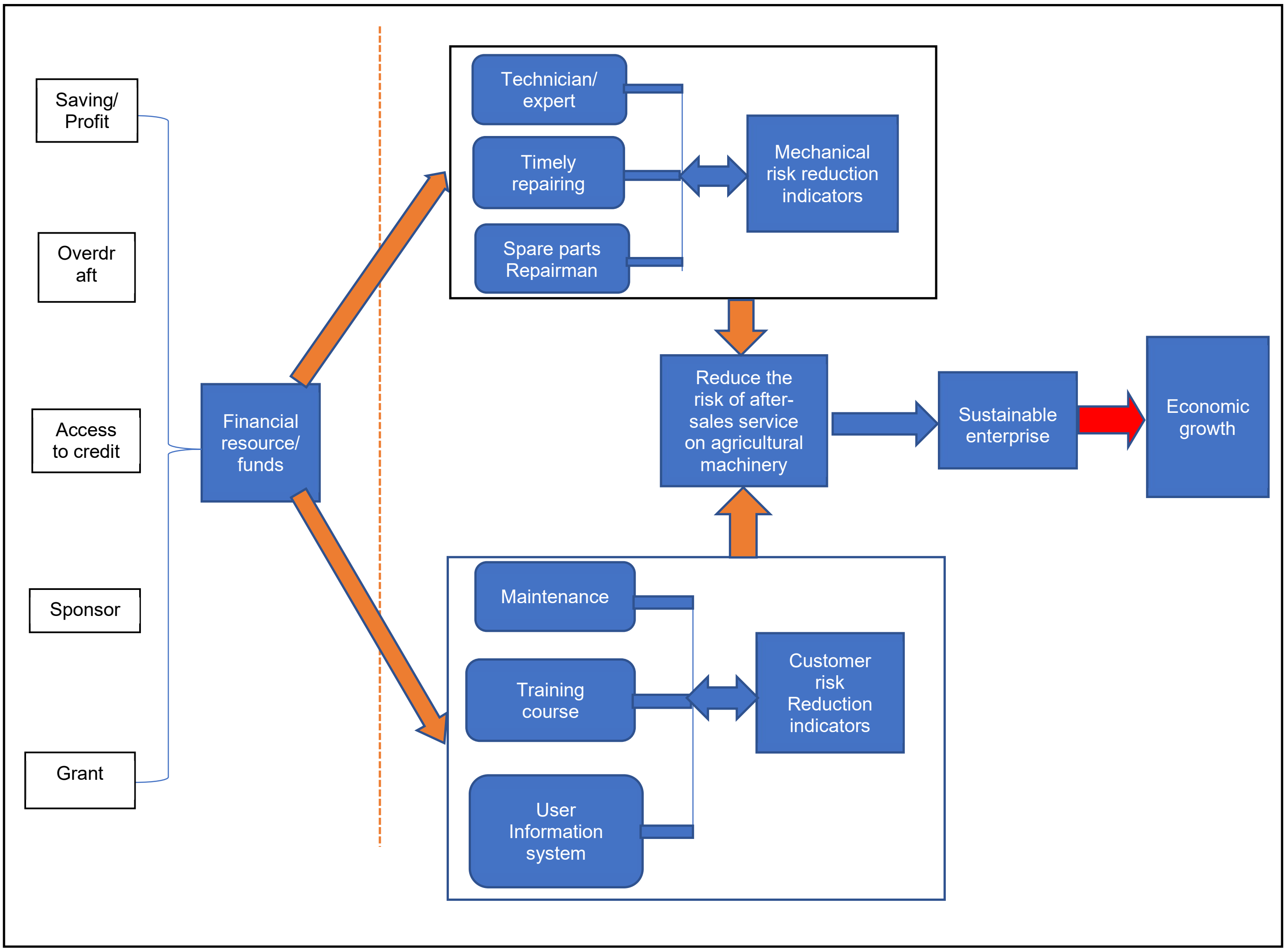

Figure 3.1: The conceptual model of risk reduction of after-sales service on agricultural machinery

3.3.4 Conclusion

In the forthcoming chapters, more data collection and analysis, including more than 730 questionnaires and focus group interviews, will be conducted in a bid to test the risk reduction model of after-sales service of agricultural machinery obtained and verified from this section. The data analysis of correlation, regression and the thematic content analysis (please see Chapter 6 and 7) will be employed to test the relationship and link among mechanical risk reduction indicators, sustainable agri-machinery enterprise and agri-economy.

3.4 Summary

In this chapter, the development of risk management theory (RMT) has been expounded in more detail. Following, the theories of risk management, such as comprehensive RMT, portfolio theory, extreme value theory, agency theory, as well as hedging theory, were also discussed in appropriate detail. The theories of risk management utilized in this research were comprehensive RMT and portfolio theory. The theory is the basis to support the practice. However, the conceptual framework, as a guidance roadmap, is another blueprint to undertake this study. Subsequently, the preliminary conceptual framework of risk reduction of after-sales service on agricultural machinery has been formed and supported via data collection and analysis of questionnaires and focus group interviews (please see the details of these in Chapter 6).

In the following chapter, the methodology regarding data collection and data analysis will be explained explicitly.

Chapter 4: Research design and methodology

4.1 Introduction

The design of research (Akhtar 2016 and Xie 2016) is a blueprint or plan of the proposed study. Moreover, the research design is intended to provide an appropriate framework of research techniques and methods picked out by the researcher or academic. On the other hand, the research method and methodology are used to guarantee the accomplishment of objectives and answers to research questions set out in chapter one. In this chapter, the research philosophy, research design, research methodology, research approach, research horizon, as well as research ethic will be demonstrated definitely one by one. The research design utilised in this research is the sequential explanatory research design, in which quantitative data collection and analysis followed by qualitative data collection and analysis is implemented. Furthermore, this study will employ the sequential mixed-method research methodology (Creswell and Pioano Clark 2007; John W Creswell and Creswell 2017), which is quantitative data collection and analysis followed by qualitative data gathering and analysis. Furthermore, this will be carried out in China and South Africa, respectively. On the other hand, both the deductive (Woiceshyn & Daellenbach, 2018) and inductive (Lisha Liu, 2016) approaches will be employed to formulate the theoretical framework with inductive reasoning and test the theoretical framework using deductive reasoning. The research ethic clearance is also explained in this chapter.

4.2 Research

The distinct researchers and scholars provide a different definition of research in a variety of research subjects. John W. Creswell (2012) explains that research is a process of steps utilised to gather and dissect data and knowledge in a bid to improve the cognition and understanding of a theme or issue. At a general level, he states that research includes three steps, namely:

1. Raise a question.
2. Gather the information or data to answer the question.
3. Provide the solution to this question.

On the other hand, Saunders, Lewis and Thornhill (2016) annotate that the definition of research is the process of people carrying out via which they can find out new information, knowledge or theory in a systemic way, thereby improving their skills and knowledge. There are two significant phrases in this definition, namely *systematic way* and *to find out novel information.* The *systemic way* recommends that the logical relationship is the base of research and not just beliefs (Saunders, Lewis and Thornhill 2016b). On the other hand, *to find out novel information* indicates there are a plentiful of probable objectives for the study (Saunders, Lewis, and Thornhill 2016b).

However, Shuttleworth and Wilson (2008) elaborate that the study is conducted in the light of the researcher's purpose, aim and intention. The researcher also operates by means of the relevant research paradigm when they carry out this research. At the same time, many people used the term "*research*" to loosely mean "*gathering information*" whilst researchers or scientists employ this word in a more concrete and specific way. The word "*research*" in an academic or scientific context usually means the entire scientific research procedure from start to end (Shuttleworth & Wilson, 2008).

According to the definition of research mentioned above, one can define research in this study as something such as a research journey that aims at employing the methodology, objectives and other information to accomplish the entire process. The research process involved 1) the research problem identification; 2) reviewing the previous literature; 3) proposing the aims and objectives for research; 4) collecting data via using the different methods (quali- or quanti-method); 5) doing the data analysis and interpretation and; 6) reporting the result of the study and evaluating research findings.

4.3 Research philosophy

Research philosophy (Saunders et al. 2015) refers to knowledge traceability and development as well as exploring the nature of that knowledge. Meanwhile, it deals with the source, nature and development of expertise (Saunders, Lewis and Thornhill 2009; Saunders, Lewis and Thornhill 2016b). The research philosophy adopted includes crucial suppositions about the way the world is viewed (Saunders, Lewis and Thornhill 2016b). These assumptions would prop up the research tactics, strategies and methods chosen by the researcher (Saunders, Lewis and Thornhill 2016b). In a simple way, explained as before, the research philosophy is a system or the ways in which data regarding some kind of phenomenon might be gathered, analysed and utilised. In particular, within the range of business research, four primary research philosophies are illustrated in Figure 4.1, namely pragmatism, positivism, realism and interpretivism (Saunders, Lewis and Thornhill 2016b).

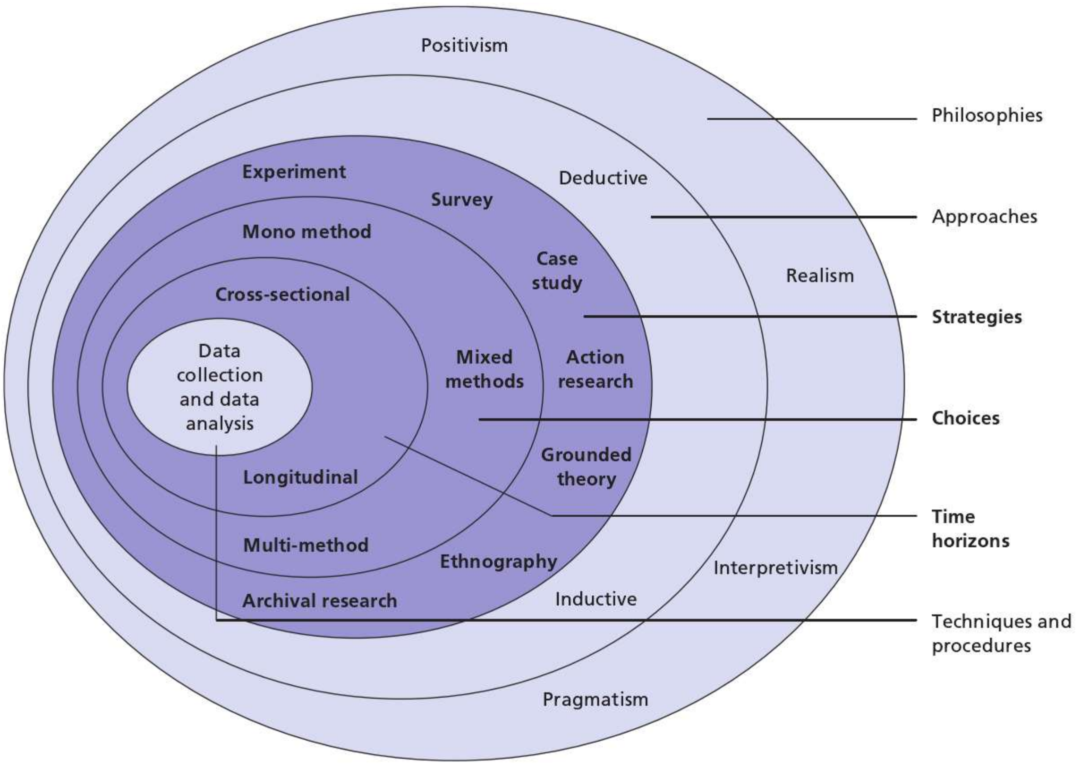

Figure 4.1: The research 'onion' (Saunders, Lewis and Thornhill 2016b)

In this study, seven branches of research philosophy will be discussed in a bid to choose the most suitable and helpful one for this research. The nine branches of research philosophy are pragmatism, ontology, epistemology, positivism, realism, interpretivism as well as axiology.

4.3.1 Pragmatism

In order to discuss the research philosophy, it is unavoidable to explain what is the pragmatism of philosophy. Pragmatism is a philosophical tradition concept in which the practical effects of the objects in this research or study are considered.

Pragmatism refers to a mixed case of conjectures and viewpoints that derives from the United States. It emerged in the United States in the 1870s (Dalsgaard, 2014). Principal early involvers and contributors to this kind of research philosophy contained Charles Sanders Peirce (founder of pragmatism), William James (one of the biggest representatives of pragmatism), and later John Dewey (philosopher, educator and psychologist) and George Herbert Mead (sociologist, social psychologist and philosopher) (Dalsgaard, 2014). Pragmatism (Morgan 2014; Hall 2013), due to the "pragmatic maxim", is sometimes referred to as the "primacy of practice" principle. The practise is the only criterion for testing truth. The practical view of pragmatism directly equates truth with usefulness. Furthermore, it should be conducted in the light of their outcomes and significance in the process of practice (Dalsgaard, 2014).

Moreover, Morgan (2014) indicates that mixed-methods research (MMR) has underlined the empirical feature of research methods. In addition, he considers pragmatism as an exemplification of social research, to a great extent refraining from close contact with pragmatism based on philosophical foundations (Hall 2013; Dalsgaard 2014).

Tashakkori and Teddlie, in 1998, being cited by Saunders, Lewis, and Thornhill (2016b), argued that pragmatism had an intuitively fascinating characteristic, largely owing to the fact. This fact prevents the researcher from undertaking the meaningless and pointless controversy regarding whether these concepts were true, real or false. From Tashakkori and Teddlie's viewpoints, the people should be focused on what attracted them as well as the value or significance of it for them (Saunders, Lewis, and Thornhill 2016b). Furthermore, distinct ways or methods should be used to work out which one is the appropriate one. Following this, the proper results in ways that can be generated actively and positively in your value system should be concluded (Saunders, Lewis, and Thornhill 2016b).

4.3.2 Realism

In accordance with Saunders, Lewis, and Thornhill (2016), realism is another kind of philosophical form which associates with scientific inquiry. The nature and substance of realism are to reproduce the social reality truthfully and objectively. Meanwhile, the existence of those objects is independent of human cogitation and thinking (Saunders, Lewis, and Thornhill 2016b). On the other hand, realism is the opposite side of idealism. Meanwhile, realism is a bifurcation of epistemology. It had a similar feature with positivism; namely, it facilitates the development of knowledge by means of a scientific approach (Saunders, Lewis, and Thornhill 2016b). Realism includes two styles: direct realism (Brewer, 2019) and critical realism (Easton, 2010).

Direct realism indicates the direct knowledge of the real existence of objects is provided by the senses of human beings in a bid to portray the world accurately and subjectively (Saunders, Lewis, and Thornhill 2016b). Meanwhile, critical realism explains that what people go through are the graphics of the things and perceptions existing already in the truthful world, rather than the objects directly mirrored in human being's minds. Critical realists indicate that the senses beguile the human being regularly.

Easton (2010) delivers that critical realism, from philosophical standards' perspective, is a relatively novel philosophical channel to epistemological, ontological and axiological issues. The fundamental dogma and principle of critical realism are that people can depict the real world through applying causal language (Easton, 2010). Because most philosophical standpoints depend on supposition, those philosophical positions can only be determined pragmatically and eventually. Furthermore, it is not in the limited sense utilised by pragmatists; on the contrary, it is employed in terms of such beliefs that can be explained in a better way (Easton, 2010). Direct realism reflects the language, procedures and explanations that the people adopt and create routinely (Easton, 2010). It is a cause-and-effect language in the absence of thinking (Easton, 2010). Nevertheless, critical realists debate the application of cause-and-effect language with think and judgement. However, the direct realists always argue with the critical realists pertaining to what the illusions are interpreted by the human being as is the fact that that people have inadequate information (Saunders, Lewis, and Thornhill 2016b).

The difference between direct and critical realism is explained in an uncomplicated and straightforward way as follows: on the one hand, critical realism states that there should be two steps to go through this world (Saunders, Lewis, and Thornhill 2016b). Firstly, it is the thing itself as well as the sense it transmits (Saunders, Lewis, and Thornhill 2016b). Secondly, some spiritual processings proceed sometime after that sensation meets the senses (Saunders, Lewis, and Thornhill 2016b). On the other hand, the critical realist also considers that according to the understanding and knowledge, it is a philosophical theory of asserting that the senses can provide the direct consciousness of the outside world (Saunders, Lewis, and Thornhill 2016b). A further crucial viewpoint to make more discrepancy between direct and critical realism is that both of them are significant in association with the chasing of business management research (Saunders, Lewis, and Thornhill 2016b).

4.3.3 Interpretivism

Interpretivism maintains that human understanding and experience on the world do not passively perceive and accept the external material world but actively know and interpret. (Kelliher 2005; Packard 2017). Furthermore, the essential supposition is to put the person in the societal circumstance, and this would provide a chance to know the perceptions of their own doings (Kelliher, 2005).

Meanwhile, Saunders, Lewis, and Thornhill (2016) indicate that it is indispensable for the researcher to come to understand the discrepancy of social players among distinct humans in the roles in terms of interpretivism. However, it emphasises the divergence of conducting study or research among people. Moreover, interpretivism debates that truth and knowledge are subjective (Ryan, 2018), which is based on human being’s experiences, sensibleness and understanding of the outside material world. They are also culturally and historically situated. Researchers can never be completely dissociated from their own knowledge, beliefs and values, so these will inescapably notify how to gather, expound and analyse data (Ryan, 2018).

On the other hand, Chowdhury (2014) explains that interpretivism refers to the means that underline the significant nature character of people's participation in both social and cultural contexts. It represents one of the research methods in which human actors explain and adopt the philosophical position that people's knowledge and understanding of reality as a social construction and reflection, so it particularly precludes the methods of natural science (Chowdhury, 2014). Interpretivism tries to find implications and intentions behind human being's activities, for instance, behaviour and interplays with others in the context of society and culture (Chowdhury, 2014).

Goldkuhl (2012) explains that the core idea of interpretivism (Packard 2017; Ryan 2018; Devin Sanchez Curry 2020) is to work with these already existing subjective knowledge and senses in society. For example, it is used to accept their presence, to re-establish them, to comprehend them, to avert misrepresenting them and take advantage of them to build the blocks in the process of forming theory.

4.3.4 Positivism

Positivism refers to a kind of philosophical theory or position that states certain knowledge positively, which is based on the experience of natural phenomena as well as their attributes and relations. Thus, information derived from perceptual experience forms the exclusive source of all certain knowledge. In the western subject of philosophy, positivism generally labels itself as the presentation of experience and rules out a metaphysical or priori doctrine or theory.

Commonly related to experiments and quanti-research, positivism is deemed either a form of empiricism or the development of it (Ryan, 2018). Bryman in 2008, being cited by (Ryan, 2018), demonstrated four significant features of positivism:

- Objectivity – Science has to remain neutral
- Phenomenalism – Genuine knowledge should only be confirmed by the science
- Deductivism – It is the process of affirming the validity of a conclusion from a series of presuppositions that have been assigned the truthful values
- Inductivism – emphasises that observations come first, then theories.

According to Saunders, Lewis, and Thornhill (2016), positivists are more partial to be associated with observable social reality. They further propose that the final form of such research can be law-like recapitulations, similar to those end-pattern brought out by the natural and physical scientists. On the one hand, such facts are coherent to the conception of a perceptible real and authentic society; on the other hand, the positivist approach to study is that the research is conducted in an equitable and impartial way (Saunders, Lewis, and Thornhill 2016b).

4.3.5 Ontology

As Smith (2012) stated, ontology, as a philosophy branch, is to explore the origin or substrate of the world. Broadly speaking, it refers to the ultimate nature of all reality. In a narrow sense, there is a difference between the research on the origin and structure of the universe and the study of the nature of the universe in the general ontology (Gu et al., 2020). *Ontology* is frequently utilised by philosophers as a substitute word for *metaphysics,* a term used by early novices of Aristotle to refer to what Aristotle himself named as *first philosophy* (Smith 2012).

Gruber (2018) delivers that an ontology is a philosophical position that provides researches conceptions such as being, existence, becoming, and reality etc. In addition, it refers to the existing subject. And it is also regularly perplexed with epistemology, which is pertaining to knowing and knowledge. Moreover, Saunders, Lewis and Thornhill (2016) reflect that ontology is related to the nature and essence of reality in which it proposes questions of the assumptions regarding the mode and way of the world running, and the group or community holding to particular views. Meanwhile, Saunders, Lewis, and Thornhill (2016) demonstrate there are two respects in the realm of ontology, namely, subjectivism and objectivism.

Subjectivism is the theory that our own mental activity and thought are the only unquestionable and undoubted fact of our experience, instead of a shared or communal one. Furthermore, there is no external or objective truth. The subjectivist view is that the feelings of certain entities reflect in mind, such as its feelings, experiences, consciousness, ideas and ideas or will, are the root and foundation of the generation and existence of things in the real world (Saunders, Lewis, and Thornhill 2016b). At the same time, everything in the external world is derived from these subjective spirits. In addition, all of these are the manifestation of these subjective spirits (Saunders, Lewis, and Thornhill 2016b). Objectivism is the opposite side of subjectivism, where the belief is in the existence of reality independent of spirit, external or objective truth. Objectivism is a theory of philosophy facilitated by Russian-American author Ayn Rand (Younkins, 2012). According to the statement, objectivist philosophy believes in the existence of reality, independent of spirit (Younkins, 2012). The individual is connected with this kind of reality through the capability of perception (Younkins, 2012). Moreover, they use rational or non-contradictory recognition to deal with the information they felt and perceived in a bid to gain knowledge. However, the viewpoints of subjectivists are that social phenomena are produced by social actors from the insights and continuous actions (Saunders, Lewis, and Thornhill 2016b). On the other hand, objectivism is a philosophy of "*living in the world*", based on reality. Its goal is to acquire knowledge with regard to the natural world, harmony and mutually beneficial interactions between humans (Saunders, Lewis, and Thornhill 2016b).

4.3.6 Epistemology

Epistemology, or the theory of knowledge, is associated with how people know what human beings do, what justifies the people in believing what people do and what standards of evidence human beings should use in seeking truths about the world and human experience (Younkins, 2012). He further indicates that epistemology might be conceived as the theory of knowledge and justification.

Epistemology, the individual's view of knowledge, is also the individual's principle in knowledge and knowledge acquisition. Meanwhile, it mainly includes doctrines pertaining to the structure and nature of knowing, as well as beliefs of knowledge sources and knowledge judgments. It also refers to the role of these beliefs in regulating and influencing the process of individual knowledge construction and knowledge acquisition. It has long been the key issue of philosophical research.

Moreover, Saunders, Lewis, and Thornhill (2016) explain that epistemology focuses on what composes acceptable and appropriate knowledge in a research domain. Moss (2013) considers that epistemology is the research of knowing. Goldman and Whitcomb (2011) explain that epistemology is a kind of theory with respect to the nature of knowledge and reasonable philosophy.

4.3.7 Axiology

Axiology, called the *theory of value*, refers to the philosophical doctrines and positions pertaining to the nature, composition, standard and evaluation of value as well as theory study of value or value judgments. It is tightly associated with two other fields of philosophy, namely aesthetics and ethics.

Tomar (2014) states that the branch of philosophy concerns the general problem of values that are the nature, origin and permanence of values. It is called axiology. He further explains that axiology pays attention to questions regarding what 'ought to be'. It focuses on the nature of values in the context of philosophy. Most philosophers demonstrate that ethics, one branch of philosophy, is related to morals (Tomar, 2014). At the same time, aesthetics is concerned with the problems of beauty and art as a subdivision of axiology (Tomar, 2014).

Moreover, Mcgregor (2011) delivers that axiology plays a crucial role in the formation of novel lore and knowledge as the theory of value (valuing and value). Axiology derives from two Greek terms, Axios (worth) and logos (theory); therefore, it refers to *the theory of value* (Mcgregor, 2011). Axiology is the understanding and cognition of the significance of various things in the objective world for the survival and development of mankind. It can influence their perspectives, actions and decisions – to explicitly comprehend, "What do human beings judge value? How do human beings value, and how do human beings make value decisions?" (Mcgregor 2011; Saunders, Lewis, and Thornhill 2016b). Axiology is the science in which people's daily life closely relates to it (Mcgregor, 2011). Moreover, all human behaviours, thoughts, emotions and wills are driven by certain interests or values. Disparate value cogitation and orientation would have a large impact on people's thinking and behaviour (Mcgregor, 2011). Axiology interprets what human beings should pay attention to, what is key and imperative, and it can assist in regulating partial opinions and biases (Mcgregor, 2011). It gauges how human beings consider and become aware of things rather than what they think (Mcgregor, 2011). Comparing to the natural science explaining human behaviours, the theory of axiology illustrates and gauges the thought (the value) that facilitates the basis for and brings about human behaviours (Mcgregor, 2011).

4.3.8 The research philosophy employed in this research

As mentioned above, positivism refers to a kind of philosophical theory that states certain knowledge positively, which is based on the experience of natural phenomena as well as their attributes and relations. In this research, the after-sales factors that influence the agricultural machinery should be certified through quantitative data collection and data analysis. Meanwhile, the financial factors that impact the after-sales service of farm equipment should also be verified by data analysis. Furthermore, the data should be collected via a structured questionnaire and then analysed on the basis of the data collected. The relationship between the risk reduction of ASS on AM, the sustainable agri-machinery enterprises and the growth of agri-economy has also been verified by way of quantitative data analysis. All these relationships should be explained and verified positively.

According to Section 4.2.3, Chowdhury (2014) states that interpretivism maintains that the human experience knowing the world is not a passive perception and acceptance of the external material world but an active understanding and interpretation. The quantitative data collected by means of questionnaires should be employed to interpret the after-sales factors that influence the agricultural machinery. Those data are also employed to test the financial factors that impact the after-sales service of farm equipment as well as the relationship among the risk reduction of ASS on AM. Furthermore, the relationship between sustainable agri-machinery enterprises and the growth of agri-economy is also examined and displayed. The field data obtaining from the focus interviews, sessions and observations being recorded should be employed to examine the participator's accurateness via data collection technology and to interpret the results concluded from data gathered (Haex et al., 2020). Qualitative data should be employed to explain and validate the result obtained from the quantitative data collection and analysis.

In the light of Section 4.2.7, axiology, called the *theory of value*, refers to the philosophical doctrines and positions pertaining to the nature, composition, standard and evaluation of value as well as theory study of value or value judgments. Axiology strives to comprehend the feature and character of values and their judgments. This study aims to formulate the risk reduction model of after-sales services of Chinese agricultural machinery in South Africa. Numerous researchers focused on mechanisation in Africa and South Africa. However, few academics concentrated on the after-sale service of agricultural machinery, which is crucial to agricultural mechanisation in Africa. Consequently, this is valuable and novel to research on the after-sales service of agricultural machinery in South Africa, which is beneficial for sustainable agri-machinery enterprise as well as the growth of the agricultural economy. Furthermore, the growth of the agricultural economy can accordingly meet the issues of poverty, unemployment as well as inequality etc.

4.4 Research design

4.4.1 The definition of research design

In the light of Kumar (2011) and Peniel (2016), a research design is a program, blueprint, design and strategy to carry out research in a bid to tackle established research question through collecting, interpreting, analysing and discussing data collected. Deutsch and Cook, cited by Kumar (2011), further indicate that a research design is the arrangement or planned to collect and analyse data in line with the research questions or purposes in order to meet the research objects in the context of the economic procedure.

With regard to research design, Creswell (2007), citing Bogdan & Taylor's viewpoint, refers to the whole research procedure is from forming a research problem, facilitating research questions to data gathering, analysis, explanation and report composing. Yin, quoted by Creswell (2007), comments that the research design is "the logical sequence that connects the empirical data to a study's initial research questions and, ultimately, to its conclusions". Wherefore, Creswell (2007) incorporates the designated features of study design to facilitate the research process and development from the comprehensive theoretical and philosophical viewpoints.

On the other hand, Peniel (2016) illustrates that a research design is the preparation of data collection and new data analysis in order to interpret the already available facts in a novel approach. Moreover, he indicates that the research design is the compendium and profile of a plan via gathering and analysing data.

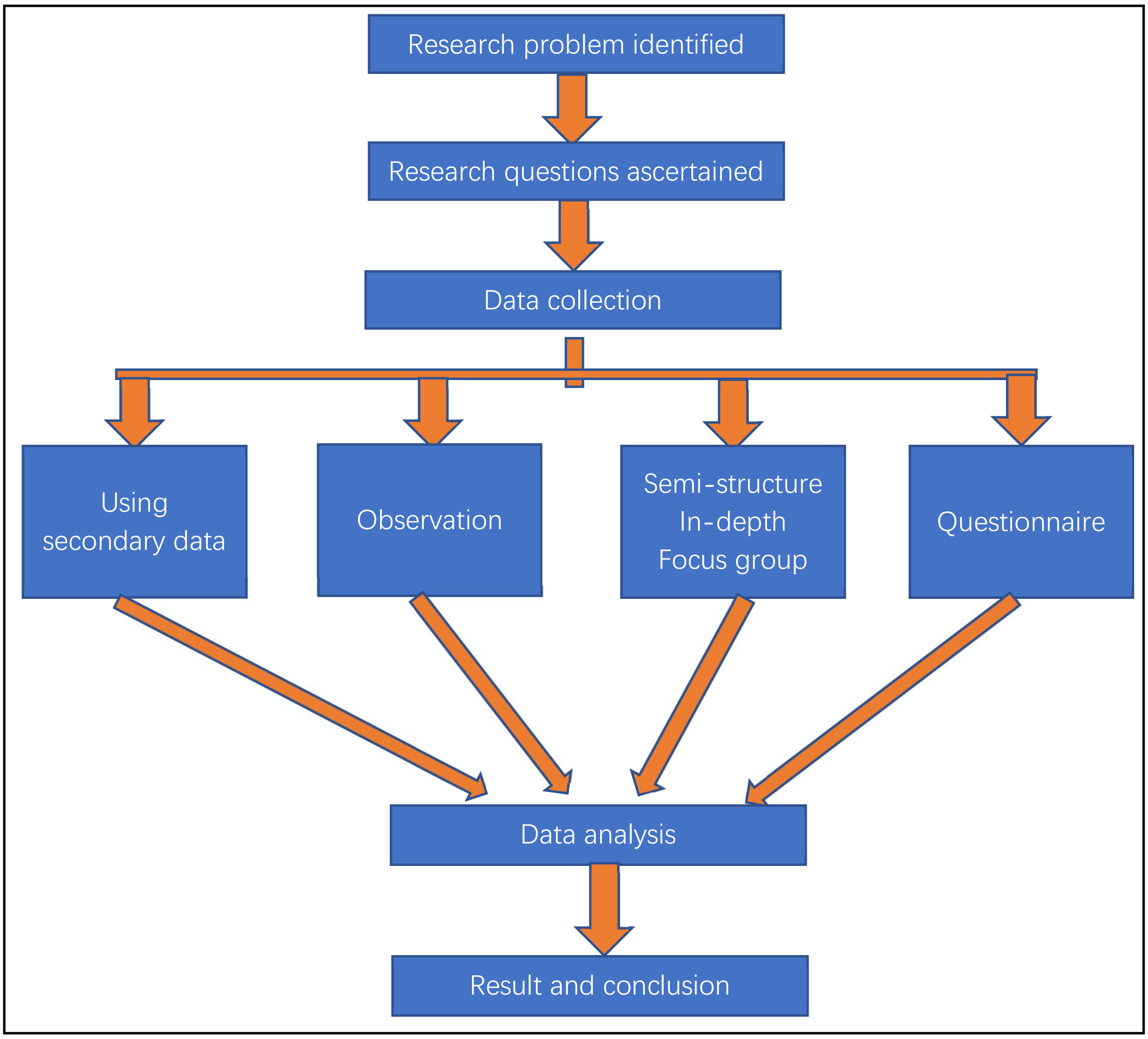

Figure 4.2: Flow diagram of the research design

In short, as illustrated in Figure 4.2, the research design is a kind of framework or plan via which research problems are identified. However, research questions should be found to meet the aim of the study in this process. Moreover, the research method should be employed for data collection, data analysis. Finally, the result and research conclusion will be formulated in this section, as shown in Figure 4.2.

4.4.2 Types of research design

In Table 4.1, Peniel (2016) introduces eight categories of research design, including descriptive design, exploratory design, ex-post-facto research design, experimental design, quasi-experimental research design, factorial research design, survey research design and cross-sectional or correlation design.

Table 4.1: Types of research design (Peniel 2016)

Type of research design	Definition
Exploratory or formulate design	It is carried out for the research problem when the researcher has no previous data or only a few types of research for citation and reference.
Descriptive design	It is used to describe the characteristics of the population or phenomenon being studied. It does not answer questions, such as how, when, why. On the contrary, it solves the "what" problem.
Ex-post facto research design	The ex-post-facto theory refers to the investigation that begins following the fact that has occurred without obstruction from the researcher.
Experimental design	It is about how to formulate appropriate experimental programs in accordance with the predetermined goals. It is mathematical principles and implementation methods for effective statistical analysis of experimental results.
Quasi-experimental designs	It refers to a research method that uses primitive groups to conduct experimental treatment in a more natural situation when there is no need to randomly arrange participants.
Factorial design	It refers to multiple factors (two or more elements) as the research object in order to explore 1) the main effect of each factor 2) the interaction influence among the different factors.
The survey method design	In empirical research, the selected sample should be surveyed based on the research questions and assumptions in order to verify the research result by means of collecting the data and doing data analysis.

Nevertheless, Crewell (2017) elaborates that there are five research designs that can be summarised or interpreted from table 4.1 as well. They are quantitative research design, qualitative research design, exploratory sequential design, explanatory sequential design as well as the mingled research design. In addition, there is another explanation in which research design included quantitative study design, qualitative study design, explanatory research design, exploratory research design and convergent design. Some of the other researchers also categorise the design of research as exploratory research design, explanatory research design and triangulation design or embedded design. In the next section, explanatory research design, exploratory research design as well as mixed research design will be discussed predominantly and respectively. Finally, the appropriate and suitable research design for this study will be chosen and motivated.

4.4.2.1 The explanatory research designs

Research that established cause-and-effect relations between variables is interpreted as explanatory research. The focus and focal point here are on researching a problem or a situation in a bid to expound the relationships between variables (Saunders, Lewis, and

Thornhill 2016b).

Explanatory research, also known as cause-and-effect research, is undertaken to determine the characteristics and the nature of causal relationships. The explanatory research can be carried out as a tool to guide people to problems and issues that might be met in the future. Furthermore, it is mainly employed to collect preliminary data in order to reveal the true nature of the research problem and possibly put forward some hypotheses or new ideas.

According to Subedi (2016), an explanatory sequential design comprised firstly gathering quanti-data, conducting quanti-data analysis and then collecting quality-data, executing quali-data analysis to help elaborate or interpret the quantitative results, as illustrated in Figure 4.3. Moreover, the fundamental for this method is that the quanti-data collection, analysis and results furnish a universal profile of the research problem. Furthermore, more data collection, analysis and results, specifically through qualitative research design, are demanded to abstract, expand or interpret the widespread picture (Subedi, 2016). Finally, this kind of study design can strongly ensure the reliability, validity, justifiability, and persuasiveness of the current study result.

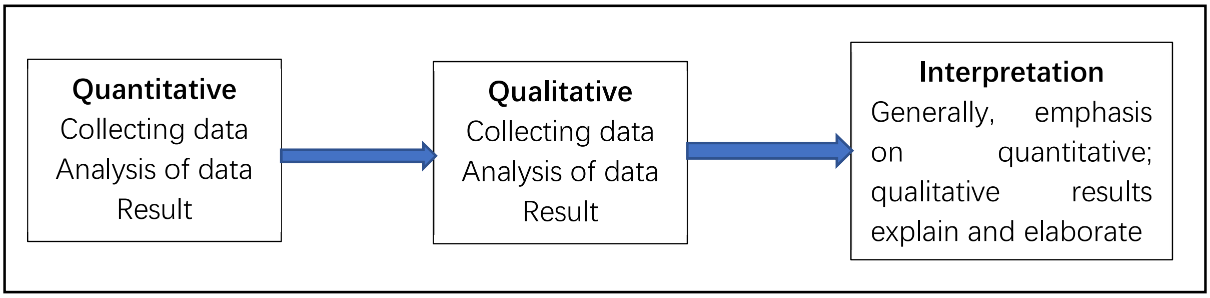

Figure 4.3: Explanatory research design

4.4.2.2 The exploratory research designs

Robson, quoted by Saunders, Lewis, and Thornhill (2016), explains that an exploratory study refers to that the researcher is to conduct this type of research under the condition of not clearing out the scope and concept of the research topic. Furthermore, the inner connection of the research object is unfamiliar, and it is difficult to determine the hypothesis and research direction and lack of predecessor research information and theories existing. It is a research method employed in situations where no specific and ready-made method can be proposed for research development (Saunders, Lewis, and Thornhill 2016b).

Exploratory research design, which is an examination into a subject in an attempt to gain further insight, is carried out for the research problem when the researcher has no previous data or only a few types of research for citation and reference. Usually, this study is unstructured and informal. It serves as a tool for the initial study that provided a hypothetical or theoretical thought and ideology of the research problem. It is often referred to as the grounded theory approach (O'Reilly et al. 2015; Thornberg and Dunne 2019) or interpretive research (Darby, Fugate and Murray 2019) to answer questions like what, why and how.

According to Subedi (2016), in terms of exploratory sequential design, the researchers firstly gather quali-data, execute quali-data analysis, and then perform quanti-data collection and data analysis. Illustrated in Figure 4.4, the intention of this exploratory sequential mingled means design consists of the process at first to collect the qualitative data in order to probe a phenomenon, followed by gathering the quantitative data to expound relationships discovered in the quali-data. In conclusion, this kind of research design can strongly ensure the reliability, justifiability, validity, and persuasiveness of the current study result.

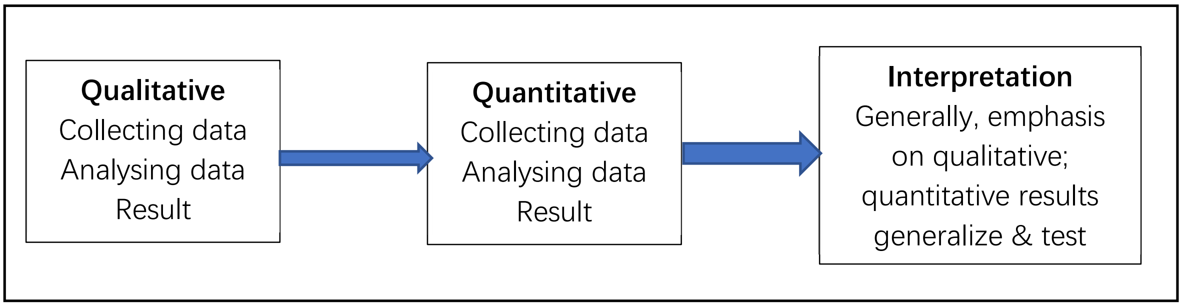

Figure 4.4: Exploratory research design

4.4.2.3 Other mixed research designs

The mixed research designs will be illustrated in the following part.

- Concurrent design

Figure 4.5 and Figure 4.6 demonstrate the concurrent design (Wang, Chen, and Wang 2017) in which the quantitative data gathering and analysis accompanies qualitative data collection and analysis.

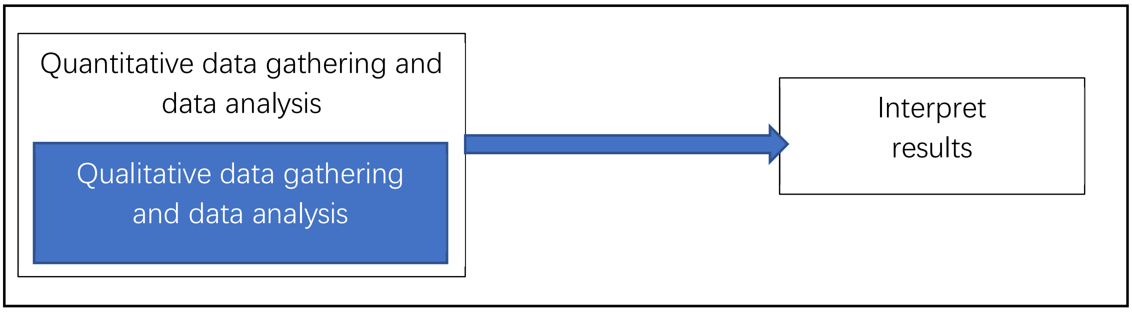

Figure 4.5: The concurrent design

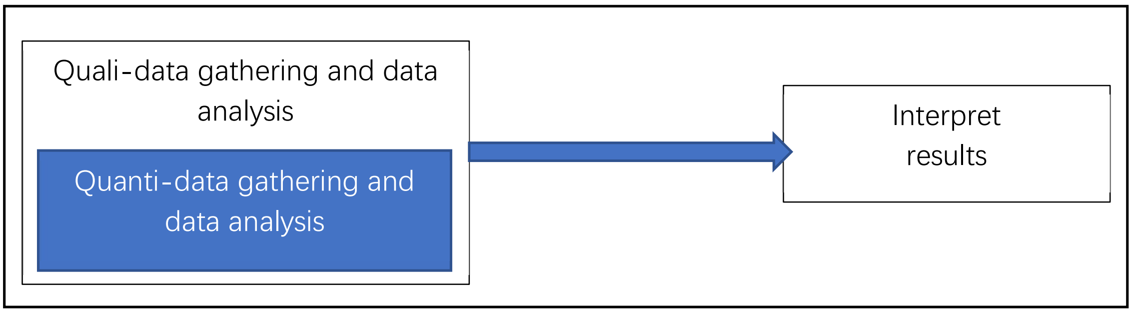

Figure 4.6: The concurrent design

- Convergent Design

Figure 4.7 showed that the convergent design (Kuss et al., 2018) refers to quantitative data collection and qualitative data analysis are employed to interpret the study result and display the discussion, while qualitative data collection and quantitative data analysis are used to validate the result simultaneously.

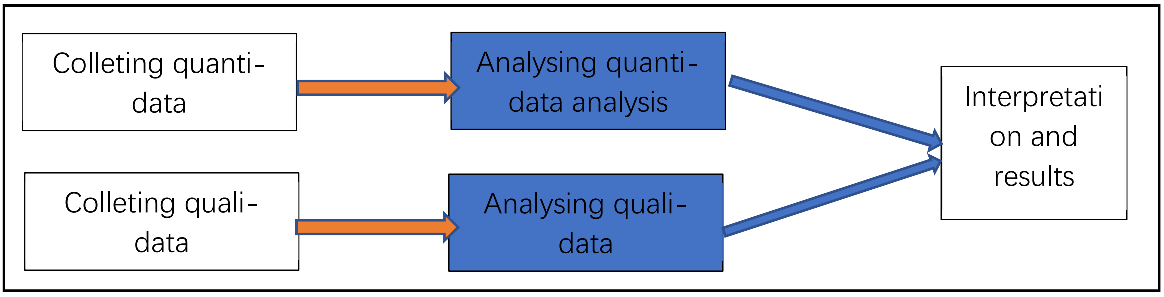

Figure 4.7: The convergent design

- Triangulation design

As shown in Figure 4.8, the triangulation design (Helen Noble & Heale, 2019) refers to employing quantitative and qualitative data gathering and analysis to yield convergent results. This design is utilised when an academic would like to compare quantitative statistical outcomes with quali-findings diametrically or to expand or validate quantitative outcomes with quali-data (Crewell, 2017).

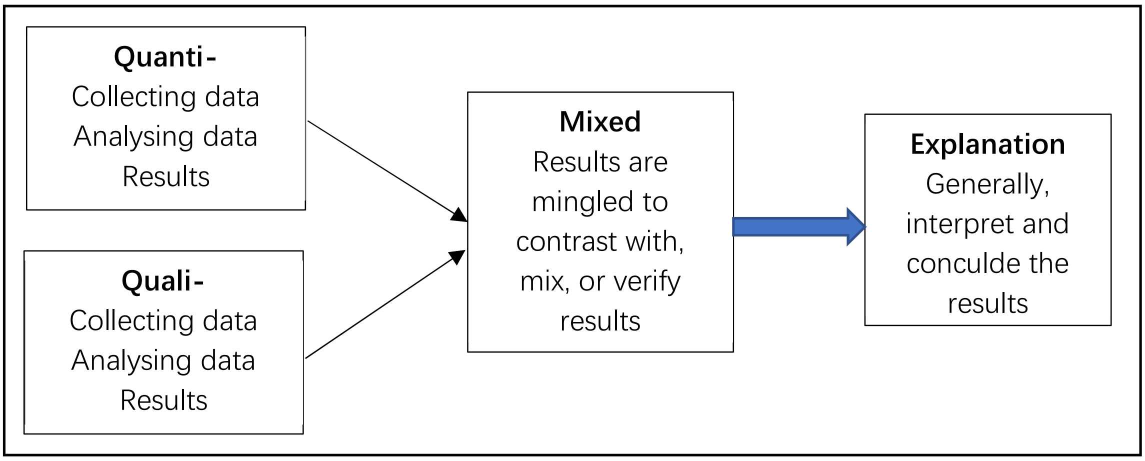

Figure 4.8: The triangulation design

- Embedded design

According to Figure 4.9, the embedded design (Helen Noble & Heale, 2019) means quantitative data gathering and analysis embedded in the qualitative data gathering and analysis, which can enhance the validity and reliability of the research outcome.

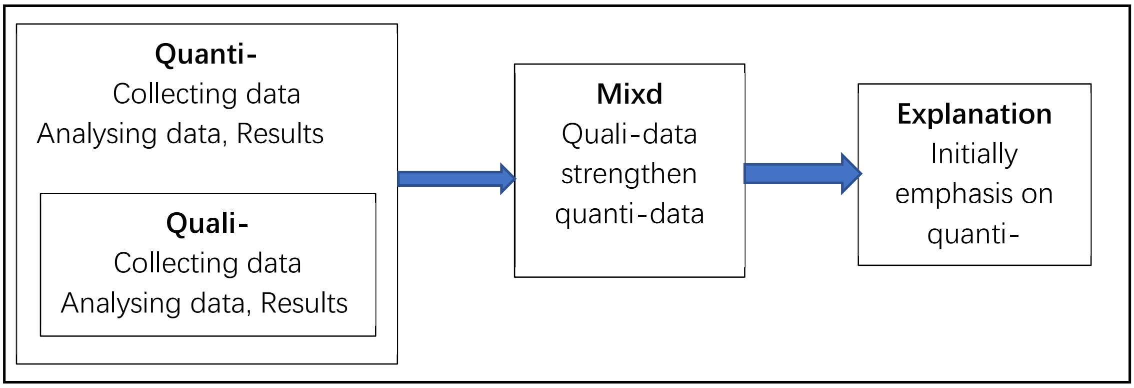

Figure 4.9: The embedded design

4.4.3 The research design employed in this study

The research design employed in this research is the explanatory research design. At first, quanti-data is gathered, and data is analysed, and then quali-data is collected and analysed. Table 4.2 illustrates the procedure of the research design employed in this research.

Table 4.2: The research design employed in this study

Phase	Procedure	Product
Quantitative data collection	Questionnaires distribution and collection	Numeric data
Quantitative data analysis	Use of descriptive and inferential statistics	Meaningful measures
Connecting quantitative and qualitative phase	Selection of participants purposefully and interview questions development	Interview protocol
Qualitative data collection	Focus-group interview	Textual data
Qualitative data analysis	Coding and thematical analysis; Thematical development through thematic analysis	Codes and themes are similar and categorised through the thematic matrix
Integration of the quantitative and qualitative phase	Explanation and interpretation of the quantitative and qualitative results	Discussion and implication of the future study

The study design procedure utilised in this research starts from quantitative data collection in which questionnaires have been distributed to participants to complete according to their viewpoint. Next is quantitative data analysis, in which SPSS is utilised to analyse the data gathered from the questionnaires. Subsequently, the focus-group interview is used to collect the qualitative data, followed by coding and analysis of quali-data. Finally, in the integration of the quantitative and qualitative phase, the description, explanation and interpretation of the quanti- and quali-results are discussed in a bid to validate in some explicit form the risk reduction model of after-sales service of Chinese agricultural machinery in South Africa. Furthermore, the conclusion, recommendation as well as future work will be illustrated after the discussion of the research results.

4.5 Research methodology

In this research, in a bid to address the objectives of the thesis, generally, a qualitative research technique, quantitative research method and combination of both (also called triangulation), as explained in the previous section, will be employed to strengthen the research study.

Qualitative research: it is the way researchers use to define or deal with problems. The specific purpose of quali-research is to study in-depth the specific characteristics or behaviour of the object and further explore the reasons for its occurrence. If quantitative research solves the "what" problem, then qualitative research solves the "why" problem Mamabolo (2009).

Quantitative research: refers to scientific research to determine the quantity of a certain aspect of a thing and deal with the number in a systematic way. It is a research method and process that utilises quantity to describe problems and phenomena and then to analyse, test, and explain the data and phenomena so as to obtain meaning and results (Rajagopal and Bojin, 2003).

Triangulation: it is also called mixed-methods research, uses more than one kind of method to study a phenomenon in order to decrease the weaknesses of an individual method and strengthen the outcome of the study (Bekhet and Zauszniewski, 2012).

In this study, methodological triangulation, which uses at least two methods, usually quali- and quanti-methodology will be employed to address the research problems and meet the study objectives (Morse et al., 1989).

4.5.1 Quantitative research methodology

The quanti-research methodology is a scientific system of the method, number-related research, and its foundations can be determined in the context of the positivist paradigm (Rahi, 2017). This methodology concentrates on primary or fresh first-hand data gathering in the light of the problem derives from the great amount of population and analysis of this kind of fresh first-hand data (Rahi, 2017). However, it neglects personal feelings and emotions or environmental context (Rahi, 2017). Meanwhile, Almeida et al. (2017) debate that the quantitative methodology hunts for gaining precise and trustworthy measuring and gauging via which data can be analysed statistically.

In quanti-research, the data should be quantified, as the research samples are typically representative of a large population (Almeida et al., 2017). Meanwhile, the results should be concluded in order to summarise sufficiently all-around and general views of the whole population (Almeida et al., 2017). Objectivity plays a crucial role in quanti-data collection through adopting a structured process and formal means. In addition, quanti-data is gathered systematically and objectively (Almeida et al., 2017). Consequently, the numerical data analysis is undertaken by means of a statistical process, frequently employing software, for instance, Stata, R or SPSS (Almeida et al., 2017). Oshagbemi (2017) concluded that unlike the academic in the qualitative paradigm, participants involved in this research process is regarded as one of the great research instruments. On the other hand, the researcher in quanti-research is believed to be exterior to practical research. Meanwhile, the research results must be anticipated to be reproducible, no matter who undertook the study procedure again. The discrepancy between quantitative research and qualitative study is illustrated in Table 4.3 as follows:

Table 4.3: Quantitative vs qualitative research: crucial viewpoints in the classical argument (Oshagbemi 2017)

Quantitative research	Qualitative research
• The aim is to classify features, count them, and construct statistical models in an attempt to explain what is observed	• The aim is a complete, detailed description
• The researcher knows clearly in advance what he/she is looking for	• The researcher may only know roughly in advance what he/she is looking for
• Recommended during latter phases of research projects	• Recommended during earlier phases of research projects
• All aspects of the study are carefully designed before data is collected	• The design emerges as the study unfolds
• The researcher uses tools such as questionnaires or equipment to collect numerical data	• The researcher is the data gathering instrument
• Data are in the form of numbers and statistics	• Data are in the form of words, pictures or objects
• Objective – seeks precise measurement and analysis of target concepts, e.g. uses surveys, questionnaires etc.	• Subjective – individuals' interpretation of events is important, e.g. uses participant observation, in-depth interviews etc.
• Quantitative data are more efficient, able to test hypotheses, but may miss contextual detail	• Qualitative data are more rich, time consuming, and less able to be generalized
• The researcher tends to remain objectively separated from the subject matter	• The researcher tends to become subjectively immersed in the subject matter

In quantitative research, the data collection method includes utilising secondary data, gathering primary data via observation (participant observation and structured observation), questionnaire, etc. However, the questionnaire employed in this study includes four dimensions. The first dimension is democratic information, including age, gender, education, position and working years, etc. The second construct consists of six items that examine the factors that influence the ASS of AM, extracted and revised from the study of Li & Ma (2017), Qin et al. (2019), and Chiguvi (2020). In addition, the third dimension has five items (saving, overdraft, access to credit, sponsorship, and grant), modified from the study of Potkány et al. (2016), Ogundeji et al. (2018), Fotiadis et al. (2019), and Wieliczko et al. (2020). The last construct has four items to examine the relationship of ASS of AM, sustainable agri-enterprise, and the growth of agri-economy.

In this research, the questionnaire as the quantitative data collection equipment or instrument is employed to gather the data in Shandong province and Henan province of China. The same procedure of quantitative data gathering should be carried out in the Gauteng province, Free State province and Limpopo province of South Africa. Due to the Covid-19 that broke out in 2019 and 2020, the questionnaire could not be collected in Gauteng province and other provinces, even if it was distributed by the Gauteng Department of Agriculture & Rural Development in November and December in 2019.

The research population in this study should be all stakeholders involved in the agri-operations, farm works, AM manufacturers, AM trade and companies, as well as researcher centres or institutions etc.

After the questionnaires have been collected in China, the quantitative data will be analysed by means of software, such as SPSS and AMOS. Moreover, the factors of the after-sales service of agricultural machinery should be generated through data analysis, followed by eliciting or deducing the financial factors that influence the ASS of AM. Subsequently, the relationship among after-sales service of AM, sustainable agri-machinery enterprise as well as the growth of the agricultural economy will be compared and summarised by way of quantitative data analysis.

4.5.2 Qualitative research methodology

The qualitative methodology aims to comprehend an intricate actuality and the implication of operations in a designated context (Rahi, 2017). However, the qualitative research methodology is believed to be appropriate and advisable when the investigator or the researcher either probes a novel research realm or attempts to pinpoint and formulate a theory of protruding issues (Jamshed, 2014). Researchers use these kinds of methods, such as historical review, literature review and analysis, interviews, observations, focus group discussion and participation experience on obtaining information and data in a natural context; furthermore, non-quantitative methods have to be employed to analyse data obtained via the above-mentioned method and propose research conclusions (Jamshed, 2014).

In qualitative research, the data collection method included using secondary data, collecting primary data via observation (participant observation and structured observation), semi-structured interview, in-depth interview as well as a focus group interview. Table 4.4 demonstrates the comparison of qualitative methods, including the method of quali-research as well as its advantages and disadvantages.

Table 4.4: Comparison of qualitative methods

Method	Contents
Observation	Observation, as this term suggests, is a kind of methodology of gathering data by means of observing. The observation research method is classified as participatory research because the researchers have to immerse themselves in the circumstance or context where their participants are. In addition, researchers should take notes and/or record what they see and notice.
Case study	A case study is a method of in-depth and specific research on a single research object
Field research	Field research is a qualitative methodology that intends to observe, interrelate and comprehend human beings in a natural environment.
Ethnography	Ethnography is a descriptive research project or process of a specific human society. The research work of ethnography is almost entirely based on field surveys. Therefore, anthropologists engaged in this research are required to thoroughly immerse themselves into the culture and daily life of the nation or nationality where the investigator is studying in a bid to do comprehensive investigations and studies.
Focus-group discussion	Focus-group discussion refers to gathering participants from analogous environments or contexts who have similar experiences and knowledge to discuss a designated topic. It is a kind of quali-research methodology where research questions are proposed to ask the participants' attitudes, opinions, perceptions, ideas or beliefs. After the discussion, the viewpoint of participants will be analysed by means of software to derive the research results.
Structured interview	A structured interview is a kind of discussion in which the participants might be asked the same questions and be conducted with the same procedure as a predetermined set or context.
In-depth interview	An in-depth interview is a one-to-one conversation between a professional interviewer and participants for a long period of time. It is utilised to collect the respondents' viewpoints on research questions or perspectives of discussion themes etc. It is usually completed in the designated place or in a centralised interview location.

The instrument of qualitative data collection employed in this research is focus-group interviews. The eight focus-group discussions were conducted in China and South Africa, respectively. Furthermore, four focus-group interviews should be undertaken in Shandong province and Henan province of China. The participants in those focus-group interviews include CEOs, after-sales managers, sales managers, technological managers, policy-makers and officials in the department of agriculture. The other four interviews should be carried on in South Africa by means of field meetings or spot-conference. Due to the outbreak of Covid-19, the Zoom meeting, Microsoft Teams conference and TenCent symposium have been employed to conduct the focus-group interviews virtually. The participants in those focus-group interviews consist of the small-holder farmers, commercial farmers, users, dealers, after-sales managers, and policy-makers at the department of agriculture.

The qualitative data analysis will be used in part of the research. Furthermore, a descriptive qualitative research method should be employed in this study (Haex et al., 2020). All focus procedures should be recorded, coded, managed and transcribed. The spot-discussion notes sorted out from the focus-group discussion process might be recorded and offer implications to the reported experiences. Decoding and paraphrasing should be employed during and following every data gathering. Moreover, this technique is employed to decide the participator's unambiguousness and accurate explanation. All interviews should be analysed by using thematic content analysis.

The quali-data analysis method employed in this study is thematic content analysis (TCA). Furthermore, it is a quali-research method for objective and systematic description presentation of qualitative data (Anderson, 2007). In this study, the thematic content analysis focuses on the influence of ASS of AM risk reduction on the sustainable agri-machinery enterprise. The focus-group interviews were conducted in South Africa and China, respectively. Furthermore, the interview transcripts and details have been recorded. The discussion of this influence, as well as the participants' explanation of their viewpoints and opinions, have also been divided into four distinct groups in a bid to further interpret and verify the results and findings analysed from quantitative data. The detailed display and explanation of thematic content analysis of quali-data will be illustrated in Section 7.7.

4.5.3 The mixed research methodology employed in this study

A pivotal aspect of the definition of the mixed method is the 'merging' of the quantitative and qualitative elements within this research. The meaning of 'merging' is the process where the quantitative and qualitative elements are intermixed to generate a more detailed interpretation of the research problem. This amalgamation can be conducted at any stage(s) in the research procedure, but it is crucial to the rigour of the mingled research methods (Halcomb & Hickman, 2015). However, the steps in the procedure of carrying out mixed-methods research are illustrated in Figure 4.10.

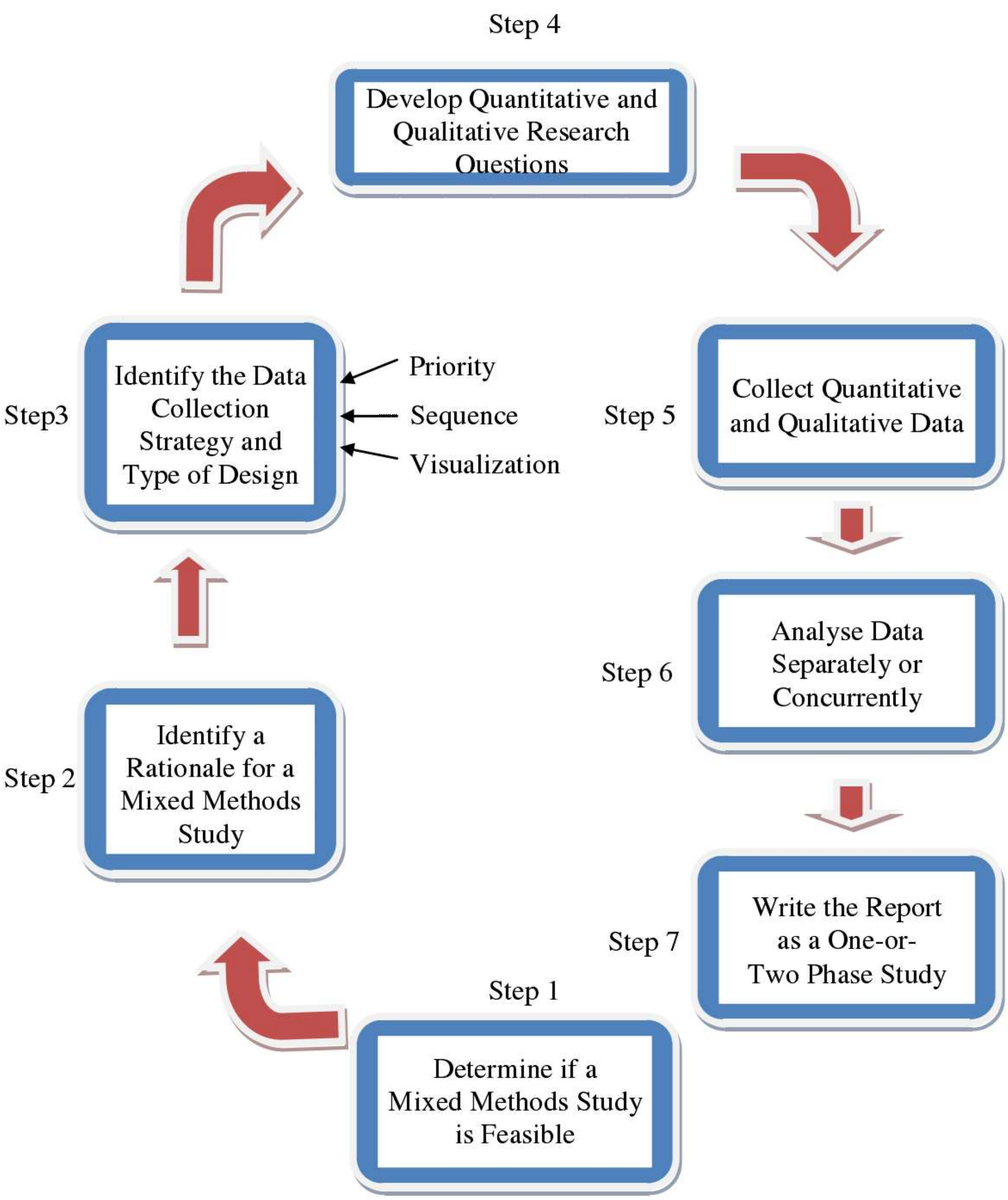

Figure 4.10: Steps in the procedure of carrying out mixed-methods research (Oshagbemi, 2017)

This research will employ the sequential mixed-method research methodology, which is quanti-data gathering and analysis followed by quali-data gathering and analysis, as explained in the previous section. Furthermore, it will be carried out in China and South Africa, respectively. In the process of the quantitative data gathering, the study employed a research method implementing the close-ended questionnaires. The objective of the quantitative research methodology should enable researchers to carry out both descriptive and explanatory (inferential) analyses. Prior to the collection of quantitative data collection, the draft questionnaire should be piloted and examined. This has been done by ten experts, after-sales managers and sales managers and users in this research. Furthermore, it should be evaluated by the after-sales managers or experts in this area to warrant its reliability and validity as well. On the other hand, in terms of qualitative data gathering, focus group interviews should be employed. The intention of utilising the qualitative method in this research should be to enhance the results obtained from quantitative data and discussion. In addition, it should be to unearth novel depictions and descriptions for this kind of phenomenon to discover the pragmatic experiences of the research interviewees. This exercise is necessary to make known the realistic reality of risk reduction of after-sales service of agricultural machinery by means of providing the new risk reduction model for AM enterprise. It may facilitate the sustainable development of AM enterprise and increase the growth of the agri-economy.

4.6 Research approach

The research approach in this study refers to the deduction method and induction method. Induction focuses on how to build theory; meanwhile, deduction discusses how to test the theory. The research approaches always relate to different research philosophies. On the one hand, deduction owes more to the positivism paradigm. In addition, the induction approach inclines to interpretivism paradigm.

4.6.1 Inductive approach

Inductive approach (Thomas 2006; Smart, Witt, and Scott 2012; Lisha Liu 2016; Zalaghi and Khazaei 2016; Dissanaike et al. 2018; McFarland et al. 2018; Fleischmann and Ivens 2019), also named as inductive reasoning, explores and begins with the watching, and then theories are formed towards the completion of the research procedure caused by observations. The inductive research method consists of the search for patterns from observation as well as the evolution of interpretations for those models by means of a number of suppositions in which theories can be formed.

Meanwhile, Smart, Witt and Scott (2012) point out that inductive reasoning is a kind of reasoning from individual instances to a general conclusion. Inductive reasoning is a kind of transition from a certain degree of viewpoints about specific things to a larger range of viewpoints. In addition, it is a kind of explanation method, derived the general principle and principle from and specific concrete examples. Thomas (2006) explains that inductive reasoning is a type of method that utilises observation of original data to generate concept, theory, theme and new model. This might be made by the researcher by means of descriptions or interpretations from original data. Inductive reasoning focuses on observation and generated interpretations and conclusions by means of observation (Zalaghi & Khazaei, 2016). It normally proceeds from specific examples to a general conclusion, as the academic or researcher derives or transmits the finite observations of particular situations to general endings (Zalaghi & Khazaei, 2016).

Inductive reasoning states that when people explain a larger thing or phenomenon, they summarise and generalise various general principles from individual and particular things or circumstances. This kind of cognition order runs through people's interpretation activities, constantly rising from the individual to the general, namely from the understanding or cognition of special things to the understanding or cognition of the general laws of things. However, it is possible to proceed from these principles and principium to draw the research conclusions with regard to individual things or circumstances (Dissanaike et al., 2018). It is significant to underline that inductive reasoning doesn't mean paying any attention to theories when drawing up research objectives and questions. This reasoning intends to yield sense and results from the raw data gathered in a bid to determine novel patterns and causal relationships to produce a theory.

The features of inductive research reasoning are elaborated explicitly and more comprehensively in Table 4.5.

Table 4.5: The features of inductive research approach (Lisha Liu 2016)

Item	Explanation
Question Sample	Depictive, procedure, explanatory: what is the main meaning in the context associated with research objectives.
Sample	Motivated; either accompanying or a priori; standard might be demographic.
Research process	Inductive is usually cyclically transmitting among research questions, data collection and analysis.
Data analysis	Concentrate on subjects and explanations among the distinct cases.
Memos of analysis	The memo is crucial, and memos might be of a lot of types.
Criteria for ending data collection	Added data yield little novel insight, understanding or information.
Design	It becomes increasingly to be focused on the process of the research. The target is an explanation of abundant and sufficient data.
Presentation of findings	To present the most significant subjects.
Generalizability	Cross-population or theoretical generalizability to similar cases

4.6.2 Deductive approach

The deductive approach (Jahn 2011; Gorat and Prijambodo 2013; Oaksford 2015; Zalaghi and Khazaei 2016; Saunders, Lewis, and Thornhill 2016b; Woiceshyn and Daellenbach 2018; Liew, Grisham, and Hayes 2018; da Silva 2020) is also associated with opening up a hypothesis or hypotheses on the base of currently-existing doctrine or theory and then devising research tactics and method to examine the hypothesis. This has been explained that a deductive approach meant reasoning from a more general level to a more particular one (Woiceshyn & Daellenbach, 2018). Deductive reasoning of research is that human beings typically relate to scientific investigation. However, a deductive design might examine whether this relationship or link obtains more general circumstances. The researcher reviews the research works of what other scholars and academics have completed. This is based on the currently existing theories of whatsoever phenomenon the researcher is researching. Finally, they test hypotheses that appear from those theories. The deductive reasoning can be interpreted by way of these hypotheses, being derived from the postulation of the theory (Zalaghi & Khazaei, 2016). On the other hand, deductive reasoning is associated with deducting results or conclusions from these hypotheses or propositions (Zalaghi & Khazaei, 2016).

Deductive reasoning composes four stages, as follows:

- commence with a currently-existing theory
- Formulate a hypothesis or hypotheses on the basis of the currently existing theory
- Collect data to test and validate the hypothesis
- Analyse and generate the results

On the other hand, Robson, being cited by Saunders, Lewis, and Thornhill (2016), enumerates five serial and successive stages via which deductive reasoning would be conducted:

1. To deduce a hypothesis or hypotheses (an able-to-be-tested hypothesis with regard to the relationships among two or more variables or conceptions) from the existing theory;
2. To express the hypothesis in an operating context, which proposes a relationship between two or more particular variables or conceptions;
3. To test this operational hypothesis;
4. To examine the designated result or consequence of the questions or inquiries;
5. if required, revise the theory by means of the discoveries or findings.

In conclusion, the deductive approach is that it employs the supposition obtained from the theory to examine the result from the premises, namely, testing theory.

4.6.3 The research approach employed in this study

If the research relates to both the deductive and inductive approaches, combining research approaches should be employed. The major difference between deductive and inductive reasoning is also illustrated in Table 4.6.

Table 4.6: Major discrepancies between deductive and inductive research approaches

Deductive focus	Inductive focus
• scientific principium • transmitting from theory to data • the collection of quantitative data • the requirements to annotate cause-and-effect relationships among variables • the application of monitoring to guarantee the validity of data and results • a thoroughly structured method • the needfulness to pick a sufficient sample size in a bid to form and generate research conclusions	• obtaining a comprehension of the significance ion of human being's attitudes to the events • an overall comprehension of the research context • the gathering of quali-data • a nimbler structure to allow altering of research focus in the process of the study • a reality that the researcher is involved in this research procedure • fewer links with the requirement to recapitulate

In this study, inductive approaches will also be employed. It will be to formulate the theoretical framework with inductive reasoning and then test the theoretical framework and form the novel risk reduction model using the same approach. At first, factors of after-sales services of agricultural machinery have been condensed and refined from the literature review. Furthermore, six factors of after-sales services of agricultural machinery are finally identified via a semi-structured interview method in a bid to build a theoretical framework. After the formulation of the original conceptual framework, the data collected by questionnaire and focus-group interview are employed to test the relationship among them. Furthermore, on the basis of a conceptual framework, the relationships among financial resources, the influential factors of ASS of AM, risk reduction of ASS of AM, sustainable enterprises and the growth of the agricultural economy have been determined. Finally, the tested novel risk reduction model will be formulated as the result of the inductive research approach.

4.7 Research time horizons

A time horizon, also known as a planning horizon, is a "snapshot" or snapshots. A snapshot is taken at a particular time. On the other hand, a series of snapshots or a diary is more akin to be a representation of plentiful events during a particular time (Saunders, Lewis, and Thornhill 2016b). The 'snapshot' time horizon is named as cross-sectional research in this study; meanwhile, the 'diary' view of the point is designated as longitudinal research (Saunders, Lewis, and Thornhill 2016b). The detailed introduction and information regarding longitudinal research and cross-sectional research will be interpreted in the forthcoming section.

4.7.1 Longitudinal research

A longitudinal study (Wang et al. 2020), also called follow-up research, refers to repeated research on the same or the same cohort of subjects over a relatively long period of time.

The characteristics of longitudinal research are:

1, Each variable must be collected at least twice or more times;
2, The objects of each research survey should be the same or at least comparable;
3, In data analysis, it involves the longitudinal comparison of data from multiple surveys

The advantages of longitudinal research are shown as follows:

1, It can detect a relatively intact and integrated interviewer's development process and some other key turning points in the study development process;
2, It is especially suitable for the stability of research and development and the role of early influence, as well as for case studies

The disadvantages of longitudinal research include:

1, It is time-consuming, costly as well as labour-intensive;
2, Timeliness is relatively poor, sometimes it takes a long time (several years or dozens of years) to get the research results;
3, Due to the longitudinal research taking a long time, the loss of participants may occur, which will affect the representativeness of participants and the generality of research results;
4, Because the longitudinal study requires repeated research on the same batch of participants, sometimes practice effects or fatigue effects may occur.

4.7.2 Cross-sectional research

Cross-sectional research, also called horizontal research, refers to a method of studying developmental trends by means of comparing participants, for example, different age groups at the same specific time.

The pros of cross-sectional research are seen as follows:

1, The cross-sectional research is time- and money-saving and is much easier to implement;
2, Because the cross-sectional research can introduce more participants, the results of the research may have a better generality; and

3, The timeliness of horizontal research is relatively strong; meanwhile, research results can be obtained quickly, both of which may avoid the loss of participants in the period of research.

The cons of cross-sectional research are shown as follows:

1, There may be group effects in the cross-sectional study; and
2, Horizontal research is not applicable to issues such as the stability of research development and the role of early influence.

4.7.3 Time horizon used in this study

The time horizon employed in this study is cross-sectional research, as the questionnaires are distributed to a large sampling population chosen in this study. Nevertheless, it can to some extent be considered as a longitudinal study because it took more than one year and a half to collect the quanti- and quali-data consecutively.

4.8 Research ethics

Doody and Noonan (2016) reviewed that ethics offers instructions for the responsible actions and operation of the study. Moreover, it facilitates and supervises scientists engaging in studies to guarantee a high ethical criterion. Within this study, ethics is an indispensable step to safeguard society, and the oldest research ethics mode appeared in the 19th-century (Doody & Noonan, 2016). Furthermore, Aluwihare-Samaranayake (2012a) demonstrates that a classic ethics definition is that the term of ethics is pertaining to attracting excellent things and precluding harmful ones. In this circumstance or context, ethics has largely been related to the role of ethical guidelines and principles advancing in the process of knowledge pursuing (Aluwihare-Samaranayake, 2012a).

Research ethics (Convery and Cox 2012; Fujii 2012; Aluwihare-Samaranayake 2012b; Resnik 2014; Doody and Noonan 2016; Saunders, Lewis, and Thornhill 2016b; Bracken-Roche et al. 2017; Special 2018) is associated with how to form the research topic and questions, choose appropriate research design, select the research methodology, gather data via proper data collection methods, analyse data gathering and conclude the research findings in an ethical and responsible way. This indicates that it will have to guarantee that participants involved in this study follow both a methodologically reasonable and an ethically defensible way, as mentioned beforehand.

Meanwhile, research ethics is an equilibrium between benefits and risks; furthermore, it is an equilibrium between the impartial selection of study populations and the guaranty of the rights of independent participants (Convery and Cox 2012; Doody and Noonan 2016). Academics are requested to guarantee that participants voluntarily and autonomously agree with participating in the study (Convery & Cox, 2012). Besides, proper and sufficient research ethics is related to acquire the research ethics admission from Research Ethics Boards (REBs); meanwhile, it is crucial to assess the researchers' insisting on principles and doctrines of confidentiality, autonomy, benevolence, respect, justice, and nonmaleficence (Aluwihare-Samaranayake 2012a; Doody and Noonan 2016; Bracken-Roche et al. 2017).

The informed consent procedure that describes the research interprets the rights of the participants and clarifies the hazards and advantages related to the participants in the process of study, ultimately protecting the participants and researchers (Convery & Cox, 2012).

4.8.1 Ethical permission

The written permissions from Yituo Machinery (Pty) Ltd (South Africa), Weifang Huaxia Agricultural Machinery Equipment Ltd, Henan Agricultural Machinery Bureau, Shandong Shuobo Education and Consultation Ltd and Gauteng Department of Agriculture & Rural Development, have been obtained by the researcher in a bid to conduct this study legally and legitimately. Furthermore, ethics approval was also obtained from the University of Pretoria before the researcher started to collect the data.

4.8.2 Confidentiality and privacy

Confidentiality means dealing with the information of the respondents in a classified and secret way (Oshagbemi, 2017). The confidentiality and anonymity of the research participants are protected by means of not leaking out their identity or names in the process of data gathering, analysis and the study findings reporting (Steffen, 2016). Furthermore, privacy and confidentiality of the interview environment are managed carefully during questionnaire distribution and collection, interview process, data analysis and reporting of the study findings (Steffen, 2016).

Meanwhile, Doody and Noonan (2016) indicate that the researcher is accountable for ensuring the confidentiality of participators and data collected. Moreover, confidential or individual information acquired from participants must not be made public or available to anyone else without the permission of participants (Doody & Noonan, 2016). Privacy is an individual or personal right to judge when, how and to what extent individuals share their information with others. Furthermore, privacy is the right of a person to have some control over how personal information is gathered, utilised, and/or divulged.

In this research, the name, contract, job, position, as well as other confidential information of the participant was not requested. Only the age, gender and education degree are asked.

The age, gender and education level of key informants are included in this questionnaire, as the people of different ages may give a distinct opinion on risk reduction of after-sales service, so do gender and education level. By including these (age, gender and education level), it will allow checking if the participants of this study will be biased towards certain groups of people according to their attributes. Therefore, it will provide a limitation of this study in Chapter 8.

4.8.3 Voluntary participation and informed consent

The principle of voluntary participation will be interpreted by the respondents. They are also notified that they have the right to draw back from the research when they feel unhappy or unsatisfied (Oshagbemi, 2017). In this study, participation is voluntary, and the participant can withdraw at any time without penalty. Throughout the survey, the privacy of the participant will be protected, and the participants will remain confidential. The researcher does not wish to analyse data individually. All the data will be transferred to a computer program to analyse the entire group, which means that participants are assured of anonymity.

The principle of the informed consent attached to the questionnaires should be explained to the interviewee or participant definitely or in an adequately clear manner by the researcher or distributor. The purpose and objective of the study should be clearly explained to the participants before permission is secured. Participants are allowed to refuse or accept to be involved in the study as well as withdraw at any time without punishment (Oshagbemi, 2017).

4.9 Ensuring the validity and reliability of results

According to Bolarinwa (2015), one of the most general assignments frequently appearing in social science research is to find out the reliability and validity of measurements. The researchers consistently look forward to understanding whether the measuring tool utilised actually gauges the intended research construct or findings (is it a real or valid measure?) or whether the tools of measurement employed to quantify the research variables can supply stabilising or constant responses (is it reliable or repeatable?) (Bolarinwa, 2015).

Reliability and validity are introduced to make the research results and study findings reliable and valid. Reliability and validity increase transparency and reduce the chances of researcher bias. In the absence of evaluating the validity and reliability of the study, it would be hard to recount the influences of measurement errors with regard to theoretical relationships (Mohajan, 2017). The intention and purpose of setting up research validity and reliability are crucial and significant to guarantee that data gathering is reasonable and replicable and the research results are exact and precise (Mohajan, 2017).

4.9.1 Reliability

Reliability (Drost 2011; Mohamad et al. 2015; Bolarinwa 2015; Heale and Twycross 2015; Noble and Smith 2015; Taherdoost 2016; Saunders, Lewis, and Thornhill 2016b; Mohajan 2017; Biasutti and Frate 2017) refers to the degree to which the results obtained are consistent when the same research methods are employed to measure the same objects repeatedly (Saunders, Lewis, and Thornhill 2016b).

Mohamad et al. (2015) indicate that reliability implies the scores of an experiment or research findings are consistent and stabilising. They indicate further that reliability is much easier to be understood by means of determining the testing methods in terms of conformity and stability. Bolarinwa (2015) shows that reliability refers to the consistency, stability and reliability of test results. Generally, internal consistency is used to test, determine and describe the reliability of the test. The higher the reliability coefficient is, the more consistent, stable and reliable the results of the test are. Moreover, Mohajan (2017) and Heale and Twycross (2015) explain that reliability is the meaning of the stability of findings and is related to the consistency of a measure. In other words, Drost (2011) shows that reliability is the degree to which the research procedure can be replicable – when distinct researchers conduct the same study process or measure the same research or test the same experiments on distinct situations, under different occasions, with supposedly alternative instruments (Taherdoost, 2016). In summary, reliability is consistency, or stability of measurement over a variety of conditions in which basically the same results should be obtained (Drost, 2011).

According to Heale and Twycross (2015), each attribute of reliability being tested is described in Table 4.7.

Table 4.7: Attributes of reliability

Attributes	Description
Stability	It is a measurement of the repeatability of a test. Furthermore, it provides the same results over time whenever it is conducted.
Internal consistency	Internal consistency refers to the homogeneity of all the research questions that make up the test.

Equivalence	The extent to which measurement on two or more forms of a test is consistent.

Straub et al., cited by Taherdoost (2016), indicate that reliability should be equal to or above 0.60 (Taherdoost, 2016) in terms of an exploratory or pilot study. Hinton et al. have recommended four cut-off scores to test reliability, which contains exceptional and superior scores of reliability (0.90 and above), high scores of reliability (0.70-0.90), moderate scores of reliability (0.50-0.70) and low scores of reliability (0.50 and below) (Taherdoost, 2016). Meanwhile, Mohajan (2017) debates that the reliability of the high-stakes setting should be bigger than 0.9. Whereas, for less crucial values, the score of 0.8 or 0.7 may be acceptable. In the general sense, the rule is that the score of reliability bigger than 0.8 is believed as high (Mohajan, 2017). In social science, the acceptable α value (an acceptable level of reliability) is 0.60, which is also practised by other researchers (Mohamad et al., 2015).

4.9.2 Validity

Validity (Drost 2011; Mohamad et al. 2015; Bolarinwa 2015; Heale and Twycross 2015; Noble and Smith 2015; Taherdoost 2016; Saunders, Lewis, and Thornhill 2016b; Mohajan 2017; Biasutti and Frate 2017) is associated with whether the research results are really about what they emerge to be about (Saunders, Lewis, and Thornhill 2016b).

On the other hand, validity refers to that the personal scores of an experiment or test that are significant and permit the researcher to draw high-quality conclusions from the sample population involved in this study (Mohamad et al., 2015). Bolarinwa (2015) highlights that if research or study has a high degree of validity, it indicates that the research results produced from this study almost correspond to real characteristics, conditions, and results in the social or physical world (Mohajan, 2017). These validity tests can be divided into two wide parts, namely, internal and external validities (Bolarinwa 2015; Mohajan 2017).

Internal validity is the extent to which a study establishes a trustworthy causal relationship between the origin and the consequence. At the same time, internal validity is the degree of certainty of the relationship between the dependent variable and the independent variable, as well as the authenticity of the experimental conclusion. The degree of internal validity is related to the uniqueness of the interpretation of the research results. If the research result has one and only one explanation, then the internal validity of the research is high. If the research result has more than one explanation, the internal validity of the research is low. On the other hand, external validity is the validity of employing the conclusions of a scientific study outside the context of that study. External validity refers to the degree of the research results defendable after the research is separated from the research context. In addition, the purpose of each study is to reflect the true relationship between the independent variable and the dependent variable. Any feature that restricts the generality of the results is a threat to external validity. If the research results can be equally applicable to other conditions outside the scope of the specific experiment, the study is considered to have external validity. On the contrary, if the result is only limited in the scope of restrictions, this means it lacks external validity.

In this study, reliability and validity will be done in chapter 7.

4.10 Summary and conclusion

This chapter concentrates on the introduction and explanation of knowledge and information with regard to research philosophy, research approaches, research strategies, research design, research methodology, the ethical issue as well as study validity and reliability. Furthermore, detailed knowledge and information of explanatory research design suitable to the current study and mixed research methodology utilized in this research have been presented. In addition, comprehensive quantitative and qualitative data collection and data analysis have been explained and explored in this section as well. In the following chapter, the detailed sampling choosing process will be demonstrated. And how to collect data will be elaborated explicitly and unambiguously by means of quantitative and qualitative research methods.

Chapter 5: Data collection

5.1 Introduction

In this chapter, the focus is on how to choose the sampling, questionnaire distribution and data collection based on the methods described in chapter 4. The target population is the participants who use, sell or know AM (agricultural machinery) or after-sales service of AM. The methods of sampling employed in this chapter are random, purposive and snowball sampling. The questionnaires are employed to collect the quantitative data. In addition, focus-group interviews were employed to acquire qualitative data. The data collection was conducted in China and South Africa, respectively. More detail will be shown as follows.

5.2 Sampling

In a bid to solve the research problem and answer the research questions, the data need to be collected from a large population, as explained in a previous chapter 4. Nevertheless, it will be impractical and unrealistic for the researcher to either gather or analyse all the data accessible and available in the study because of restrictions of cost, time, expenditure and accessibility.

The sampling technique is a kind of statistical survey method that takes a part of the population of the research object as a sample for investigation and infers the characteristics of the total population based on the part of the actual survey results (Saunders, Lewis, and Thornhill 2016b). Figure 5.1 illustrates that a sample can be chosen from a large population and represent the population in a bid to save time and expenditure as well as to ensure the accessibility of data.

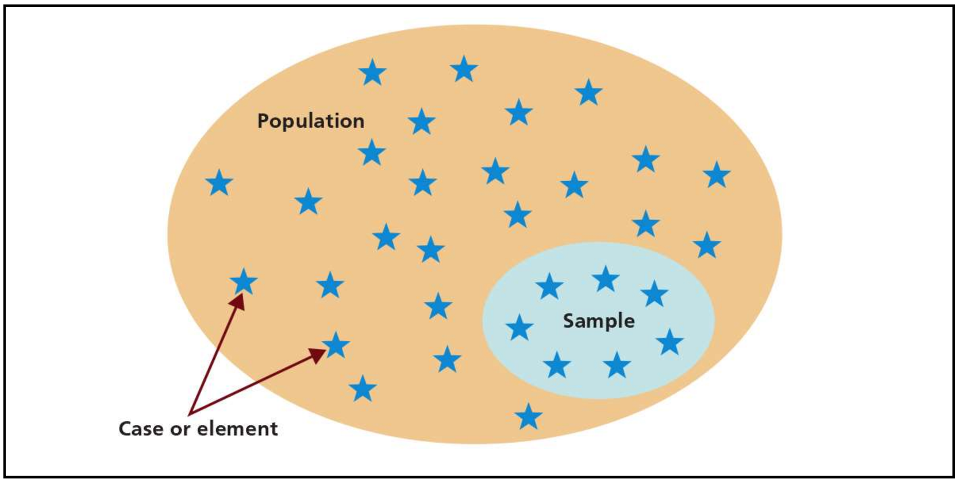

Figure 5.1: Population, sample and individual cases (Saunders, Lewis, and Thornhill 2016b)

5.2.1 Target population

The target population in this study are staff, workers, directors, managers, CEOs, and presidents who work at agricultural machinery enterprises. The government officials, staffs, fellows, the directors who are professionals in agricultural machinery and provide the after-sales service, information and knowledge for agri-machinery users are also involved in this research as participants. In addition, academics, including professors, doctors and researchers whose study is about after-sales service of agricultural machinery or relevant is part of the target population. Meanwhile, small-holder farmers or users who make use of farm machinery in both South Africa and China, as well as other relevant people who know the after-sales service of agricultural machinery, are the interviewees or participants of the target population in the process of quanti- and quali- data collection.

The research participants in focus-group interviews are managers, after-sales service managers, technical directors, CEOs, dealers who sell AM, customers who use AM. In addition, the officials in the department of agriculture who know AM and formulate the policy of AM, economic analysts, as well as financial staff are also involved in this quali-data collection process.

5.2.2 Sampling techniques

According to the method of selecting samples, sampling surveys (Sharma, 2017) can be broken up into two categories or types (probability sampling and non-probability sampling), as shown in Figure 5.2:

• representative or probability sampling;
• judgmental or non-probability sampling.

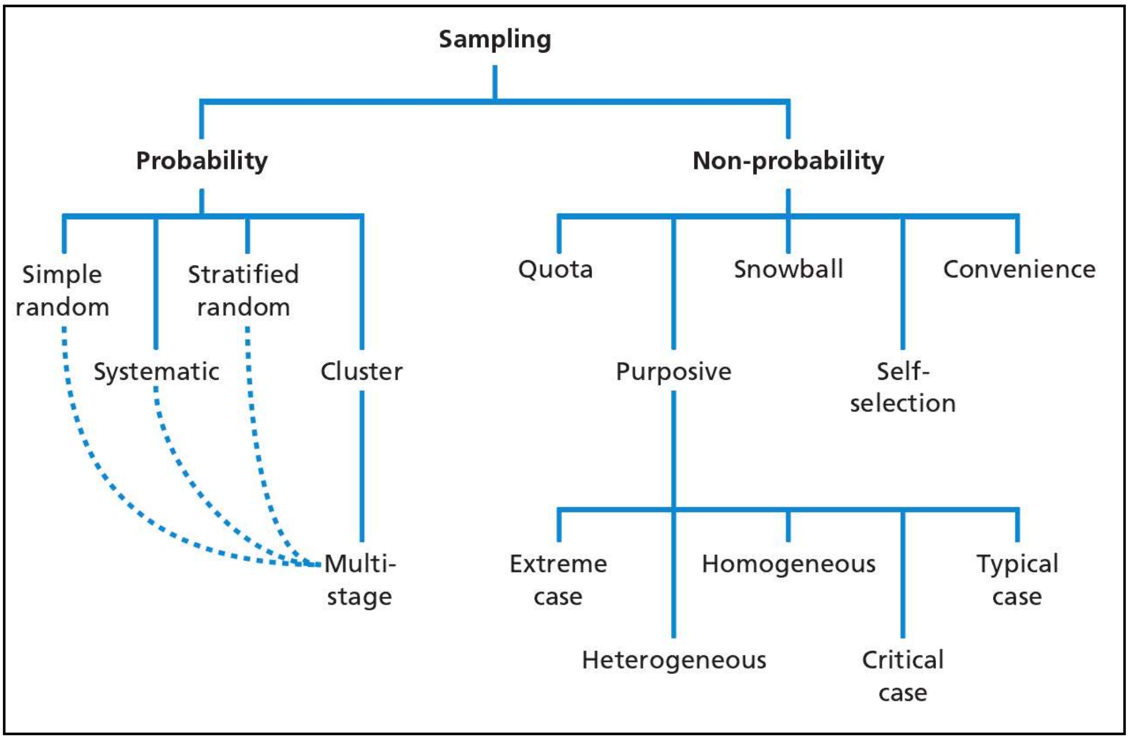

Figure 5.2: Sampling techniques (Saunders, Lewis, and Thornhill 2016b)

5.2.2.1 Simple random sampling and purposive sampling

Simple random sampling (usually also called random sampling) means a sample is drawn from the total population by a method of drawing one by one, and the probability of each individual being drawn is equal each time (Saunders, Lewis, and Thornhill 2016). Purposive sampling enables judgement to choose cases or samples which can be best to meet the study objectives and to answer the research questions (Saunders, Lewis, and Thornhill 2016).

A simple random sample and snowball sampling technique should be employed to determine the quantitative data sampling unit, while purposive sampling and snowball sampling may be used for the qualitative data. Moreover, the sample used in this study is chosen randomly in Shandong province of China at the first stage from the population mentioned above in a bid to collect the data by means of questionnaires followed by the same questionnaires formulated through utilizing the principle of non-probability sampling techniques, such as snowball, in order to acquire more data. In the following focus-group interview, purposive sampling was used to provide the assistance to conduct the interviews following the snowball sampling employed to obtain sufficient qualitative data from the Chinese context.

5.2.2.2 Purposive sampling and snowball

The definition of purposive sampling has been explained in the previous section. Snowball sampling technique is to take a number of people with the required characteristics as the initial survey subjects. Furthermore, it relies on them to provide qualified survey subjects for further data collection. Subsequently, these participants provide the third batch of survey samples and so on. In a nutshell, the sample is like a snowball from small to large (Saunders, Lewis, and Thornhill 2016).

The steps of the snowball technique, therefore, are shown as follows:

1. To identify and communicate one or two samples in the research population.
2. Request these cases to introduce further cases.
3. Repeat the second step.
4. Terminate when either no novel samples are provided or the cases are large enough

A purposive and snowball sampling technique will be employed to determine the quantitative data sampling unit, respectively. Furthermore, purposive sampling and snowball sampling will be used for the qualitative data consecutively. However, the sampling population used in this study is advised purposively in the Henan province of China by the director (who assists the researcher in communicating with the participants and the researcher collected questionnaires by himself) at the Bureau of Agriculture at the first stage from the population mentioned above. It aims to collect the data by means of questionnaires formulated through using the principium of non-probability sampling techniques such as snowball. Moreover, more data will be acquired by means of arranging to conduct the data collection process via introducing the new participants. In the following focus-group interview undertaken in South Africa, purposive sampling was used to ensure the participants who are familiar with us and provide the support and assistance to carry out the interviews. Furthermore, snowball sampling is employed to obtain adequate qualitative data from the South African context by way of introducing new participants to this study.

5.2.3 Sample size

- **The sample size of ensuring the factors that influence the after-sale service of agricultural machinery (the pilot test)**

The samples from both the South African side (24 valid collected questionnaires from 4 groups) and the Chinese side (24 valid collected questionnaires from 4 groups) have been collected mainly from the population alluded to above. The total number of participants was 48. Moreover, the first six participants were identified via the basic random method. Furthermore, the sampling method of snowball and purposive sampling has been employed to collect the remaining questionnaires and to undertake the focus group discussion.

- **The sample size of examining the risk reduction model of the after-sale service of agricultural machinery (quanti-data collection)**

Three hundred and eighty-four questionnaires available have been collected in Shandong province, while another 355 questionnaires were collected in Henan province. Both provinces in China are two of the largest in agricultural machinery manufacturing. It was planned to obtain another 300 questionnaires on the South African side. Due to the effect of the Covid-19, which broke out early in China in December 2019 and lasted a long time in South Africa since March 2020, the researchers cannot obtain the data from questionnaires that were distributed in November 2019 in South Africa. Due to the enduring influence of the novel coronavirus, the online interview technique was used instead of planned questionnaires collection on the South African side.

- **The sample size for conducting the qualitative data collection**

The participants from both the Chinese side (20 valid collected questionnaires from 4 groups) and the South African side (20 valid collected questionnaires from 4 groups) were involved mainly in the research population mentioned above. The total number of participants is 40.

5.3 Research participants

Research participants have also been named as study participants or subject or research object involved in the study, following being given information to be the subject of the research. Furthermore, they voluntarily participate in the study as a research subject after signing the informed consent form to be the participants of the survey or study.

5.3.1 Research participants in a pilot test

Research participants in this study are staff, workers, directors, managers, CEOs as well as presidents who work at agricultural machinery enterprises and small-holder farmers or users of farm machinery in both South Africa and China. By means of focus group interview, 48 valid participants, including the relevant personnel from agricultural machinery enterprises, sales facilities, after-sales centre, repairing shops and households of small-holder farmers who use agricultural machinery in both China and South Africa were involved.

5.3.2 Research participants in the main research process

In the main research process, two processes are included, namely quanti-data gathering process and quali-data collection procedure. The research participants involved in the research processes of quanti-data gathering process and quali-data collection will be shown in the following section.

5.3.2.1 Research participants in quanti-data collection process

Research participants in this study are staff, workers, directors, managers, CEOs, and presidents who work at agricultural machinery enterprises. The government officials, staff, fellows, the directors who are professionals in agricultural machinery and provide the after-sales service, information and knowledge for agri-machinery users are also involved in this research. Academics, including professors, doctors and researchers whose study is about after-sales service of agricultural machinery or relevant are also participants. Small-holder farmers or users of farm machinery in both South Africa and China, as well as other relevant people who know the after-sales service of agricultural machinery, are the interviewees or participants in the process of quanti- and quali- data collection.

5.3.2.2 Research participants in quali-data collection process

The research participants in focus-group interviews are managers, after-sales service managers, technical directors, CEOs, dealers who sell AM and customers who use AM. In addition, the officials in the department of agriculture who know AM and formulate the policy of AM, economic analysts, as well as financial staff are also involved in this quali-data collection process.

5.4 Data collection

Data collection is the procedure of collecting and measuring information in someone's research, which then enables the researcher to answer and address relevant research questions and conclude the result and consequence. The means of data collection consists of secondary data collection, collecting primary data via observation (structured observation and participant observation), questionnaire, observation (structured observation and participant observation), semi-structured interview, in-depth interview as well as a focus group interview. In this study, secondary data collection, questionnaires (quantitative data collection), and focus-group interviews (qualitative data collection) will be employed as the data collection method. These three data collection methods are discussed in detail as follows.

5.4.1 Data gathering to determine the factors that impact the ASS of AM

5.4.1.1 Secondary data collection

Secondary data was relative to the original data, which referred to statistics information or material that had been collected not for ongoing research but for other purposes. Common sources of secondary data in the context of social science included censuses, information collected by government agencies, organizational records, and data originally collected for other research purposes. In contrast, primary data were collected by the investigators who were conducting the research. In addition, compared with original or primary data, secondary data had the advantages of rapid acquisition, low cost and easy access etc.

In addition, secondary data regarding the factors of after-sales service on agriculture machinery has been collected. Through the literature review, factors influencing the after-sales service of agri-machinery are technician, spare part, timing repairing, maintenance, training as well as a customer information system and service centre (please see the information shown in Section 2.4.4), which were important sources for secondary data.

Except for refining these factors from the literature review by means of employing the secondary data, these six factors have been validated via focus group interviews to support finally these the factors that influence after-sales service of AM, as shown in Section 5.3.1.2.

5.4.1.2 Data collection method to determine the factors that impact the ASS of AM in a pilot study

A pilot study or pilot experiment is a small-scale preliminary study carried out before the start of the formal large-scale research plan in a bid to evaluate the feasibility, time, cost, and negative effects etc. However, this is or can be more than a pilot study. On the other hand, data collection methods contain using secondary data, gathering primary data through observation, gathering primary data through semi-structured, in-depth and group interviews as well as gathering preliminary data by means of questionnaires (Saunders, Lewis, and Thornhill 2016a).

Four focus-group discussions are conducted in both China and South Africa, respectively. The group's members from both the South African and Chinese sides include CEOs, sales managers, technicians, staff, as well as farmers or small-holder farmers. The four focus groups in China are named as C1, C2, C3 and C4 (in which C represents the Chinese focus group), comparing them to the groups from South African labeled as SA1, SA2, SA3 and SA4 (in which SA means South African focus group) respectively. Every group is comprised of six people, who are CEOs, sales managers, technicians, staff, as well as farmers.

The data gathering process to determine the factors that influence the ASS of AM is elaborated in the following part. Data collection was completed in a focus group interview. Each group has 6 relevant participants. There were two stages of the same procedure for each group. In the first part, the participants had to accomplish the close-ended questionnaire in a bid to gather the quantitative data. In the second stage, a focus group discussion was employed to collect the qualitative data on other factors that influence the after-sales service of agricultural machinery except for six factors found in the literature review. The deliberations and the objective of the focus group interview were used to complement the information of the quantitative data in a bid to provide more explanation of quantitative data as well as verify the result obtained from it. After the data analysis, the six factors that influence the ASS of AM, have been finally determined, as illustrated in Table 5.1.

Table 5.1: The factors that influence the after-sales service of agricultural machine

Item	The factors that influence the after-sales service of agricultural machine
B-1	Technician
B-2	Spare parts
B-3	Timing repairing
B-4	Maintenance
B-5	Training course
B-6	Farm machinery user information management system

The aim of collecting this data at this stage is to formulate the original conceptual framework. This can be the basis of conducting the main data collection and analysis in a bid to answer the research questions and meet the objectives of this study.

5.4.2 Data collection method employed in the main process

The method of data collection utilized in the main research process is a mixed method of data gathering. This can be divided into two types of data gathering, namely, quanti-data gathering and quali-data collection.

5.4.2.1 Quantitative data collection

The method and instrument of quantitative data collection employed in this study is a survey questionnaire. Furthermore, the questionnaire is one of the general methods to collect data. Each person involved in the questionnaire collection process is asked to answer or reply to the same set of questions that have been ordered in a predetermined way. However, the questionnaire must have two functions; namely, it can convey the questions to the participants and make the participants at ease to answer. Generally speaking, there are two types of questionnaire questions: closed questionnaire and open questionnaire. Furthermore, the questionnaire type employed in this study is a closed questionnaire.

On the other hand, the design of the questionnaire will influence the response rate, the validity and reliability of the data collected. Meanwhile, response rates, reliability (Taherdoost, 2016) and validity (Heale & Twycross, 2015) might be maximized by:

- considerate plan of every question;
- explicit and clear arrangement of the questionnaire;
- clear and unequivocal explanation of the questionnaire's aim;
- pilot testing;
- well planning and conducting the process of the whole questionnaire.

As discussed in a previous section, questionnaires were employed to gather the quanti-data in Shandong province and Henan province. On the one hand, a total of 384 questionnaires was gathered in the Shandong province of China. On the other hand, 355 questionnaires were collected in Henan province. However, another 200 questionnaires were planned to be obtained from the South African side. Due to the effect of the Covid-19, which broke out early in China in December 2019 and lasted a long time in South Africa since March 2020, it was very difficult to get the data via the questionnaires which have been distributed in November 2019 in South Africa. Subsequently, the full data only obtained from China should be employed to do quanti-data analysis.

5.4.2.2 Qualitative data collection

Qualitative data collection methods include structured interviews, semi-structured interviews, full-structured interviews, focus-group interviews, observations, etc. The method and instrument of qualitative data collection employed in this research is focus-group discussion (Oshagbemi, 2017). Furthermore, the focus group interview method, also known as the group discussion method, is undertaken through selecting a group of homogenous participants or stakeholders in the form of a small seminar. Meanwhile, a trained moderator (usually, researcher) talks to a group of participants or involvers in an unstructured and natural way in order to gain or unearth an in-depth understanding of related questions or issues.

In this study, the focus-group interviews were conducted in China and South Africa between September 2020 and January 2021. Four focus-group discussions were undertaken in South Africa. Meanwhile, the other four focus-group discussions were organized in China during that period. However, the four focus-group interviews are named SAFGI 1, SAFGI 2, SAFGI 3 and SAFGI 4 (in which SAFGI means South African focus-group interview), comparing them to the groups from China labeled as CFGI 1, CFGI 2, CFGI 3 and CFGI 4 (in which CFGI represents the Chinese focus-group interview) respectively. On the China side, face-to-face focus-group interviews were carried out in the meeting room of each agri-machinery enterprise. The researcher was responsible for guiding the interview and recording and explaining the inquiries and questions during the discussion. On the South African side, due to the pandemic, the Zoom meetings and Microsoft Teams conferences were employed to conduct the focus-group discussion. The researcher was in charge of recording and explaining the questions and inquiries during this discussion.

5.5 Data analysis method

The main sources of data in this study were identified by means of focus-group interviews and questionnaires, which were referred to as original and primary sources of data. Moreover, a literature review as secondary data was also collected and refined to obtain the factors that influenced the after-sales service of AM from the literature review. On the other hand, data analysis refers to analyze the collected data via the proper and appropriate methods. Furthermore, a number of statistical methods should be employed to aggregate, understand and analyze the data gathered and further seek to expand the function of the data in a bid to exploit the role of the data fully. Data analysis is the process of detailed research and summary of data in order to extract detailed information and form conclusions

Oshagbemi (2017) states that when analysing quantitative and qualitative data using a framework of mixed-methods, researchers should undertake or conduct at least seven stages, which have been adopted in this research. In the following part, Table 5.2

illustrates the operation and process of the seven stages of the data analysis in the upcoming section:

Table 5.2: Seven steps in the data analysis process (Oshagbemi 2017)

Stages in the mixed methods data analysis process	Description of each stage	Application in quantitative data analysis	Application in qualitative data analysis
1. Data Reduction	Reducing the dimensionality of the qualitative and quantitative data	Via descriptive statistics, exploratory factor analysis and cluster analysis	Via exploratory thematic analysis
2. Data Display	Pictorially describing both the qualitative and quantitative data	Using tables and graphs	Using matrices, charts, graphs, networks, lists, rubrics, and Venn diagrams
3. Data Transformation		Quantitative data are converted into narrative data that can be analyzed qualitatively	Qualitative data are converted into numerical codes that can be represented statistically
4. Data Correlation		Quantitative data is correlated with qualitative data	Qualitative data is correlated with quantitative data
5. Data Consolidation	Both qualitative and quantitative data are combined to create new or consolidated variables		
6. Data Comparison	Involves comparing data from both the qualitative and quantitative data sources		
7. Data Integration	This is a final stage, wherein both qualitative and quantitative data are integrated into either a coherent whole or two separate sets of coherent wholes		

5.5.1 Data analysis method employed in a pilot process

In this pilot study, the descriptive analysis evaluated the characteristics of a population in the sample that essentially summarizes the research data (Christensen et al., 2015). According to the viewpoints before-mentioned, this kind of analysis allowed a researcher to make sense of the set of data and to make the key characteristics easily understood. The descriptive result offered the means, standard deviation, percentages and frequencies of primary data. These were completed with the purpose of characterizing the population or the sample.

In this pilot study, the mean (as quanti-data analysis) will be employed to measure the extent of the after-sales service of agricultural machinery. If the value of mean on this factor is more than three (3) of the data collected, it is considered that this factor belongs to the component of the after-sales service of agricultural machinery. This research utilizes the SPSS software as the analysis tool for proper and appropriate analysis in this pilot study. On the other hand, the content analysis (as quali-data analysis in this research) will be employed to analyze the data obtained from questions in a bid to verify the results got from the quanti-data collection.

5.5.2 Data analysis method employed in the main process

The data analysis method employed in the main process will be demonstrated in the following section.

5.5.2.1 Quantitative data collection

In this research, the principal axis factoring (PAF) will be first to categorize the factors that influence the ASS of AM. Furthermore, the standard multiple regression analysis (MRA) is employed to estimate the impact of factors that influence the ASS risk reduction of AM. In addition, the Pearson correlation coefficient is used as a measure of the strength degree of a linear relationship to determine the correlation extent between financial resources, mechanical reduction, customer reduction and ASS risk reduction of AM.

In the context of the relationship of financial resources of the ASS of AM, the analysis method employed in this research is multiple regression analysis (MRA)) (Hossain et al. 2012; Ngo and Puente 2012; Yarnold et al. 2016). The financial resource of after-sales service of agricultural machinery (Qin et al. 2019) is treated as the dependent variable in the data analysis process; on the other hand, the values including saving, overdraft, access to credit, sponsorship as well as grants are regarded as the independent variables. The MRA is employed to predict and unfold the relationship of financial resource of after-sales service of Chinese agricultural machinery in South Africa.

The Pearson correlation will be employed to analyze the relationship between the risk reduction of ASS of AM, the sustainable agri-enterprise and the growth of agri-economy. Schober & Schwarte (2018) explain that the Pearson correlation coefficients are the gauge of a linear relationship between two normally distributed variables. The correlation coefficients are scaled from –1 to +1, which means in the opposite (negative correlation) direction or in the same (positive correlation) direction (Schober & Schwarte, 2018). Moreover, zero indicates that there is no linear association. Subsequently, the basic linear regression will be used to test the relationship between the risk reduction of ASS of AM and the sustainable agri-enterprise and the agri-economic growth in a bid to further determine the influence degree of the risk reduction of ASS of AM on the sustainable agri-enterprise and agri-economic growth. SPSS, as data analysis software, was employed to conduct the process of data analysis.

Finally, the SEM (Structural Equation Model) will be employed to test the novel model, including model goodness of fit and hypothesis testing. For this purpose, AMOS, as data analysis software, will be used to form the ASS of AM risk reduction model and the relevant values and variables.

5.5.2.2 Qualitative data analysis

Thematic content analysis (TCA) is a quali-research method for objective and systematic description and presentation of qualitative data (Anderson, 2007). An appropriate TCA can describe the thematic interview content (or other transcripts and texts) by means of determining the general themes for analysis (Anderson, 2007). In addition, Vaismoradi et al. (2013) interpret that the study results and findings can be put on a continuum revealing the extent to data transformation during the data analysis procedure from depiction to explanation. Meanwhile, the purpose of thematic content analysis is to depict the characteristics of the interview's detail and content by exploring what the participants say and provide in a bid to evaluate, analyse and report patterns (or themes) within data (Vaismoradi et al., 2013). In the process of carrying out a TCA, the researcher's epistemological standpoint and stance are objectivistic or objective. In this study, the thematic content analysis focuses on seven topics. They are the factors that influence the ASS of AM, the financial factors impacting the ASS of AM, the relationship between MRRI (mechanical risk reduction indicator), CRRI (customer risk reduction indicator) and FR (financial resources), the correlation between MRRI, CRRI and AMRR (agricultural machinery risk reduction), the relationship between FR and AMRR, the effect of AMRR on SAE (sustainable agri-machinery enterprise) as well as the influence of SAE on AEG (agricultural economic growth). The focus-group interviews were conducted in South Africa and China, respectively, as described previously. Furthermore, the interview transcripts and details were recorded. The discussion of this influence, as well as the participants' explanation of their viewpoints and opinions, were also divided into four distinct groups in a bid to further interpret and verify the results and findings formulated from quantitative data.

The detailed data analysis, results and discussion for this research will be explained and elaborated on in Chapter 6 and Chapter 7.

5.6 Summary and conclusion

This chapter discussed the sampling, sampling technique, secondary data collection, questionnaire, and focus-group interview employed for the data collection. Fundamental random sampling and snowball techniques have been used to ensure the scope of the study population. Furthermore, purposive sampling and the snowball method have also employed in this study. A structured questionnaire has been employed to collect the data as a quantitative method. The focus group interview approach has been used to collect qualitative data in a bid to consolidate and enhance the result obtained from quantitative data collection and analysis. In the following chapter, the result of the data collected and analysed will be elaborated on thoroughly and comprehensively.

PART 3: DATA RESULTS, ANALYSIS, DISCUSSION AND CONCLUSION

Chapter 6: Results of research

6.1 Introduction

This section provides general characteristics of the data used in the study. The information collected is summarized and described by using figures and tables. It discusses the participants' biographic information comprising age, gender, level of position, educational achievements, educational background, business and sales experience of the sampled Chinese agricultural machinery participants. The result of six factors that influence the after-sales service of agricultural machinery has been illustrated in this section. Furthermore, the outcome of financial resources has been explained in this part, followed by the resulting display of relationship among after-sales service, sustainable AM enterprise, and agricultural economic growth.

The participants involved in this research have been presented and discussed in the previous chapters. The two stages of data collection have been demonstrated in Chapter 5. Moreover, qualitative data has also been shown in this chapter after the quantitative data exhibition. The qualitative result has been obtained from four South African focus group interviews and another four Chinese focus group discussions. The explicit information will be illustrated in section 6.5.

6.2 The research results of a pilot test to generate the factors influencing after-sales service

6.2.1 Demographics of research participants

The demographic profiles of the study participants included six items, which are age, gender, position in the company, degree of education, educational background or major as well as working years. Four groups, in which there are six participants and each one with a total of 48 participants, are involved in this research from both China and South African side. In this study, age and working years have five and four scale variables, respectively. Gender is measured by frequency and percentage, consisted of two categorical variables, which are male and female. Position, degree of education and major are measured in terms of six, five and six nominal categorical variables which are gauged in percentages and frequency.

Table 6.1: Descriptive analysis of the participants

	China			South Africa			
Description		Frequency	Percentage	Description		Frequency	Percentage
Age	20-29	5	20.8	Age	20-29	3	12.5
	30-39	8	33.3		30-39	14	58.3
	40-49	8	33.3		40-49	6	25.0
	≥ 50	3	12.5		≥ 50	1	4.2
	Total	24	100.0		Total	24	100.0
Gender	Male	19	79.2	Gender	Male	17	70.8
	Female	5	20.8		Female	7	29.2
	Total	24	100.0		Total	24	100.0
Position	CEO	1	4.2	Position	CEO	1	4.2
	Manager	4	16.7		Manager	2	8.3
	Director	7	29.2		Director	6	25.0
	Staff	10	41.7		Staff	7	29.2
	Farmer	3	12.5		Farmer	4	16.7
	Total	24	100.0		Others	4	16.7
Degree	High school	12	50.0	Degree	High school	6	25.0
	College	6	25.0		College	9	37.5
	Bachelor	4	16.7		Bachelor	4	16.7
	Postgraduate	1	4.2		Postgraduate	1	4.2
	Others	1	4.2		Others	4	16.7
	Total	24	100.0		Total	24	100.0
Major	Agriculture	7	29.2	Major	Agriculture	7	29.2
	Economic	5	20.8		Economic	3	12.5
	Management	3	12.5		Management	3	12.5
	Engineering	1	4.2		Engineering	0	0
	Mechanical	5	20.8		Mechanical	7	29.2
	Others	3	12.5		Others	4	16.7
	Total	24	100.0		Total	24	100.0
Working Years	0-10	7	29.2	Working Years	0-10	5	20.8
	11-20	8	33.3		11-20	11	45.8
	21-30	8	33.3		21-30	7	29.2
	>30	1	4.2		>30	1	4.2
	Total	24	100.0		Total	24	100.0

This research has illustrated the essential characteristics of participants involved in this study in Table 6.1. According to the results, the majority of participants' age is 30-39 (33.3%) and 40-19 (33.3%) from China's side, comparing with 30-39 (58.3%) from the South African side. The age group of more than 50 years old in South Africa is lower than in China. The results seem to suggest that the people whose age is between 30 and 49 are more involved in his research. Comparing South African and China, more males (79.2%) participate in this research in China, and more females (29.2%) in South Africa join in this topic. It seems that females in South Africa would rather engage in this study than Chinese females. The data obtained from quanti-data analysis shows that staff and directors make up the majority of participants, where staff and directors account for 54.2% in South Africa and 70.9% from China's side. Moreover, from the same outcome, the percentage on the degree of high-school of Chinese interviewees is the highest among these five items, which are 50% compared to the highest degree of South African participants, college (37.5%).

However, from both the South Africa and China perspective, agriculture as the educational background of the participants make up the majority in these six items, where both are 29.2%. The interesting thing is that there is no interviewee whose major is engineering in the South African side involved in this study. From the South African point of view, participants whose majors are agriculture and mechanics or electromechanics (29.2%) are the same. The working years of 11-20 years and 21-30 years account for 66.6% and 75% in China and South Africa, respectively. The working-age of more than 30 years is lower on both sides in this research.

6.2.2 Discussion of six factors that influence the after-sale service of agricultural machinery

The six factors that impact the after-sales service of agricultural machinery have been summarized from the prior researchers' study from the literature review. Those six factors, also as variables in this research, are technician, spare parts, repairing timely, maintenance, training, as well as user information management system and service centre. This research applies the SPSS statistics software as the analysis tool for proper and appropriate analysis in this study. The descriptive output provided the minimum, maximum, means as well as standard deviation.

In this part, the mean will be employed to measure the extent to which the after-sales service of agricultural machinery belongs. If the value of mean on this factor is more than three obtained from the data collected, it means that this factor belongs to the component of the after-sales service of agricultural machinery.

According to the result in Table 6.2, from B1 to B6, all variables' values are above three (3). For all factors that influence the after-sales service of AM, they are in the spectrum of after-sales service of AM. The spare part's value is the highest at 4.6, followed by maintenance (4.1) and training (4.0). The value of the technician is measured as the lowest one by Chinese participants in this study at 3.4 points.

Table 6.2: The result of Chinese participants

	N	Minimum	Maximum	Mean	Std. Deviation
B1-Technician	24	2.00	5.00	3.4167	.77553
B2-Spare parts	24	4.00	5.00	4.5833	.50361
B3-Repair	24	3.00	5.00	3.9167	.77553
B4-Maintenance	24	3.00	5.00	4.0833	.71728
B5-Training	24	2.00	5.00	4.0000	.83406
B6-UD-ISC	24	2.00	5.00	3.9167	.77553
Valid N (listwise)	24				

On the other hand, South African interviewees provide the point of more than three, which means all of six factors belong to the after-sales service of agricultural machinery in the light of the data collected, as displayed in Table 6.3. The highest point is the value of spare parts from the perspective of South African participants, followed by repairing (4.4), maintenance (4.4), technician (4.3) and training (4.2). The user database and information system centre are considered less important than other factors by South African participants in Table 6.3.

Table 6.3: The result of South African participants

	N	Minimum	Maximum	Mean	Std. Deviation
B1-Technician	24	3.00	5.00	4.2917	.80645
B2-Spare parts	24	3.00	5.00	4.4583	.77903
B3-Repair	24	3.00	5.00	4.3750	.76967
B4-Maintenance	24	3.00	5.00	4.4167	.77553
B5-Training	24	3.00	5.00	4.2083	.65801
B6-UD-ISC	24	3.00	5.00	3.8750	.79741
Valid N (listwise)	24				

Note: UD-ISC is an abbreviation of User Database and Information System Centre

An interesting point that should be illustrated is that both South African participants and Chinese ones considered user database and information system centre as less significant than other factors in this study, as shown in Table 6.2 and Table 6.3. The average point obtained from data collected demonstrates all factors summarized from the literature review are in the spectrum of the after-sales service of agricultural machinery.

A T-test is also employed here to examine whether there are significant differences between the means of Chinese and South African participants in terms of their choice on the factors influencing the ASS of AM. The analytical results show that technician ($t=-3.831$, $p<0.001$) and repair ($t=-2.055$, $p<0.05$) have a significant difference between China's group and the South Africa group. South African groups much more largely agree that technician and repair are the crucial factors impacting the ASS of AM than their Chinese counterparts. On the other hand, spare parts ($t=0.660$, $p>0.05$), maintenance ($t=-1.546$, $p>0.05$), training ($t=-0.961$, $p>0.05$) and user information system center ($t=0.184$, $p>0.05$) have no significant difference between those two group. The detailed table display will be illustrated in the appendix.

6.2.3 Other factors that influence the after-sale service of agricultural machinery

In this section, the qualitative data analysis is used to analyze whether there are other factors that belong to the after-sales service of agricultural machinery.

Eight focus-group discussions were conducted in both China and South Africa, respectively. The group's members from both the South African and Chinese sides include CEOs, sales managers, technicians, staff as well as farmers or small-holder farmers. The four focus groups in China are named as C1, C2, C3 and C4 compared to the groups from South African, which were labeled as SA1, SA2, SA3 and SA4, respectively. Every group comprises six people, who are CEOs, sales managers, technicians, staff, as well as farmers.

Table 6.4: The focus-group discussion in China

Group 1 China	**Result of discussion**
C1	1, Sanbao is an important factor that impacts after-sales service in China 2, Downtime caused adverse effects
C2	1, Customer's satisfaction 2, Sanbao policy 3, Re-visiting
C3	1, Maintenance 2, Sanbao in two years for free 3, timely training 4, Technology assistance
C4	1, Tracking service 2, Sanbao Policy

From the focus group discussion of four separate groups in China, C1 all indicated that Sanbao is an important factor for after-sales service; meanwhile, down-time is another factor impacting on after-sales service of AM illustrated in Table 6.4. Three Guarantees (Sanbao) is the abbreviation of "repair, replacement and return" for the distinct kind of retail products (J. Zhu et al., 2019). In this study, Sanbao has been allocated to B2-Repair and B6-UD-ISC. Down-time is assigned to a group of B2-Repair and B6-UD-ISC as well. In Table 6.4, C2 concludes three factors, including customers' satisfaction, Sanbao policy and Re-visiting in which customers' satisfaction is assigned to the spectrum of B6-UD-ISC; Sanbao policy is in the range of B2-Repair and B6-UD-ISC, and Re-visiting belongs to B6-UD-ISC. C3 points out that maintenance, Sanbao in two years for free, timely training and technology assistance are four factors that influenced the after-sales service of AM in this study shown in Table 6.4. Finally, the group of C4 offers a result that tracking service and Sanbao policy are two other factors that affected after-sales service. According to this study, those two are allocated into B6-UD-ISC shown in Table 6.4.

On the other hand, from the South African focus group discussion, SA 1 concludes that after-sales service interviews and unexpected downtime are other factors impacting the after-sales service of AM demonstrated in Table 6.5. In this study, they are arranged into B2-Repair and B6-UD-ISC separately. SA2 agrees that the factors impacting agricultural machinery are technician, timing repair, spare parts, maintenance, training course and user management system and service centre without adding any other factors. Moreover, the group of SA3 indicated that two other factors are users' satisfaction regarding after-sales service of agricultural machinery and timely communication with farmers and users in which we put them into B6-UD-ISC. The last group, SA4, illustrated in Table 6.5, explains that sufficient accessories and availability are very significant for after-sales service. This factor is involved in B3-Spare parts shown in Table 6.5.

Table 6.5: The focus-group discussion in South Africa

Group 2 South Africa	Result of discussion
SA1	1, After-sales service interview 2, Unexpected downtime
SA2	No
SA3	1, Users' satisfaction regarding after-sales service of agricultural machinery 2, timely communication with farmers and users
SA4	Sufficient accessories and availability

In light of the group discussions, six factors getting from the literature review have been confirmed further and explicitly as main factors affecting the after-sales service of farm machinery in this study.

This section focuses on the determination of factors that impact the after-sales service of agricultural equipment by means of a pilot test. This is employed to identify the factors of ASS of AM in order to form and conceptually support the original framework of a conceptual model for this study. In the forthcoming section, the concentration should be on the main results of data gathered and analysed in a bid to answer the research questions and meet the study objectives, as stated in Section 1.4.

6.3 Data description of the main process of data collected

The information collected is summarized and described by using figures and tables in this section. It discusses the participants' biographic information comprising age, gender, level of position, educational achievements, educational background, business and sales experience of the sampled Chinese agricultural machinery involvers. The explicit explanation and illustration will be demonstrated in the following sections.

6.3.1 Age of the respondents in the survey

Table 6.6 shows the participants' age categories. According to the results, the highest number (32.9%) of the participants in this sector are within 30 to 39 years old. The second highest (31.7%) participants have been found to be in the age range of 40 to 49 years of age. On the other hand, the participants at the age of 20 to 29 constitute the third-largest (16.5%) part of the sample. Simultaneously, the participants who are aged in the range of 50 and above are the fourth biggest (16.1%). Those participants whose age is 20 years and below are the lowest in terms of participation. These results appear to agree with other research studies that portray that these sectors are dominated by entrepreneurs at the working-age (Ravshanjon Baxritdinovich Ismoilov et al. 2020; Wang 2020; Lin et al. 2020).

Table 6.6: The age of the sampled agricultural entrepreneurs

Age	Frequency	Percentage	Valid Percentage	Cumulative Percentage
<20	21	2,8	2,8	2,8
20-29	122	16,5	16,5	19,4
30-39	243	32,9	32,9	52,2
40-49	234	31,7	31,7	83,9
>50	119	16,1	16,1	100,0
Total	739	100,0	100,0	

Source: Own survey data (2019-2020)

6.3.2 Gender of the participants

In this study, gender participation is skewed to the male respondents, implying that males dominate these types of entrepreneurship according to the survey data collected in China. According to Table 6.7, the male constitutes the majority by 72% relative to 28 % of the female participants' counterparts. This observation may imply that the industry is not well represented in gender when other conditions for transformation are held constant. Wang et al. (2020) demonstrate that women are risk-averse and associate agricultural involvement with high risk. This observation by Wang et al. (2020) might explain why women's participation in this sample is relatively low.

Table 6.7: Participant of the survey by gender

	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Male	532	72,0	72,0	72,0
Female	207	28,0	28,0	100,0
Total	739	100,0	100,0	

Sources: Own survey data (2019-2020)

6.3.2.1 Distribution of the management and leadership roles by gender

Table 6.8 shows the distribution of the respondents in terms of their management and leadership roles. The illustration of these roles is presented based on their gender. The results show that male respondents dominate in management roles more so than their female counterparts. However, females are fairly represented at the specialist (35.7%), middle management (28.4%), and senior management (27.9%) but largely underrepresented in the CEO's level (8.8%). These results suggest that female respondents may have a lower influence on these businesses' strategic direction. If this observation is correct, the transformation of this sub-sector is a cause for concern. The detailed information is demonstrated in Table 6.8.

Table 6.8: Management roles by gender of the participants

Management roles	Gender	Frequency	Percentage	Valid Percentage	Cumulative Percentage
CEO	Male	73	91,3	91,3	91,3
	Female	7	8,8	8,8	100,0
	Total	80	100,0	100,0	
Senior Manager	Male	124	72,1	72,1	72,1
	Female	48	27,9	27,9	100,0

	Total	172	100,0	100,0	
Manager	Male	101	71,6	71,6	71,6
	Female	40	28,4	28,4	100,0
	Total	141	100,0	100,0	
Specialist	Male	182	64,3	64,3	64,3
	Female	101	35,7	35,7	100,0
	Total	283	100,0	100,0	
Other	Male	52	82,5	82,5	82,5
	Female	11	17,5	17,5	100,0
	Total	63	100,0	100,0	

Source: Own survey data (2019-2020)

6.3.2.2 The distribution of the participants per educational achievements

The educational achievements of the respondents are presented in Table 6.9. The results show that males have more educational achievements relative to their female counterparts, as shown in Table 6.9. On the one hand, the best achievements by the males were in the attainment of the senior certificate (89.3%), compared with the females (37.7%) in the attainment of the degree qualifications. On the other hand, the dominant involvement of male participants is located in the domain of degree (185 out of 739), compared to the female interviewees that dominated in the field of degree (112 out of 739) as well. In a nutshell, the respondents are dominated by participants with a degree qualification (40.2%), followed by a diploma (29.6%) and senior certificates (17.7%) qualification. This educational achievement is sound for this type of entrepreneur (Wang et al., 2020). It is implied that the respondents' educational achievements could shape their entrepreneurial intentions (AL-Qadasi & Gongyi, 2020). In addition, the detailed description and interpretation of educational achievements are displayed in Table 6.9.

Table 6.9: The participants' educational achievements by gender

Educational Achievements	Gender	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Senior certificate	Male	117	89,3	89,3	89,3
	Female	14	10,7	10,7	100,0
	Total	131	100,0	100,0	17.7
Diploma	Male	159	72,6	72,6	72,6
	Female	60	27,4	27,4	100,0
	Total	219	100,0	100,0	29.6
Degree	Male	185	62,3	62,3	62,3
	Female	112	37,7	37,7	100,0
	Total	297	100,0	100,0	40.2
Masters	Male	38	69,1	69,1	69,1
	Female	17	30,9	30,9	100,0
	Total	55	100,0	100,0	7.4
PhD	Male	4	80,0	80,0	80,0
	Female	1	20,0	20,0	100,0
	Total	5	100,0	100,0	0.7
Post-graduate	Male	6	85,7	85,7	85,7
	Female	1	14,3	14,3	100,0
	Total	7	100,0	100,0	0.9
None	Male	23	92,0	92,0	92,0
	Female	2	8,0	8,0	100,0
	Total	25	100,0	100,0	3.4

Source: Own survey data (2019-2020)

6.3.2.3 The distribution of the participants' sectoral experience

The participants' sector experience by gender is presented in Table 6.10. These results show that those male-dominant respondents (34.8%) are in the agricultural sector while the female counterparts are slightly dominated (26.1%) by those with science experience. Notably, there are the fewest participants who are from humanities, as demonstrated in Table 6.10. Those who have experience in management constitute the third biggest in all the genders, as shown in Table 6.10. These results suggest that the participants have good exposure to agricultural, science, and management sciences. Regarding the detailed information, please see Table 6.10.

Table 6.10: The participants' sector experience by gender

Gender	Sector	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Male	Agriculture	185	34,8	34,8	34,8
	Science	67	12,6	12,6	47,4
	Management	64	12,0	12,0	59,4
	Engineering	98	18,4	18,4	77,8
	Humanities	14	2,6	2,6	80,5
	Other	104	19,5	19,5	100,0
	Total	532	100,0	100,0	
Female	Agriculture	52	25,1	25,1	25,1
	Science	54	26,1	26,1	51,2
	Management	26	12,6	12,6	63,8
	Engineering	23	11,1	11,1	74,9
	Humanities	19	9,2	9,2	84,1
	Other	33	15,9	15,9	100,0
	Total	207	100,0	100,0	

Source: Own survey data (2019-2020)

6.3.2.4 The distribution of the participants' enterprise experience

The experience of business and sales is depicted in Table 6.11. These results show that males have more (M = 3.55, SD = 1.92) business and sales experience (M = 2.85, SD = 1.82) compared to the female counterparts (M = 2.99, SD = 1.72 and M = 2.28, SD = 1.53 respectively). These results suggest that females may need capacity building to bolster their interest in this type of enterprise.

Table 6.11: The participants' enterprise experience by gender

Gender	Experience	N	Mean	Std. Deviation
Male	Business	532	3,5526	1,91610
	Sales	532	2,8534	1,81776
Female	Business	207	2,9952	1,71373
	Sales	207	2,2754	1,53488

Sources: Own survey data (2019-2020)

6.4 The result of impact factors on the after-sales service of agricultural machinery

The Likert Scale used in this research is gauged from one to seven, namely one is the minimal influence, and seven is the maximal effect. The biggest mean of value is timely repair 5.22, followed by spare parts (5.06), as shown in Table 6.12. The UIS and training have the lowest value of the mean, which are 4.57 and 4.68, respectively. The standard deviation of expert and UIS (User Information System) are 1.95 and 1.92 separately, as illustrated in Table 6.7.

Table 6.12: Factors that influence the after-sales service of agricultural machinery

	N	Minimum	Maximum	Mean	Std. Deviation
Experts_B1	739	1.0	7.0	4.867	1.9530
S_Parts_B2	739	1.0	7.0	5.066	1.8434
T_Repair_B3	739	1.0	7.0	5.222	1.8499
Maintance_B4	739	1.0	7.0	4.892	1.8166
Training_B5	739	1.0	7.0	4.682	1.8273
UIS_B6	739	1.0	7.0	4.567	1.9245
Valid N (listwise)	739				

Note: S_Parts = Spare Parts, T_Repair = Timely Repair, and UIS = User Information System
Sources: Own survey data (2019-2020)

The Likert Scale used in this study is measured from one to seven which means from no influence (1) to be highly influential (7). In Table 6.13, the highest value of expert's impact on the after-sales service risk reduction of agricultural machinery is 26.9%, followed by 19.8% (Variable 6) and 17.2% (Variable 5). The percentage of item two and item one is the lowest one, namely 7.0% and 8.8 %, respectively.

Table 6.13: The degree of expert influencing the after-sales service risk of agricultural machinery

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	65	8.8	8.8	8.8
	2	52	7.0	7.0	15.8
	3	76	10.3	10.3	26.1
	4	74	10.0	10.0	36.1
	5	127	17.2	17.2	53.3
	6	146	19.8	19.8	73.1

	7	199	26.9	26.9	100.0
	Total	739	100.0	100.0	

Sources: Own survey data (2019-2020)

In Table 6.14, the highest value of spare parts' impact on the after-sales service risk reduction of agricultural machinery is 29.6% (Variable 7), followed by 19.5% (Variable 6) and 18.5% (Variable 5) separately. The participants involved in item one and item two have the lowest percentage, which are 6.1% and 6.8%, respectively.

Table 6.14: The degree of spare parts influencing the after-sales service risk of agricultural machinery

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	45	6.1	6.1	6.1
	2	50	6.8	6.8	12.9
	3	59	8.0	8.0	20.8
	4	85	11.5	11.5	32.3
	5	137	18.5	18.5	50.9
	6	144	19.5	19.5	70.4
	7	219	29.6	29.6	100.0
	Total	739	100.0	100.0	

Sources: Own survey data (2019-2020)

From Table 6.15, the highest proportion of timely repair's impact on the after-sales service risk reduction of agricultural machinery is 36.4%, followed by Variable 6 (16.9%), Variable 5 (14.1%) and Variable 4 (14.9%), respectively. The percentage of item two is the lowest one, namely 4.7%.

Table 6.15: The degree of timely repair influencing the after-sales service risk of agricultural machinery

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	46	6.2	6.2	6.2
	2	35	4.7	4.7	11.0
	3	50	6.8	6.8	17.7
	4	110	14.9	14.9	32.6
	5	104	14.1	14.1	46.7

	6	125	16.9	16.9	63.6
	7	269	36.4	36.4	100.0
	Total	739	100.0	100.0	

Sources: Own survey data (2019-2020)

In Table 6.16, the highest value of maintenance's impact on the after-sales service risk reduction of agricultural machinery is 24.6%, followed by 20.0% (Variable 5) and 18.4% (Variable 6) separately. The participants involved in Variable 2 and Variable 1 obtain the lowest percentage, which is 5.8% and 6.8%, respectively.

Table 6.16: The degree of maintenance influencing the after-sales service risk of agricultural machinery

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	50	6.8	6.8	6.8
	2	43	5.8	5.8	12.6
	3	71	9.6	9.6	22.2
	4	109	14.7	14.7	36.9
	5	148	20.0	20.0	57.0
	6	136	18.4	18.4	75.4
	7	182	24.6	24.6	100.0
	Total	739	100.0	100.0	

Sources: Own survey data (2019-2020)

Table 6.17 shows that the highest proportion of training that impacts the after-sales service risk reduction of agricultural machinery is 20.1% and 20.4%, followed by Variable 4 (16.2%) and Variable 6 (16.2%), respectively. The percentage of Variable 2 is the lowest one, which is 6.4%.

Table 6.17: The degree of training influencing the after-sales service risk of agricultural machinery

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	56	7.6	7.6	7.6
	2	47	6.4	6.4	13.9
	3	90	12.2	12.2	26.1
	4	120	16.2	16.2	42.4

	5	151	20.4	20.4	62.8
	6	120	16.2	16.2	79.0
	7	155	21.0	21.0	100.0
	Total	739	100.0	100.0	

Sources: Own survey data (2019-2020)

Table 6.18 shows the highest values of the user information system that impact the after-sales service risk reduction of agricultural machinery are 20.7% and 20.3%, followed by 15.8% (Variable 6) and 13.8% (Variable 4) separately. The participants involved in Variable 2 and Variable 1 get the lowest percentage equivalently, which is 9.3%.

Table 6.18: The degree of user information system influencing the after-sales service risk of agricultural machinery

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	69	9.3	9.3	9.3
	2	69	9.3	9.3	18.7
	3	79	10.7	10.7	29.4
	4	102	13.8	13.8	43.2
	5	150	20.3	20.3	63.5
	6	117	15.8	15.8	79.3
	7	153	20.7	20.7	100.0
	Total	739	100.0	100.0	

Sources: Own survey data (2019-2020)

The Likert Scale used in this research is gauged from one to seven, namely one is the minimal influence, and seven is the maximal effect. This section aims to elaborate on the mean and standard deviation of MRRI (mechanical risk reduction indicator) and CRRI (customer risk reduction indicator) that affect the risk reduction of after-sales service agricultural machinery. Apparently, the mean of MRRI (4.97) is higher than CRRI (4.54), as shown in Table 6.19, which implies that MRRI has a more significant influence on risk reduction of ASS of AM than CRRI.

Table 6.19: The mean and standard deviation of MRRI and CRRI influencing the after-sales service risk of agricultural machinery

	N	Minimum	Maximum	Mean	Std. Deviation
MRRI_B7	739	1.0	7.0	4.972	1.8677

CRRI_B8	739	1.0	7.0	4.541	1.8411
Valid N (listwise)	739				

Note: MRRI = Mechanical Risk Reduction Indicator and CRRI = Customer Risk Reduction Indicator
Sources: Own survey data (2019-2020)

As illustrated in Table 6.20, the highest value of MRRI that impacts the after-sales service risk reduction of agricultural machinery is 26.9%, followed by 21.0% (Variable 6), 16.6% (Variable 5) and 14.2% (Variable 4) separately. Variable 1 (7.8%), Variable 2 (5.3%) and Variable 3 (8.1%) have a similar rating. However, the participants involved in Variable 2 have the lowest percentage, which is 5.3%.

Table 6.20: Percentage of MRRI influencing the after-sales service risk of agricultural machinery

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	58	7.8	7.8	7.8
	2	39	5.3	5.3	13.1
	3	60	8.1	8.1	21.2
	4	105	14.2	14.2	35.5
	5	123	16.6	16.6	52.1
	6	155	21.0	21.0	73.1
	7	199	26.9	26.9	100.0
	Total	739	100.0	100.0	

Note: MRRI = Mechanical Risk Reduction Indicator
Sources: Own survey data (2019-2020)

From Table 6.21, the highest value of CRRI that impacts on the after-sales service risk reduction of agricultural machinery is 23.3%, followed by 17.2% (Variable 4), 16.5% (Variable 6) and 16.9% (Variable 7) separately. Variable 1 (9.9%), Variable 2 (7.0%) and Variable 3 (9.2%) have a similar rating. However, the participants involved in Variable 2 has the lowest percentage, which is 7.0%.

Table 6.21: Percentage of CRRI influencing the after-sales service risk of agricultural machinery

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	73	9.9	9.9	9.9
	2	52	7.0	7.0	16.9

3	68	9.2	9.2	26.1
4	127	17.2	17.2	43.3
5	172	23.3	23.3	66.6
6	122	16.5	16.5	83.1
7	125	16.9	16.9	100.0
Total	739	100.0	100.0	

Note: CRRI = Customer Risk Reduction Indicator
Sources: Own survey data (2019-2020)

6.5 The result of financial resources

The Likert Scale used in this research is gauged from one to seven, namely from zero influence to the maximal effect. The highest values of the mean financial resource that impact the after-sales service risk of agricultural machinery are grants (4.90) and saving (4.86), respectively, as shown in Table 6.22. ATC (Access to Credit) (4.08), overdraft (4.16) and sponsorship (4.17) are the lower values of mean, which influence the after-sales service risk of agricultural machinery. From Table 6.22, it is not difficult to find out that the standard deviation of grant (1.88) and saving (1.87) are relatively large. Furthermore, the standard deviation of ATC (1.79) and sponsorship (1.79) is comparatively lower.

Table 6.22: The mean and standard deviation of financial resources influencing the after-sales service risk of agricultural machinery

	N	Minimum	Maximum	Mean	Std. Deviation
Saving_C1	739	1.0	7.0	4.866	1.8798
Overdraft_C2	739	1.0	7.0	4.168	1.8247
ATC_C3	739	1.0	7.0	4.088	1.7925
Sponsorship_C4	739	1.0	7.0	4.179	1.7982
Grant_C5	739	1.0	7.0	4.903	1.8845
Valid N (listwise)	739				

Note: ATC = Access to Credit
Sources: Own survey data (2019-2020)

The Likert Scale used in this study is measured from one to seven which means from no influence (1) to be highly influential (7). Table 6.23 shows the highest value of saving that impacts on the after-sales service risk reduction of agricultural machinery is 25.2%, followed by 20.0% (Variable 6) and 17.1% (Variable 5) separately. It means 25.2% of participants extraordinarily agree that saving has an extremely large influence on the after-sales service risk reduction of agricultural machinery. Variable 2 (6.4%) and Variable

1 (7.6%) have the lowest rating, as shown in Table 6.23, which means 6.4% and 7.6% of participants consider that saving has the least impact on ASS of AM.

Table 6.23: The degree of saving influencing the after-sales service risk of agricultural machinery

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	56	7.6	7.6	7.6
	2	47	6.4	6.4	13.9
	3	78	10.6	10.6	24.5
	4	98	13.3	13.3	37.8
	5	126	17.1	17.1	54.8
	6	148	20.0	20.0	74.8
	7	186	25.2	25.2	100.0
	Total	739	100.0	100.0	

Sources: Own survey data (2019-2020)

Table 6.24 illustrates the highest value of overdraft that impacts on the after-sales service risk reduction of agricultural machinery are 21.0% (Variable 5), followed by 18.0% (Variable 4) and 14.7% (Variable 6) separately. It means 21.0% of participants consent to a moderate extent that overdraft has a little bit higher than medium-influence on the after-sales service risk reduction of agricultural machinery. The other categories, including Variable 2 (10.1%), Variable 1 (11.1%) as well as Variable 7 (11.2%) have a similar rating, as shown in Table 6.24, which means 10.1% and 11.1% of participants think overdraft has the least impacts on ASS of AM while 11.2% of participants think overdraft extremely largely influences it.

Table 6.24: The degree of overdraft influencing the after-sales service risk of agricultural machinery

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	82	11.1	11.1	11.1
	2	75	10.1	10.1	21.2
	3	102	13.8	13.8	35.0
	4	133	18.0	18.0	53.0
	5	155	21.0	21.0	74.0
	6	109	14.7	14.7	88.8
	7	83	11.2	11.2	100.0
	Total	739	100.0	100.0	

Sources: Own survey data (2019-2020)

Table 6.25 displays the highest value of ATC (Access to Credit) that impacts on the after-sales service risk reduction of agricultural machinery is 20.7% (Variable 5), followed by 19.8% (Variable 4) and 15.8% (Variable 3) separately. It means 20.7% of participants concur to a moderate extent that ATC has a little bit higher impact than medium-influence on the after-sales service risk reduction of agricultural machinery. The other categories, including Variable 2 (10.1%), Variable 1 (10.8%), Variable 6 (11.5%) as well as Variable 7 (11.2%) have a similar rating, as shown in Table 6.25. This means 10.1% and 10.8% of participants approve ATC has the least impact on the ASS of AM, while 11.5% and 11.2% of participants consider that ATC has a large influence.

Table 6.25: The degree of ATC influencing the after-sales service risk of agricultural machinery

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	80	10.8	10.8	10.8
	2	75	10.1	10.1	21.0
	3	117	15.8	15.8	36.8
	4	146	19.8	19.8	56.6
	5	153	20.7	20.7	77.3
	6	85	11.5	11.5	88.8
	7	83	11.2	11.2	100.0
	Total	739	100.0	100.0	

Note: ATC = Access to Credit
Sources: Own survey data (2019-2020)

Table 6.26 demonstrates the highest value of sponsorship that impacts on the after-sales service risk reduction of agricultural machinery are 21.2% (Variable 5), followed by 18.8% (Variable 4) and 16.2% (Variable 3) separately. It means 21.2% of participants approve to the moderate extent that sponsorship has a little bit higher effect than medium-influence on the after-sales service risk reduction of agricultural machinery. The other variables, including Variable 1 (10.3%), Variable 6 (12.4%), as well as Variable 7 (12.3%) have a similar rating, as shown in Table 6.26. This means 10.3% and 12.4% of participants consent that sponsorship has the least impact on the ASS of AM, while 12.4% of participants think sponsorship largely influences it. Meanwhile, 12.3% (Variable 7) of participants think sponsorship one-hundred percent influence the ASS of AM.

Table 6.26: The degree of sponsorship influencing the after-sales service risk of agricultural machinery

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	76	10.3	10.3	10.3
	2	66	8.9	8.9	19.2
	3	120	16.2	16.2	35.5
	4	139	18.8	18.8	54.3
	5	155	21.0	21.0	75.2
	6	92	12.4	12.4	87.7
	7	91	12.3	12.3	100.0
	Total	739	100.0	100.0	

Sources: Own survey data (2019-2020)

Table 6.27 shows the highest value of saving that impacts on the after-sales service risk reduction of agricultural machinery is 28.0%, followed by 17.9% (Variable 5), 16.2% (Variable 6) and 14.9% (Variable 4), respectively. It means 28.0% of participants extraordinarily agree that saving has an extremely large influence on the after-sales service risk reduction of agricultural machinery. Variable 2 (6.2%) and Variable 1 (7.4%) have the lowest rating, as shown in Table 6.27. This means 6.2% and 7.4% of participants approve that saving has the least impact on the ASS of AM.

Table 6.27: The degree of grant influencing the after-sales service risk of agricultural machinery

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	55	7.4	7.4	7.4
	2	46	6.2	6.2	13.7
	3	69	9.3	9.3	23.0
	4	110	14.9	14.9	37.9
	5	132	17.9	17.9	55.8
	6	120	16.2	16.2	72.0
	7	207	28.0	28.0	100.0
	Total	739	100.0	100.0	

Sources: Own survey data (2019-2020)

The Likert Scale used in this research is gauged from one to seven (namely, from the minimal influence to the maximal effect). This section aims to elaborate on the mean and standard deviation of FR (financial resources) that affect the risk reduction of after-sales service agricultural machinery. Apparently, the mean of FR (4.48) is higher than the average (3.5), as shown in Table 6.28, which implies that FR has a more significant influence on the risk reduction of ASS of AM.

Table 6.28: The mean and standard deviation of financial resources influencing the after-sales service risk of agricultural machinery

	N	Minimum	Maximum	Mean	Std. Deviation
FR_C6	739	1.0	7.0	4.484	1.8750
Valid N (listwise)	739				

Note: FR = Financial Resource
Sources: Own survey data (2019-2020)

The Likert Scale used in this study is measured from one to seven which means from no influence (1) to be highly influential (7). Table 6.29 illustrates the highest value of financial resources that affect the after-sales service risk reduction of agricultural machinery is 21.4% (Variable 5), followed by 19.2% (Variable 7) and 17.3% (Variable 4) separately. It means 21.4% of participants agree to the moderate extent that financial resources have a little bit higher than medium-influence on the after-sales service risk reduction of agricultural machinery. Variable 2 (8.7%) and Variable 1 (9.2%) have the lowest rating, as shown in Table 6.29. This means 8.7% and 9.2% of participants agree that financial resources have the least impact on the ASS of AM.

Table 6.29: The degree of financial resource influencing the after-sales service risk of agricultural machinery

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	68	9.2	9.2	9.2
	2	64	8.7	8.7	17.9
	3	84	11.4	11.4	29.2
	4	128	17.3	17.3	46.5
	5	158	21.4	21.4	67.9
	6	95	12.9	12.9	80.8
	7	142	19.2	19.2	100.0
	Total	739	100.0	100.0	

Sources: Own survey data (2019-2020)

6.6 The result of the relationship between agricultural machinery risk reduction, sustainable agri-enterprise and agri-economic growth

The Likert Scale used in this research is gauged from one (no influence) to seven (highly influential). The means of AMRR_ D1 (agricultural machinery risk reduction) and AMRR_SAE_D2 (agricultural machinery risk reduction and the sustainable agricultural enterprise) are almost consistent, as shown in Table 6.30. The mean of the relationship between AMRR (agricultural machinery risk reduction) and AEG (agricultural economic growth) is 4.63, which is a little bit higher than the mean of the relationship between SAE (sustainable agricultural enterprise) and AEG (agricultural economic growth).

On the other hand, the standard deviation of AMRR_AEG_D3 (1.89), as well as SAE_AEG_D4 (1.89), is higher than it of AMRR (1.839) and AMRR_SAE_D2 (1.835). The smaller standard deviation of AMRR and AMRR_SAE_D2 means the there is less difference between the value and the mean. On the other hand, it implies that the fluctuation of sample data of AMRR & AEG and SAE & AEG is larger than it of AMRR and SAE, as illustrated in Table 6.30.

Table 6.30: The relationship between AMRR, SAR and AEG

	N	Minimum	Maximum	Mean	Std. Deviation
AMRR_D1	739	1.0	7.0	4.997	1.8391
AMRR_SAE_D2	739	1.0	7.0	4.993	1.8350
AMRR_AEG_D3	739	1.0	7.0	4.631	1.8943
SAE_AEG_D4	739	1.0	7.0	4.610	1.8970
Valid N (listwise)	739				

Note: AMRR = Agricultural Machinery Risk Reduction, SAE = Sustainable Agricultural Enterprise, and AEG = Agricultural Economic Growth
Sources: Own survey data (2019-2020)

Table 6.31 illustrates the highest value of AMRR (agricultural machinery risk reduction) that affects the after-sales service of agricultural machinery is 28.7% (Variable 7), followed by 18.8% (Variable 6), 15.8% (Variable 5) and 14.7% (Variable 4) separately. It means 28.7% of participants approve to an extremely large extent that agricultural machinery risk reduction has the largest influence on the after-sales service of agricultural machinery. Variable 2 (5.4%) and Variable 1 (6.2%) have the lowest rating, as shown in Table 6.31, which means 5.4% and 6.2% of participants indicate that AMRR has the least impact on the ASS of AM.

Table 6.31: The relationship between AMRR and AMASS

	Frequency	Percentage	Valid Percentage	Cumulative Percentage

Valid	1	46	6.2	6.2	6.2
	2	40	5.4	5.4	11.6
	3	76	10.3	10.3	21.9
	4	109	14.7	14.7	36.7
	5	117	15.8	15.8	52.5
	6	139	18.8	18.8	71.3
	7	212	28.7	28.7	100.0
	Total	739	100.0	100.0	

Note: AMRR = Agricultural Machinery Risk Reduction and AMASS= Agricultural Machinery's After-sales Service
Sources: Own survey data (2019-2020)

Table 6.32 displays the highest value of AMRR (agricultural machinery risk reduction) that affect SAE (sustainable agricultural enterprise) is 30.7% (Variable 7), followed by 17.9% (Variable 5), 15.8% (Variable 4) and 14.1% (Variable 6) separately. This means 30.7% of participants assent to an extremely large extent that agricultural machinery risk reduction has the largest influence on the sustainable agricultural enterprise. Variable 1 (5.4%) has the lowest rating, as shown in Table 6.32. This means 5.4% of participants indicate that AMRR has the least impact on SAE.

Table 6.32: The relationship between AMRR and SAE

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	40	5.4	5.4	5.4
	2	48	6.5	6.5	11.9
	3	71	9.6	9.6	21.5
	4	117	15.8	15.8	37.3
	5	132	17.9	17.9	55.2
	6	104	14.1	14.1	69.3
	7	227	30.7	30.7	100.0
	Total	739	100.0	100.0	

Note: AMRR = Agricultural Machinery Risk Reduction and SAE = Sustainable Agricultural Enterprise
Sources: Own survey data (2019-2020)

Table 6.33 illustrates the highest values of SAE (sustainable agricultural enterprise) that affects AEG (agricultural economic growth) are 20.0% (Variable 7) and 19.9% (Variable 6), followed by 17.5% (Variable 6) and 16.1% (Variable 4) separately. It means 20.0% and 19.9% of participants approve to an extremely large extent that sustainable agricultural enterprise has the largest influence on agricultural economic growth. Variable 3 (8.3%) has the lowest rating, as shown in Table 6.33, which means 8.3% of participants indicate that SAE has relatively lower impacts on AEG.

Table 6.33: The relationship between SAE and AEG

		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	1	67	9.1	9.1	9.1
	2	68	9.2	9.2	18.3
	3	61	8.3	8.3	26.5
	4	119	16.1	16.1	42.6
	5	147	19.9	19.9	62.5
	6	129	17.5	17.5	80.0
	7	148	20.0	20.0	100.0
	Total	739	100.0	100.0	

Note: SAE = Sustainable Agricultural Enterprise and AEG = Agricultural Economic Growth
Sources: Own survey data (2019-2020)

In the previous section, the results of quantitative data were demonstrated. Furthermore, the results and outcomes of the focus-group interviews will be explained and illustrated comprehensively in the following section.

6.7 The result of qualitative data

The results of the focus-group interviews are illustrated and explained in more detail in the following part. The original questions of focus-group interviews are extracted from the quanti-data (the questionnaire data from China's side) results are demonstrated in appendix 7.

6.7.1 The results of qualitative data from South Africa

The results of qualitative data of South Africa focus-group interviews analysed are displayed comprehensively as follows:

6.7.1.1 Result of South African focus-group one

The information of participants in the South African focus-group one, as well as the result of data analysed, will be shown and explained explicitly and demonstratively as follows:

6.7.1.1.1 The information of participants

The company of agricultural machinery where five participants take part in the focus-group interview has more than ten thousand employees. The total sales of AM are more than 1 billion CNY ($ 150 million) (please see Appendix 7 in terms of company classification standard). This enterprise is classified as a mega-company. It has seven plants or sub-enterprises in Africa. The subordinate company in South Africa is located in the Eastern Cape province. The five participants in this sub-enterprise are from the department of after-sale service, technology service as well as management. All participants have been there for more than one year. They are well informed regarding the ASS of AM, marketing information, local users, farmers, customers etc. It took around one hour to complete the interview. The software of Tencent Voov Meeting was employed to conduct the focus-group interview due to the influence of the Covid-19 pandemic lasting for more than a year in both China and South Africa. The researcher was responsible for recording and explanation regarding the inquires and questions during the interview.

6.7.1.1.2 Result of South African focus-group one

- The answer to question one

The participants involved in this focus-group interview approximately agree with the result obtained from the 739 questionnaires analysis. Furthermore, all factors that influenced the after-sales service of agricultural machinery had a positive effect on the risk reduction of agricultural machinery. However, the quanti-data results showed that expert/technician (B1), timely repair (B2), spare parts (B3) and maintenance (B4) had considerable influence, followed by training course (B5) and user information system (B6) by means of PAF (principal axis factoring) analysis.

In the context of South Africa, they explain that the expert/technician (B1), timely repair (B2) and spare parts (B3) are critical and significant to ASS, as the Chinese spare parts are different from the spare parts overseas. It means the delivery timeliness of spare parts is extraordinarily significant to users in South Africa. Meanwhile, with the assistance of spare parts delivering timely, the technician can repair the machine without delay so as to satisfy the customer.

Some participants argue that the relatively large influence factors of ASS are maintenance (B4) and training courses (B5). The least effective factor of ASS should be the user system and centre (B6). There are insufficient Chinese user-service centres in South Africa, leading to the least influence on ASS compared with other factors.

Others debate that maintenance has less impact on ASS compared to the automobile industry. The principal and fundamental factors are repairs and spare parts in South Africa. Due to the harsh and grim agrarian environment, it is easy for AM to be broken or in downtime, so it is thoroughly significant to repair without delay and deliver the spare part promptly.

- The answer to question two

According to quantitative results from the surveys, the factors that impact the financial resource, including saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on the after-sales service of agricultural machinery. All participants fundamentally recognize the result, as mentioned above. The factor of grant (C5) affects extremely largely, followed by the sponsorship (C4) and access to credit (C3). Saving (C1) and overdraft (C2) have the least influence. The participants principally agree with the conclusion.

If the farmers in South Africa can get the grant from the government, the grant will be a major influential factor to ASS. Meanwhile, they debate that grant, sponsorship and profit are more important than other factors.

- The answer to question three

They agree that the FR (saving, overdraft, access to credit, sponsor and grant) impact greatly on MRRI (0.51) (technician, timely repair and spare parts) and CRRI (0.48) (maintenance, training course and user system and centre). On the other hand, the magnitude effect of FR on MRRI (0.51) and CRRI (0.48) is nearly equivalently important.

However, some participants explained that if the AM companies and dealers get more finance, they will put a little more funds on the MRRI than CRRI. The cost of technician and spare parts is more than maintenance (B4), training course (B5) and user system and centre (B6) from the perspective of AM companies and dealers. Due to the labour cost, the distance of sparse repair centre and repairing, the AM companies and dealers should pay a little bit more attention to MRRI.

- The answer to question four

All participants fully concur with the result analysed from the quantitative data. MRRI (0.43) influences the AMRR much more than CRRI (0.11).

If the AM company or dealer can provide sufficient and timely spare parts, professional and skilled technicians can timely provide the repair service. In that case, the customer will be satisfied with the product and after-sales service, which can help them to win word-of-mouth. Without those items, there is little meaning to talk about the after-sales service like the 4S automobile shop in China. Comparatively speaking, CRRI has less influence than MRRI from the perspectives of AM companies, the dealers as well as users.

- The answer to question five

They basically agree with the result of the quantitative data analysis for this question. The more financial resources the AM company acquires, the less risk of after-sales service. However, they argue that the magnitude or degree of influence should be a little bit higher than the results obtained above.

- The answer to question six

All participants consider that the results summarised by participants for this question is absolutely and exceedingly true. From the perspective of dealers in South Africa, the ASS of AM is very significant in terms of long-term development. With the development of science and technology in modern society, there is not much more difference in terms of technology and quality to manufacture the tractors of 50 and 180 horsepower in China nowadays in the context of big AM enterprises. The only reason that can sustain the long-standing survival of AM enterprise is therefore after-sales service. Except for the one-off business, all of the focus for AM enterprise should be on ASS.

Because the competition is so fierce today, the after-sales service is apparently extraordinarily significant for the enterprise's long-standing survival and development. In conclusion, the result obtained from the quantitative data analysis is very critical for AM enterprises both in South Africa and China.

- The answer to question seven

This result of question seven obtained from the surveys is fully approved by participants. The agricultural machinery is part of the value chain, which can facilitate the development of up- and downstream companies, such as the engine, spare part, type, iron, steel and engine oil etc. The AM enterprises can supply advanced and high-quality machines for farmers who can use them to promote their agri-productivity, which is beneficial for the growth of the agricultural economy.

As agriculture is becoming more and more mechanized, the demand for farm equipment, including tractors, seeders as well as harvesting machines, becomes bigger and bigger. However, a sustainable agricultural machinery company can meet this gap. Furthermore, it can improve the evolution and growth of agri-economy through advanced machines, which can further enhance agricultural productivity.

6.7.1.2 Result of South African focus-group two

The information of participants in South African focus-group two, as well as the result of data analysed, will be shown and explained in more detail as follows:

6.7.1.2.1 The information of participants

The company of agricultural machinery where five participants take part in the focus-group interview has more than ten thousand employees. The total sales of AM are more than 1 billion CNY ($ 150 million) (please see Appendix 7 in terms of company classification standard). This enterprise is classified as a mega-company. It has collaborated with dealers in South Africa. The dealer's office in South Africa is located in Johannesburg. The five participants in this sub-enterprise are sales managers, after-sales managers, as well as technology managers. All participants have been there for more than two years. They are well informed regarding the ASS of AM, marketing, local users, farmers, customers etc. It took around one hour and a half to complete the interview. The software of Zoom Meeting was employed to conduct the focus-group interview due to the influence of the Covid-19 pandemic lasting for roughly more than a year in both China and South Africa. The researcher was responsible for recording and explanation regarding the inquires and questions during the interview.

6.7.1.2.2 Result of South African focus-group two

- The answer to question one

The participants involved in this focus-group interview approximately agree with the result based on the 739 questionnaires analysis. In South Africa, timely repair (B2) and spare parts (B3) are the most significant factors that influence the ASS of AM. From the users' perspective, the user system and centre (B6) have less effect than others. However, the user system and centre (B6) are very crucial for dealers and agents. It involves after-sales service, sales management, technological assistance, as well as marketing management. Some argue that if there are sufficient dealers, agents or cooperative shops, it becomes much easier to provide adequate spare parts and timely repair. With the increasing maturity of the agricultural machinery service system, training can further support this ASS system. On the other hand, owing to the high-quality and professional team or user system establishment in South Africa, maintenance also plays a key role in the ASS of AM.

Compared to the other markets, the spare parts in South Africa are distinct and incompatible, which leads to its most significant character of incompatibility and mismatching. On the other hand, some participants state that the different users would give distinct points of view of influence factors the ASS of AM. From the professional users' perspective, they will take the spare part more seriously than others, as they know how to repair and maintenance without a training course. In addition, commercial farmers who have higher agri-mechanization will need more ASS, such as training courses, technicians, spare parts, and maintenance. Meanwhile, the user system is similar to the service hotline via which the customer can contact the expert of ASS to assist them in addressing the problem. They consider that timely repair and spare parts are more significant than other factors. Some elaborate that the user system is the factor, which does not have a positive influence on the ASS of AM.

- The answer to question two

According to quantitative results from the surveys, the factors that impact the financial resource, including saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on the after-sales service of agricultural machinery. All participants fully recognize the result obtained from quanti-data analysis, as mentioned above. The factor of grant (C5) affects extremely largely, followed by the sponsorship (C4) and access to credit (C3). Saving (C1) and overdraft (C2) have the least influence. In a nutshell, the participants principally agree with this conclusion.

The most influential factor of FR is grants based on the quanti-research. This is a phased product. According to their points of view, access to credit is crucial for ASS in medium- and high-end markets. Sponsor and overdraft are similar keys to ASS as well. From the South African dealer or agent perspective, the saving or profit of AM is extremely significant to survive in the market.

In South Africa, some dealers can acquire the grant and sponsor via collaboration with banks and the relevant institutions. Due to the insufficient and small profit of AM, so many big enterprises have been trapped in a dilemma to operate their business in the South African local market. They run the commerce through cooperation with the local mature and experienced institutions in a bid to decrease the operation cost.

In addition, some participants argue that the grant and saving are more important than access to credit, sponsor and overdraft in the context of South African AM.

- The answer to question three

They fully agree that the FR (saving, overdraft, access to credit, sponsor and grant) impact enormously on MRRI (0.51) (technician, timely repair and spare parts) and CRRI (0.48) (maintenance, training course and user system and centre). On the other hand, the magnitude of the effect of FR on MRRI (0.51) and CRRI (0.48) is practically equivalently important.

FR has strongly related positive effects on MRRI or CRRI. If the FR is strong enough, it will definitely reduce the risk of MRRI and CRRI. The dealer or agent in South Africa acquires the financial resource to support their sales of AM. Furthermore, they will focus on the MRRI and CRRI for guaranteeing that the customer can be provided with high-quality ASS, no matter they are MRRI or CRRI, in a bid to cut down the risk of them.

- The answer to question four

All participators extremely concur with the result analysed from the quantitative data. MRRI (0.43) influences the AMRR much more largely than CRRI (0.11).

From their viewpoints, they debate that MRRI has a significant influence on AMRR. However, some participants advise that CRRI should have a little bit higher influence than the result. In conclusion, most of them in this group basically approve this result.

- The answer to question five

As discussed previously, financial resources largely influence the after-sales service of agricultural machinery risk reduction. From the enterprise and South African agent perspective, they agree with this result. Maybe distinct stakeholders have different judgements regarding how much it can affect. In conclusion, they believe that it has a positive influence on ASS risk reduction.

- The answer to question six

There is no need to express in detail, as this result of question six is tremendously reasonable and correct. Perhaps, the rate of influence is much higher than this quantitative result. As mentioned previously, the systematic standard of after-sales service establishing is much more significant for the long-standing development of AM enterprise. Meanwhile, it is also one of the most important competitor factors for surviving. This is the survival baseline for a dealer in South Africa.

Nowadays, the company takes the bundling strategy, which means the AM company integrates all the factors together in a bid to exert its advantage to compete with other enterprises. If the after-sales service risk is reduced via using this strategy, it should be extremely crucial for the sustainable AM enterprise as well as the long-term dealers or agents of Chinese AM in South Africa.

- The answer to question seven

All participants on the South Africa side debate that the sustainable agricultural machinery enterprise has a large and positive influence on the growth of the agricultural economy. Especially in Africa and South Africa, its effects should be much larger due to the provision of food and other agri-issue. If it can accomplish the agri-mechanization in

Africa and South Africa, it can extremely heighten the quantity of crop grain, vegetables and food. Meanwhile, all of these cannot survive without agricultural mechanization. Furthermore, agricultural mechanization needs high-quality farm equipment manufactured and provided by sustainable AM enterprises.

Someone states that the magnitude of influence between SAE and AGE is relatively reasonable in this result, as the factors that impact the agricultural economy are various. However, SAE occupies a large part of it, so the values and results obtained from the data analysis are acceptable from their points of view.

Compared with the South African AM marketing, the Chinese government encourages the AM enterprise to develop the machinery via offering the proper grant strategy, no matter to AM company or to farmers. It can facilitate the AM firms to enhance the research to manufacture superb and advanced machines in a bid to meet the marketing demand and promote agri-productivity. All of these can further facilitate agricultural development. In Africa and South Africa, it is difficult for the government to offer large-scale financial resources, so it is hard to improve the development capability of AM enterprises. However, it can improve the price of agri-product by means of promoting agri-mechanization to facilitate agricultural economic growth.

6.7.1.3 Result of South African focus-group three

The information of participants in South African focus-group three as well as the result of data analyzed will be explained in more detail as follows:

6.7.1.3.1 The information of participants

The participants taking part in this focus-group interview in South Africa are farmer, AM dealer, AM user as well as a government official in the division of agriculture. The five participants in this focus-group interview know agricultural machinery or use AM by themselves or formulate the policy and regulation for the utilization of farm equipment. The software of the Microsoft Teams conference was employed to conduct the focus-group interview due to the influence of the Covid-19 pandemic lasting for roughly a year in both China and South Africa. It took around one hour and a half to complete the interview. However, it takes a long time to prepare the focus-group interview due to the limitation and inconvenience caused by Covid-19 and remote distance. The researcher was responsible for recording and explanation regarding the inquires and questions during the interview.

6.7.1.3.2 Result of South African focus-group three

- The answer to question one

The participants involved in this focus-group interview fully agree with the result obtained from the 739 questionnaires analysis. Furthermore, all factors that influenced the after-sales service of agricultural machinery to have a positive effect on the risk reduction of agricultural machinery. On the other hand, expert/technician (B1), timely repair (B2), spare parts (B3) and maintenance (B4) had considerable influence, followed by Training course (B5) and user information system (B6) by means of PAF (principal axis factoring) analysis, as discussed in Section 7.2.

Some of the South African participants argue that timely repair (B2), training course (B5) and the user information system (B6) have a considerable effect on the after-sales service of farm equipment. Meanwhile, timely repair is needed on the after-sales service of AM in a bid to make the fieldwork done well. Moreover, training is also needed for the ideal operation of the AM. The user information system is essential in South Africa to be able to get the response following the problems offered by the users and farmers.

Some participants also debate that expert/technician (B1) and spare parts (B3) are needed in South Africa for farmers and users, as the malfunction of AM must be dealt with within as little time as possible. From some South African interviewee's perspectives, maintenance has limited influence on South African farmers and the users who know how to use AM.

- The answer to question two

According to quantitative results from the surveys, the factors that impact the financial resource, including saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on the after-sales service of agricultural machinery. Most of the participants basically recognize the result, as mentioned above. The factor of grant (C5) affects extremely largely, followed by the sponsorship (C4) and credit (C3). Saving (C1) and overdraft (C2) have the least influence. In a nutshell, the participants principally agree with this conclusion.

Some dispute that grants have a large influence on the ASS of AM because the customer should be able to have the money available to require the service needed. On the other hand, access to credit and sponsor also have a significant effect on the ASS of AM, as it will determine the ability to obtain finance for farmers and users in South Africa. However, some participants argue that the better way to get sponsorship is to ensure that the AM enterprise can have an excellent track record. Meanwhile, the AM companies think the savings and overdraft play little role in determining the ASS risk reduction of AM in South Africa.

- The answer to question three

They elementally agree that the FR (saving, overdraft, access to credit, sponsor and grant) impact greatly on MRRI (0.51) (technician, timely repair and spare parts) and CRRI (0.48) (maintenance, training course and user system and centre). On the other hand, the magnitude effect of FR on MRRI (0.51) and CRRI (0.48) is nearly equivalently significant.

The participant basically approves the point of view mentioned above. Some South African participants argue that it is true because the stakeholders need all of the financial resources mentioned above to be able to have a good relationship with the after-sales service of AM in South Africa. This can assist South African farmers in obtaining the AM and ASS in a bid to get rid of drudgery and improve productivity.

- The answer to question four

All participants fully concur with the result analysed from the quantitative data. MRRI (0.43) influences the AMRR much more largely than CRRI (0.11).

If the AM companies or dealers can provide sufficient spare parts and timely repair, the customer will be satisfied with the products and after-sales service. This can be beneficial for them to win word-of-mouth. However, even if there is no CRRI, it can operate by the AM enterprise. Comparatively speaking, CRRI is less influence than MRRI for AM companies, dealers and users.

- The answer to question five

They basically agree with the result of the quantitative data analysis. The more financial resources the AM company acquires, the less risk of after-sales service. However, some South African participants argue that the rate of influence should be a little bit higher than this result.

- The answer to question six

This result summarized from the surveys is exceedingly right. From the perspective of South African dealers, the ASS of AM is much more significant in terms of the long-term development of AM company. With the development of science and technology in modern society, the easy way that can sustain the long-standing of AM enterprise is after-sales service.

Especially when the competition is so intense nowadays, the after-sales service is extraordinarily significant for AM enterprise’s long-standing survival and development. In conclusion, the result obtained from the quantitative data analysis is much more significant for AM enterprises both in South Africa and China.

- The answer to question seven

This result of question seven generated from the surveys is exactly true. AM enterprises can supply advanced and high-quality machines for farmers and users who can use them to improve the agri-productivity, which is beneficial for the growth of the agricultural economy.

As agriculture is becoming more and more mechanized in South Africa, the demand for farm equipment, including tractors, seeders, and harvesting machines, becomes stronger and stronger. However, sustainable agricultural machinery companies can bridge this gap. Furthermore, it can improve the growth of the agri-economy by means of providing advanced AM.

6.7.1.4 Result of South African focus-group four

The information of participants in South African focus-group four as well as the result of data analysed will be displayed and explained in more detail as follows:

6.7.1.4.1 The information of participants

The participants taking part in our focus-group interview in South Africa are farmer, AM dealer, AM user as well as a government official in the division of agriculture. The five participants in this focus-group interview know agricultural machinery or use AM by themselves. Furthermore, the software of Zoom Meeting was employed to conduct the focus-group interview due to the influence of the Covid-19 pandemic lasting for roughly a year in both China and South Africa. It took around one hour and a half to complete the interview. However, it took a long time to prepare the focus-group interview due to the limitation and inconvenience caused by Covid-19 and remote distance. The researcher was responsible for recording and explanation regarding the inquires and questions during the interview.

6.7.1.4.2 Result of South African focus-group four

- The answer to question one

The participants involved in this focus-group interview fully agree with the result based on the 739 questionnaires data analysis. Subsequently, all factors that influenced the after-sales service of agricultural machinery have a positive effect on the risk reduction of agricultural machinery. On the other hand, expert/technician (B1), timely repair (B2), spare parts (B3) and maintenance (B4) had considerable influence, followed by training course (B5) and user information system (B6) by means of PAF (principal axis factoring) analysis.

Some argue that expert/technician, timely repair and spare parts are also significant influential factors that impact the ASS of AM in South Africa. It is impossible to repair the AM without skilled technicians and sufficient spare parts. Some participants argue the maintenance and training are also crucial to the ASS of AM, as maintenance can guarantee the machinery operating normally. However, the training can ensure the users or customers to use the AM proficiently and do simple repair and maintenance. Compared with these factors mentioned above, some SA participants debate that the user information system is neglected in South Africa due to the disregard made by AM enterprise.

- The answer to question two

According to quantitative result, the factors that impact the financial resource, including saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on the after-sales service of agricultural machinery. Most of the participants basically recognize the result recapitulated from the surveys, as mentioned above. The factor of grant (C5) affects extremely largely, followed by the sponsorship (C4) and credit (C3). Saving (C1) and overdraft (C2) have the least influence. In a nutshell, the participants fully agree with this conclusion.

Some participants dispute that grant is the lack in South Africa than in China. In addition, credit, overdraft and saving are relatively significant to small-holder farmers in South Africa. However, the grant from the government and relevant institutions is largely significant for the survival of AM enterprises.

- The answer to question three

They fully agree that the FR (saving, overdraft, access to credit, sponsorship and grant) impact largely on MRRI (0.51) (technician, timely repair and spare parts) and CRRI (0.48) (maintenance, training course and user system and centre). On the other hand, the magnitude effect of FR on MRRI (0.51) and CRRI (0.48) is equivalently important.

The SA participants basically approve of the points of view mentioned above, which is summarized from the survey data. The financial resources are much more significant to the risk reduction of after-sales service of agricultural machinery in South Africa.

- The answer to question four

All participants concur with the result obtained from the quantitative data. MRRI (0.43) influences the AMRR much more largely than CRRI (0.11).

If the AM companies or dealers can provide sufficient spare parts and timely repair, the customer will be satisfied with the product and after-sales service. Furthermore, this can be helpful for AM companies to get more customers. Compared to MRRI, CRRI is relatively less influential than MRRI.

- The answer to question five

They basically agree with the result of the quantitative data analysis. The more financial resources the AM company acquires, the less risk of after-sales service. However, some SA participants argue that if they can obtain more financial resources, they can get more AM and service to reduce the risk of ASS of AM in South Africa.

- The answer to question six

This result of question six from the surveys is fully exact. From dealers' perspective in South Africa, ASS is much more important in terms of the long-term development of agricultural machinery enterprises. However, the easy way that can sustain the long-standing machinery enterprise is after-sales service.

Especially in a society where competition is so fierce, the after-sales service is very significant for AM enterprise long-standing survival and development. Furthermore, the excellent ASS can further guarantee the survival and development of farm equipment companies in South Africa.

- The answer to question seven

This result obtained from the surveys is exactly affirmative. The agricultural machinery can provide advanced machinery to assist farmers in improving their agri-productivity in all regards. Furthermore, it can also assist farmers in getting rid of drudgery. Meanwhile, agricultural mechanization also depends on advanced farm equipment providing as well.

However, sustainable agricultural machinery companies can bridge this gap. Furthermore, it can improve the evolvement of the agri-economy by employing advanced machines.

6.7.2 The result of qualitative data from China

The results of qualitative data of Chinese focus-group interview analysed will be displayed in more detail as follows:

6.7.2.1 Result of Chinese focus-group one

The information of participants in Chinese focus-group one as well as the result of data analysed will be shown and explained in more detail as follows:

6.7.2.1.1 The information of participants

The company of agricultural machinery where four participants take part in this focus-group interview in China has more than ten thousand employees. The total sales of AM are more than 1 billion CNY ($ 150 million) (please see Appendix 7 in terms of company classification standard). This enterprise is classified as a mega-company. The four participants in this enterprise are from the department of after-sale service, technology service as well as management. The focus-group interview was conducted in the enterprise's meeting room. It took around two hours to complete the interview. The researcher was responsible for recording and explanation regarding the inquires and questions during the interview.

6.7.2.1.2 Result of Chinese focus-group one

- The answer to question one

The participants involved in this focus-group interview basically agree with the result that the researcher got based on the 739 questionnaires analysis. Furthermore, all factors that influenced the after-sales service of agricultural machinery have a positive effect on the risk reduction of agricultural machinery. However, expert/technician (B1), timely repair (B2), spare parts(B3) and maintenance (B4) have considerable influence, followed by training course (B5) and user information system (B6) by means of PAF (principal axis factoring) analysis.

They mention that the training of AM is very crucial for risk reduction of ASS. After the AM is sold to the users, the AM enterprises should conduct the training for customers, including the basic and key operation and maintenance of AM. If the users can operate and maintain the AM properly, it can avoid the damage of AM. Furthermore, it can reduce the operation cost of AM firms. On the other hand, if the AM enterprises can employ professional technicians who can train users timely, it can decrease secondary damage to AM as well as providing timely repair, which is beneficial for AM companies. Spare parts are also a crucial factor. From the perspective of AM enterprises, it can decrease the spare part's cost if they can manufacture more spare parts. The users and dealers need to stockpile the common parts and wearing parts in a bid to provide timely repair once the AM is broken. Maintenance has less influence on the ASS of AM, according to the results from the surveys. However, it can impact the risk reduction of ASS indirectly, according to this focus-group interview. The reason is that the less the risk of maintenance, the less need for technicians, spare parts and repair. Furthermore, they also conclude that maintenance is neglect in China. For example, the farmer leaves the plough on the ground randomly, not put it in the warehouse. The user information system (B6) should play an important role in informing the customer via phone call, airtime or email etc., to maintain the machine timely.

- The answer to question two

According to quantitative result from the surveys, the factors that impact the financial resource, including saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on the after-sales service of agricultural machinery. The factor of grant (C5) affects extremely largely, followed by the sponsorship (C4) and credit (C3). Saving (C1) and overdraft (C2) have the least influence.

If the AM enterprise gets more finical resources, it can improve the level of ASS of agricultural machinery. Furthermore, the AM company can use these financial resources to employ more technicians, store more spare parts, offer timely repair and a training course. They also mention that the national policy is very crucial for risk reduction of ASS of AM, such as grants provided by the government, access to government credit as well as a sponsorship from governments or institutions.

- The answer to question three

They fully agree that the FR (saving, overdraft, access to credit, sponsor and grant) impact largely on MRRI (0.51) (technician, timely repair and spare parts) and CRRI (0.48) (maintenance, training course and user system and centre); on the other hand, the magnitude effect of FR on MRRI (0.51) and CRRI (0.48) is nuanced.

The participants discuss that both MRRI and CRRI need fund support, no matter they are saving, overdraft, access to credit, sponsorship or grant. So, their decision is that FR definitely impacts MRRI and CRRI. Nevertheless, the difference of influence degree is trivial. When the AM enterprise obtains the funds to ASS, there is no tendency or partiality apparent to decide which one should be taken more seriously, as all of them are very significant for ASS. If the FR is plentiful and abundant, the AM enterprise will proactively provide the ASS of AM. Meanwhile, if AM company offers more and more training courses, maintenance and spare parts, the risk of ASS on AM should be reduced accordingly and definitely. On the contrary, with the risk reduction of ASS, more and more customers will be satisfied with the products. Furthermore, the AM enterprise obtains more FR accordingly, which can provide better ASS further. This is a benign circulation.

- The answer to question four

The participants principally concur with the result analysed from the quantitative data. MRRI (0.43) influences the AMRR much more largely than CRRI (0.11).

MRRI is a direct and principal factor that impacts the AMRR, because the most crucial parts of ASS of AM incorporate technician, spare parts and timely repair, which belong to MRRI in the light of the common understanding. On the contrary, CRRI (maintenance, training course and user system and centre) has an indirect impact on AMRR. They serve for MRRI. If the mechanical equipment is broken, maintenance can be provided. For example, even if the maintenance has not been done well, the technician can deal with the issue by providing spare parts timely and repair promptly to some extent. If the training course cannot be done well, there is a potential broken issue for AM, which can be solved by MRRI finally. Meanwhile, the user system and centre can't affect the AMRR greatly. In conclusion, the participants decide that MRRI (0.43) is much more significant than CRRI (0.11) in terms of influencing the AMRR.

- The answer to question five

As mentioned above, the FR is very significant to AMRR. The participants agree with the impact of FR on AMRR, but they are not very definite about the influence degree. On the other hand, they argue that if the AM enterprise gets more FR, they can provide better and high-quality ASS, customer care etc., so that the FR has a positive influence upon AMRR.

- The answer to question six

According to the quantitative result, AMRR impacts vary hugely on SAE (0.94). The ASS reduction leads to bad word-of-mouth, which further causes the unsustainability of AM enterprise development. The users may not be very professional to the AM, so they need the ASS. Once the AM is broken without timely repair and after-sales service, the customer will never buy their machines again and also tell other customers not to buy these enterprise products. This is harmful to sustainable AM development.

With the development of technology, there are not many more technological differences among the AM machines in China. Subsequently, the ASS of AM becomes a very key competing factor in the survival and success of sustainable AM enterprises. In China, AM companies rely on after-sales service to occupy the market. If the company provides excellent ASS to farmers, they are satisfied with the service. They will further introduce more customers to purchase AM, which can become a benign circulation. Subsequently, the company can maintain long-term development and offer better ASS via the FR they get from this kind of benign cycling.

- The answer to question seven

The sustainable agricultural enterprise has an exceeding influence upon the growth of the agricultural economy (0.54) in light of the quantitative result from the surveys.

One participant offers an example: two or three decades ago, when they were young, the hand equipment and ox were usually used to harvest the wheat and plough the land. Nowadays, harvesting machines and ploughs are employed to do farm work effectively and efficiently. If farmers use the sickle to harvest the wheat, it will take the whole day for the tiny area. However, if farmers utilize harvesting machines, it just takes one hour or half an hour to reap the large area. Sustainable agricultural enterprises can provide modern and large machinery in a bid to improve agri-productivity. On the other hand, farmers relieved from the drudgery can get other jobs to increase their input which further put into the agarin activities that can facilitate the growth of the agricultural economy somehow. The enhancement of agri-productivity and effectiveness means that it can produce more agri-production now, which can increase the agri-economy.

If the AM enterprises develop sustainably, it can provide excellent ASS and the AM products which is beneficial to the improvement of agricultural habits, productivity enhancement and the novel AM model researching. Furthermore, the company can invest in research for better and large machinery in a bid to meet the marketing need. If the AM enterprises go bankrupt and collapse, there is no way for AM firms to develop and provide a better product to promote the agri-economy. In this regard, sustainable agri-enterprises are very crucial to the growth of the agri-economy.

6.7.2.2 Result of Chinese focus-group two

The information of participants in Chinese focus-group two as well as the result of data analysed will be shown and explained in more detail as follows:

6.7.2.2.1 The information of participants

There are around five hundred employees in this enterprise of agricultural machinery where five participants take part in our focus-group interview in China. The total sales of AM are between 50 million and 1 billion CNY ($ 7.5 to $ 150 million). It is assigned to the category of a large company (please see Appendix 7 in terms of company classification standard). The five participants in this enterprise are CEO assistance, after-sales manager, technological director, manufactural manager, as well as sales manager. The focus-group interview was carried out in the enterprise's meeting room. It took roughly one hour and a half to conduct the interview. The researcher was responsible for recording and explanation regarding the inquires and questions during the interview.

6.7.2.2.2 Result of Chinese focus-group two

- The answer to question one

The participants involved in this focus-group interview fully agree with the result based on the 739 questionnaires analysis. Some participants believe that timely repair (B2), spare parts (B3) influence the ASS risk reduction extremely largely. For example, if the AM is broken when it operates in the crop field, it is very crucial to send the spare parts in time. It can be delivered to the spot in less than one day or three to five days for long-distance via the Shunfeng Express (Shunfeng Express is one of the fastest delivery enterprises in China). The timely repair can guarantee to provide seasonable service in a bid not to delay the usage of AM. All in all, spare parts and timely repair are the most significant, according to their viewpoints. The training course (B5) and user system and centre (B6) are catalogued into the largely influential classification. They also believe that expert/technician (B1) is strongly determinant to ASS risk reduction. Meanwhile, they argue that maintenance (B4) has an energetic influence on ASS risk reduction, as AM needs maintenance of hydraulic system, engine oil, and important parts cleaning etc. It can beget downtime of AM, which can delay the fieldwork during the busy farming season.

Some participants debate that timely repair (B2) is the most important factor that influences the ASS of AM, along with expert/technician (B1) and spare parts (B3), especially in the busy farming season. Once the downtime of AM happens, a timely repair can help users save their time and cost with the help of a technician. On the other hand, the training course is a crucial factor for ASS risk reduction. They always invite the dealers and farmers to attend a training course during the slack season, including the Sanbo, operation of AM, maintenance, precautions etc. The user system and centre (B6) can affect the ASS risk reduction largely but extremely largely. They have a bit of advice for maintenance via which the AM enterprise or dealers can inform the users to maintain their AM in the prescribed time. Nevertheless, farmers do not take maintenance seriously in China, as most of them do not know how to maintain it. They conclude the maintenance of AM will be a trend via using the example of the automotive mode (regularly maintain the automotive at 4s shops) in a bid to decrease and avoid downtime in the future.

- The answer to question two

According to quantitative results, the factors that impact the financial resources, including saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on the after-sales service of agricultural machinery. The factor of grant (C5) affects extremely largely, followed by the sponsorship (C4) and credit (C3). Saving (C1) and overdraft (C2) have the least influence. The participants fully agree with this conclusion.

Undoubtedly, the financial factor that impacts largely on ASS is a grant (C5) in China.

Every province in China has a distinct grant policy, which leads to the distinct sales of AM. For instance, they sold a large number of 160 horsepower tractors in 2018; nevertheless, 180 horsepower tractors became much more popular in 2019. On the other hand, the grant has been distributed not only to farmers but also to AM enterprises so that the AM company can invest more at ASS. They argue that the saving affects the ASS of AM largely as the enterprise's profit is crucial for its development as well as an after-sales service offering. They also debate that if the AM company has more profit, they can provide a perfect after-sales service. If the company has not had sufficient profit, it is difficult for customers to receive ASS from AM enterprises. Other participants consider that if they get 50% in profits, they can provide 30% of ASS freely. If they have 100% in profits, they can supply ASS freely. The powerful AM enterprise can afford the high-quality after-sales service so as to reduce the risk of ASS of AM. In conclusion, the participants concur with all five financial factors affecting the ASS risk reduction positively.

- The answer to question three

They fully agree that the FR (saving, overdraft, access to credit, sponsor and grant) impact largely on MRRI (0.51) (technician, timely repair and spare parts) and CRRI (0.48) (maintenance, training course and user system and centre). On the other hand, the magnitude effect of FR on MRRI (0.51) and CRRI (0.48) is nuanced.

The FR will influence the MRRI and CRRI directly and largely, as mentioned above. There is not big discrepancy of effect on MRRI and CRRI.

- The answer to question four

All participants fully concur with the result analysed from the quantitative data of the surveys. MRRI (0.43) influences the AMRR largely than CRRI (0.11).

Obviously, some of the participants concur that MRRI (0.43) influences the AMRR largely than CRRI (0.11), as technicians, timely repair, and spare parts are much more significant than others comparatively. The result obtained from the data analysis is the situation quo of ASS of AM in China. The reality is that MRRI influences the AMRR largely than CRRI in China. However, CRRI will impact AMRR largely in the future, not now.

In China, if the farmers or users have any problems or questions about the ASS of AM, they prefer to seeking assistance from a technician, AM company or dealers to acquire timely repair and spare parts. This aims to solve their AM issues timely. Nevertheless, from a long-term perspective, the provision of better maintenance and training courses can also reduce the downtime during the fieldwork. These factors belong to service potential, which can meet the problem in advance.

MRRI is the apparent matter that needs MRRI to solve when farmers have a problem. However, CRRI is an invisible and imperceptible issue that is not extremely urgent or imperative for AM users. Accordingly, CRRI has a lower influence rate, as ASS will deal with the imperative issues firstly.

- The answer to question five

They agree the financial resources have a positive impact on ASS risk reduction of AM. However, they dispute that the magnitude or degree of the FR influence is underestimated. Furthermore, the value should be higher than this result. Meanwhile, the situation is that if the AM enterprises get the FR, they can put more funds on ASS in a bid to cut down the risk of ASS of AM.

- The answer to question six

All participants fully approve that AMRR affects sustainable AM enterprises tremendously and remarkably. The participants debate that the users trust the AM enterprises because they can provide high-quality ASS. Compared to the quality and price of AM, the customers would prefer that the enterprises or dealers can supply spare parts or repair timely once they have any problem. Once the problem is met by AM enterprises, they will buy more machinery and recommend their friends and relatives to purchase. Furthermore, this can lead to the company's prosperity and sustainability.

They also provide an example: some customers seek for their AM to replace other firms' because they get information that the participants' company can deliver the spare parts timely and repair without delay. In the meanwhile, the homogeneous competition of AM enterprises is very serious in China, so ASS has become one of the most crucial factors to sustainable AM enterprises.

- The answer to question seven

The sustainable agricultural enterprise's view influencing the growth of the agricultural economy exceedingly (0.54) has been accepted basically by all participants.

The future of Chinese agriculture depends on agricultural modernization, which needs agricultural mechanization. The small-holder farmers who have small land, such as 0.1-0.5 ha (1 Mu to 10 Mu), dominate the majority of farmers in China. However, the farmers in north China can manage large land, such as hundreds or thousands of hectares. They need farm equipment to promote productivity and yields, so it can enhance the growth of the agricultural economy accordingly. Meanwhile, if the AM enterprises can develop for the long term and provide high-quality AM gradually, it is beneficial and favourable to the agarin economic growth.

They also argue that SAE and AEG interact. The SAE impacts on AEG; on the contrary, AEG can facilitate sustainable agricultural company development reversely. AM can promote agri-productivity exceedingly, so it can incur the huge heightening of the agricultural economy.

6.7.2.3 Result of Chinese focus-group three

The information of participants in Chinese focus-group three as well as the result of data analysed will be shown and explained explicitly as follows:

6.7.2.3.1 The information of participants

The two enterprises of agricultural machinery where six participants take part in this focus-group interview in China have around sixty and fifteen employees, respectively. The total sales of AM are 5 million to 50 million CNY ($ 0.75 to $ 7.5 million) and less than 5 million CNY ($ 0.75 million) separately. It is allocated to the category of the medium and small company, respectively (please see Appendix 7 in terms of company classification standard). The six participators in this enterprise are CEOs, after-sales manager, technological director, as well as sales managers. The focus-group interview was carried on in the medium enterprise's meeting room. It took roughly two hours to conduct the interview. The researcher was responsible for recording and explanation regarding the inquires and questions during the interview.

6.7.2.3.2 Result of Chinese focus-group three

- The answer to question one

The participants involved in this focus-group interview fully agree with the result that the researcher got based on the 739 questionnaires analysis.

They state that all factors are crucial for ASS. One participant mentions that it is very powerful to facilitate the user system platform, such as 10086 (China's Mobile). If the customers or users have any problems regarding the after-sales service of AM, they can phone the service center to meet and solve the problem. Even for the training course and timely repair, they can be provided and solved via their online software. The technician is insufficient and inadequate in China now. It is very significant to foster AM experts. If there are enough AM technicians, it is beneficial to promote the ASS of AM in China.

From the perspectives of medium- and small-AM enterprises, the maintenance and training courses are much more important factors than others, as some of the farmers do not know how to operate and maintain the AM. Maintenance is crucial for engine usage and farm equipment's life. Nowadays, older-age farmers do not understand how to maintain agricultural machinery. On the other hand, the AMs of medium- and small-AM enterprises are cheap in China. If it is broken, the users would like to buy a new one, so it is unnecessary to repair or maintain the machine. Some participants consider that maintenance has a positive and relatively less influence on the users of medium- and small-AM enterprises.

Some participants argue that the timely repair and spare parts are very significant to the ASS of AM. However, some small glitches are easy to be repaired by dealers and technicians because they have abundant and adequate spare parts and professional technicians.

- The answer to question two

According to quantitative result, the factors that impact the financial resource, including saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on the after-sales service of agricultural machinery. All participants more or less recognize the result, as mentioned above. The factor of grant (C5) affects extremely largely, followed by the sponsorship (C4) and credit (C3). Saving (C1) and overdraft (C2) have the least influence. In a nutshell, the participants fully agree with this conclusion.

From the perspectives of medium- and small-AM enterprises, FR has an exceeding impact on the ASS of AM. If the AM company cannot get the financial resources, such as enterprise profit, grant, credit etc., how does the AM firm provide the ASS? No way.

Some of the participants argue that the grant has the most significant influence on ASS risk reduction. Many commercial farmers subconsciously ask whether the AM has a government grant or not, as the grant is very important for them. For instance, if they buy one tractor for 50,000 CNY, the government will grant them 20,000 CNY in a bid to decrease the economic load of the farmer. The more AM farmers buy, the more financial resource AM enterprises can get. All those factors will lead to the risk-reduction of ASS.

In terms of the small farm equipment, the grant's influence on ASS is minimal. Because the subsidy amounts of small tractors are very little compared with the big tractors in China, the farmers are reluctant to apply for grants when they buy the small AM. In addition, there is also another issue for medium- and small-AM enterprises that they don't dire to apply for credit, get sponsorship or apply for overdrafts, as they are frightened that they cannot pay back those ones.

- The answer to question three

They basically agree with the results from the surveys analysed and got from the quantitative data. They state that if the farmers or users obtain more profit from the crop or vegetable product, they will purchase AM, vice versa. If the farmers purchase more farm machinery, the government and AM enterprises can get more tax and funds. Furthermore, the AM enterprise will put more funds on MRRI and CRRI.

The influence of FR on MRRI and CRRI is similar, as the AM enterprise will spend the equivalent fund on those two aspects, namely after-sales service.

- The answer to question four

All participants strongly concur with the result analysed from the quantitative data. MRRI (0.43) influences the AMRR largely than CRRI (0.11).

Someone provides the information that once the tractors, irrigation system and ploughs are broken, the farmers need technicians to repair the machinery promptly and timely with sufficient spare parts. Comparatively speaking, training, maintenance and user system seem not as significant and crucial as MRRI.

- The answer to question five

From the perspective of medium- and small-AM enterprises, it is challenging for them to get grants, profit, and credit. If it is difficult for the AM company to get the financial resources, how does the AM firm provide the exceptional ASS? For example, if the AM company loses 5,000 CNY per tractor, how excellent ASS can be provided without sufficient capital! Moreover, it is tough for medium- and small-AM enterprises to obtain more profit than large AM companies, as the price of small AM is too much lower in China. It is also hard for them to acquire grants and credit from the government and banks, compared with the large and high-technology AM companies. Due to the increase in labour cost, the farmers neglect the value of grants for the small and cheap machines. This is the key issue for medium- and small-AM enterprises in China. All the above-mentioned problems of FR have a large influence on ASS risk reduction.

The AM enterprises need a considerable and large amount of capital in the context of after-sales service. However, based on the current situation in China, it is extraordinarily hard to accomplish this objective. Accordingly, they approve the result that FR does not have exceedingly and tremendously high influence on AMRR.

- The answer to question six

It is certain that ASS impacts largely on sustainable agricultural enterprises. The users are farmers in the rural areas in China. If the company can provide perfect ASS, farmers will feel comfortable, satisfied and dependable on AM plants. They will buy more products. Furthermore, they will recommend their relatives, friends and acquaintances to purchase the products, which could facilitate impetus to the sustainable development and long-term prosperity of AM enterprises.

ASS plays a very significant and conclusive role in the sustainability of AM enterprise. For instance, if someone buys the farm equipment which always broke and cannot provide ASS in time, the customer will not be satisfied with this AM enterprise. And then, more and more users will not purchase their products. Finally, the AM enterprises cannot survive in the long term.

- The answer to question seven

The participants explain that if the AM company can supply high-quality farm equipment and excellent ASS to farmers and users, it can improve agricultural productivity. The farmers will get more profit from these agricultural products. Furthermore, they can afford more funds and taxes to benefit the government. Thereupon, the government will provide AM firms with more grants and sponsorship. In conclusion, this is beneficial for agricultural economic growth.

Some participants elaborate that the high-tech and faultless products can be provided by AM enterprises via using sufficient funds, advanced and exceptional technology, and more experts and researchers. Furthermore, this can reduce the risk of after-sales service and improve agricultural productivity. From the perspective of history, every increase in productivity will promote the growth of the agricultural economy.

China is a powerful agricultural country where the farmers necessitate agricultural machinery. Meanwhile, it also requires agricultural mechanization and modernization. The agricultural mechanization and modernization with outstanding and superior ASS will enhance the improvement and advancement of the agricultural economy.

6.7.2.4 Result of Chinese focus-group four

The information of participants in Chinese focus-group four as well as the result of data analysed will be shown and explained explicitly as follows:

6.7.2.4.1 The information of participants

The last participants in this focus-group interview are from the Bureau of Agricultural Machinery in China. Five officials were taken part in this discussion who are directors, staff as well as agricultural policymakers. The focus-group interview was conducted in the conference room of this agricultural bureau. It took roughly one hour and a half to conduct this interview. The researcher was responsible for recording and explanation regarding the inquires and questions during the interview.

6.7.2.4.2 Result of Chinese focus-group four

- The answer to question one

The participants involved in this focus-group interview fully agree with the result obtained from the 739 questionnaires analysis. Subsequently, all factors that influenced the after-sales service of agricultural machinery have a positive effect on the risk reduction of agricultural machinery. In addition, expert/technician (B1), timely repair (B2), spare parts (B3) and maintenance (B4) have considerable influence, followed by training course (B5) and user information system (B6) by means of PAF (principal axis factoring) analysis, as discussed in Section 7.2.

Some participants debate that technician (B1), timely repair (B2), spare parts (B3) have a large influence on ASS of AM followed by training course (B5) and user system and centre (B6). The factor of maintenance (B4) is exactly the least one to impact the ASS of AM. In the Chinese agricultural machinery market, the most significant factor affecting the ASS is spare parts, as the technician always utilizes them to repair the machinery without delay.

In the current Chinese AM market, the user system and centre (B6) denote a simple bridge to connect the dealers or AM enterprises and customers in order to provide the information and maintenance. The alleged training course refers to teach the users how to operate and maintain the machine when they purchase the equipment. However, the AM customers in China are professional and skilled operators, so training course is apparently not that crucial for tractor operators. Absolutely, maintenance has the least influence in China nowadays, as tractor drivers can do the basic maintenance by themselves, for instance, to change engine oil or replace the oil filter.

On the other hand, they elaborate that there is not a definite standard and criterion for expert or technician. Usually, the AM enterprises would like to utilize the dealers for employing the technicians who have repair experience and knowledge to deal with the issue of farm equipment. There are fewer technical and professional repair centres of AM in China currently.

- The answer to question two

According to quantitative results from the survey, the factors that impact the financial resource, including saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on the after-sales service of agricultural machinery. All participants basically recognized the result, as mentioned above. The factor of grant (C5) affects extremely largely, followed by the sponsorship (C4) and credit (C3). Saving (C1) and overdraft (C2) have the least influence. The participants principally agree with this conclusion.

The grant is very significant to farmers who buy agricultural machinery. Furthermore, the AM enterprises can get more profit and funds following the AMs being purchase by farmers, and then they will invest more in the ASS accordingly.

- The answer to question three

Certainly, the financial resource would affect the MRRI and CRRI to a large extent. However, the magnitude influence is indistinguishable. All of the participants accept and concur with the result obtained from the quantitative data analysis of the surveys.

- The answer to question four

Basically, the participants approve that the MRRI is much more significant than CRRI in terms of affecting AMRR. However, the enterprises, dealers and agents can provide timely repair by means of the professional and proficient technician with sufficient and ample spare parts. In that case, the customers can use their machine seasonably in a bid not to delay their fieldwork which can bring them more profit. Consequently, MRRI is more crucial to the after-sales service of farm equipment than other factors.

For instance, if maize or wheat harvesting machines are broken during the busy season while the AM enterprises cannot provide the timely ASS, farmers will lose their incomes. Meanwhile, they will be not dissatisfied with the equipment and company. This leads to fewer sales of AM, which cannot maintain sustainable AM enterprises.

However, the AM drivers in China, who have long-standing utilization experience of AM, usually know how to maintain and operate the AM. On the other hand, the mature and experienced user system and centres are inadequate and scanty in China, leading to less influence.

- The answer to question five

Absolutely, if the AM enterprises can get more finance and funds, it would be beneficial and favourable to the ASS of AM. Once the AM companies have more ways to obtain finance, the money input on the ASS is more. On the other hand, if the AM company takes advantage of financial resources to improve the quality of farm equipment, it can indirectly reduce the glitch and problem of machinery and further reduce the cost of after-sales service.

- The answer to question six

Yes, exactly. The AMRR has a large impact on the sustainable agricultural enterprise. All participants agree a hundred percent with this conclusion.

If the enterprises and dealers can supply the high-quality ASS of AM, it can win an exceptional and satisfying reputation. Furthermore, more and more customers will purchase their AM products in the effect of those users who acquired superb ASS. Some participants explained that the risk reduction of AM and excellent AM determine the survival of AM enterprises.

Nowadays, with the advancement and development of technology, there is not much more different in terms of the quality of AM products in China (only based on the small and medium tractors). The most significant factor for enterprises' sustainability, prosperity and stableness is to provide excellent after-sales service. It is a decisive and life-and-death factor to SAE.

- The answer to question seven

The sustainable AM enterprises can supply high-quality and exceptional farm equipment, such as tractors, ploughs, harvesting machines, planters as well as irrigation systems etc. All these high-tech and professional machinery can promote the productivity of agricultural products.

For instance, the sales of tractors in Weifang municipality (part of Shandong province in China) occupy 30%-40% in the Chinese AM market compared to the 70%-80% in Shandong provincial market. They rely completely on high-quality AM products and superb ASS providing. That is why Weifang municipality, among roughly 334 district municipalities in China, can occupy one-third tractor market in the whole of China.

Agricultural modernization cannot survive without the mechanization of AM. The mechanization of AM has a large extent depends on the AM enterprises. However, agricultural modernization is the precondition of agricultural improvement all over the world. Only the sustainable AM company can supply high-quality and advanced farm equipment to meet the users' demand. This can further achieve agricultural mechanization and improve extraordinarily outputs and productivity of agriculture. Finally, it can accelerate the improvement and enhancement of the agricultural economy.

With the promotion and development of agricultural mechanization in China, it enhances the operation level of AM per hectare, which can further facilitate the agroeconomic and decrease environmental pollution to some extent. It simultaneously fits the general direction of national policy on agricultural machinery in recent years.

The growth of the agricultural economy relies on the large agri-outputs that depend mainly on labour, AM, and agricultural material, such as fertilizer, seed and pesticide. The promotion of the AM level can directly influence the outputs of agricultural productivity.

6.8 Summary and conclusion

This chapter provides general characteristics of data used in the study. The information collected is summarized and described by using figures and tables. According to the results, the highest number (32.9%) of the participants in this sector are within 30 to 39 years old. In the light of data analysis, the male constitutes the majority by 72% relative to 28 % of the female counterparts, which may imply that the industry is not well represented in gender when other conditions for transformation are held constant.

The results show that male respondents dominate their female counterparts. However, females are fairly represented at the specialist (35.7%), middle manager (28.4%), and senior manager (27.9%) but acutely underrepresented in the CEO's level (8.8%). The results show that those dominant male respondents (34.8%) are in the agricultural sector while the female counterparts are slightly dominated (26.1%) by those with science experience. The detailed demographic profiles of the study participants have been demonstrated in Table 6.6, 6.7 6.8, 6.9 6.10 and 6.11.

The Likert Scale used in this research is gauged from one to seven, namely one is the minimal influence, and seven is the maximal effect. The biggest mean of value is timely repair (5.22), followed by spare parts (5.06), maintenance (4.89), expert (4.86), training (4.68) as well as UIS (4.56). The highest values of the means of financial resource that impact the after-sales service risk of agricultural machinery are grant (4.90) and saving (4.86) followed by ATC (4.08), overdraft (4.16) and sponsorship (4.17).

The means of AMRR (agricultural machinery risk reduction) and SAE (sustainable agricultural enterprise) are almost consistent, as shown in Table 6.30. The mean of the relationship between AMRR (agricultural machinery risk reduction) and AEG (agricultural economic growth) is 4.63, which is a little bit higher than the mean of the relationship between SAE (sustainable agricultural enterprise) and AEG (agricultural economic growth).

The results of the focus-group interview collected from South Africa and China have been discussed in more detail in this chapter. Eight focus-group interviews conducted in South Africa and China have been done by means of field interviews, Zoom conferences, Microsoft Team meeting, as well as Tencent symposium. The detailed results have been recorded and written down in this chapter.

A thorough and comprehensive data analysis and explanation will be presented and discussed in the next chapter. Furthermore, some interesting and valuable viewpoints will be addressed in Chapter 7.

Chapter 7: Data analysis and discussion

7.1 Introduction

This section of the study presents and discusses the empirical results relative to the quantitative data collected in the surveys and quali-data in focus-group interviews etc. Recapping, this study aimed to develop the risk reduction model of after-sale service of Chinese farm machinery in South Africa that can lead to or facilitate farm equipment enterprises being sustainable. The following specific objectives underlined this aim:

a) To identify the factors that affect the risk reduction of ASS of AM;
b) To judge the relationship among financial resources and mechanical risk reduction, customer risk reduction regarding after-sales service of agricultural machinery and risk reduction of ASS of AM;
c) To determine the factors that affect the financial resources of after-sales service of agricultural machinery;
d) To judge the relationship among risk reduction of agricultural machinery, sustainable agri-enterprises and the growth of the agricultural economy;
The main aim was: To develop the risk reduction model for the after-sale services of AM.

The quanti-data were collected in China by means of questionnaires. On the other hand, the quali-data were gathered in South Africa and China via focus-group interviews. Furthermore, the quanti-data were analysed by software of SPSS and AMOS (SPSS). The quali-data were analysed by means of the thematic content analysis. In addition, the similarities and contrasts found in the current studies will be presented and discussed to constitute the new knowledge and the unique contribution to the body of knowledge. The summary and conclusions, and recommendations will be presented at the end of this chapter.

7.2 The factors that impact the risk reduction of agricultural machinery

The factors that affect the risk reduction of agricultural machinery in China have been investigated. The investigation was done using the seven-item questionnaire. The Likert Scale employed in this study was arranged from one to seven which means from no influence (1) to be highly influential (7). This analysis was subjected to the principal axis factoring (PAF) with Promax rotation. The principal axis factoring (PAF) (Grieder & Steiner, 2020) was a least-square fitting approach in EFA (exploratory factor analyses). The basic idea was to extract the first common factor from the sample correlation matrix of multiple variables so that the square sum of the common factor's coefficients accounts for the largest proportion of the common factor variance of all variables (Grieder & Steiner, 2020). Subsequently, the second common factor should be extracted from the residual correlation matrix, and also, the square sum of the common factor's coefficients accounts for the largest proportion of the common factor variance of the remaining common factors. This continued extraction should be stopped until the total common factor variance decomposition is completed.

Before running the PAF, the data were examined for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests (see Table 7.1), and results revealed that the factors were not normally distributed. It's possible that the data weren't that far from normal, but that the p-value is low because of the relatively large sample size. Moreover, the results in Table 7.1 revealed that the determinant was found to be 0.001 and is higher than 0.00001. This result implied that the correlation matrix for the risk reduction factors was free from multicollinearity. Bartlett's Test of Sphericity was highly significant at p-value=0.05, implying that the data was appropriate and suitable for the factor analysis. Furthermore, the value of the Kaiser-Meyer-Olkin (KMO) Measure for Sampling Adequacy was 0.903 and was much greater than 0.600, implying that the sample was suitable and adequate for the factor analysis (see Table 7.2).

Table 7.1: Test for the risk reduction factors' normality

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Experts_B1	.186	739	.000	.878	739	.000
S_Parts_B2	.185	739	.000	.873	739	.000
T_Repair_B3	.196	739	.000	.849	739	.000
Maintance_B4	.159	739	.000	.898	739	.000
Training_B5	.146	739	.000	.916	739	.000
UIS_B6	.157	739	.000	.910	739	.000
MRRI_B7	.188	739	.000	.879	739	.000
CRRI_B8	.165	739	.000	.916	739	.000

a. Lilliefors Significance Correction

Notes: S_Parts= spare parts, T_Repair= timely repair, UIS_B6= user information system, MRRI_B7 = the mechanical risk reduction indicator, CRRI _B8= customer risk reduction indicator

Source: Own survey data (2019-2020)

The one factor (with eigenvalues exceeding 1) was determined as the underlying one of the seven questionnaire items. In total, the percentage of the variance is 68.24% in the questionnaire. The loading factor values are presented in Table 7.2. Although all these factors appear to be very important in the risk reduction of the Chinese agricultural machinery, experts (0.876), spare parts (0.841), and timely repair (0.823) are revealed to be the top three high loading factors. Ishak and Wijaya (2020) reiterate the importance of spare parts relative to other factors. On the other hand, Hanum, Haekal, and Prasetio (2020) underscore the importance of expert consultation in the agricultural machinery industry. This observation appears to confirm the findings of this study. In addition, experts, spare parts and timely repair are classified as mechanical risk reduction indicators via the principal axis factoring analysis. On the other hand, maintenance, training course and user information system are assigned into group of customer risk reduction indicators through PAF analysis, as shown in Table 7.2.

Table 7.2: Factor analysis of the risk reduction of agricultural machinery

Factors	Initial	Extraction	Factor loading
Experts	0,709	0,654	0,876
Spare Parts	0,763	0,677	0,841
Timely Repair	0,720	0,707	0,823
Maintenance	0,753	0,768	0,821
Training	0,682	0,674	0,809
User Information system (UIS)	0,595	0,498	0,799
Mechanical Risk Reduction (MRRI)	0,635	0,638	0,706
Customer risk reduction (CRR)	0,623	0,493	0,702
% of variance			68,241

Notes: a. Extraction Method: Principal Axis Factoring, Determinant= 0.001, Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) = 0.903, Bartlett's Test of Sphericity, Chi-square = 4842,524; df = 28, P = 0.000.
Source: Own survey data (2019-2020)

The MRA's (Multiple Regression Analysis) application is appropriate and proper, following the assumption of normality (see Figure 7.1 and Figure 7.2), and homoscedasticity (see Figure 7.3) are met. On the one hand, Rani Das (2016) explained that the most commonly used statistical methods are correlation, regression and experimental design (Schmidt & Finan, 2018; Littlejohn & Dutant, 2020). In addition, all of them were based on one basic assumption that the observation followed a normal (Gaussian) distribution (Rani Das, 2016; Littlejohn & Dutant, 2020). The inferential methods are required to examine the normality of assumption prior to the further discussion (Rani Das, 2016). Generally, histograms, percent-percent (P-P) plots and quantile-quantile (Q-Q) plots were applied largely and frequently for normality assumption checking (Rani Das, 2016). In this study, the application of histogram (Figure 7.1) and percent-percent (P-P) plots (Figure 7.2) illustrated well the normality of factors that influence the risk reduction of agricultural machine.

Before the MRA output presentation and analysis, the risk reduction factor's normality was determined (see Figure 7.1 and Figure 7.2). The results indicated that the factor of interest is normally distributed. The test for normality was followed by the test of homoscedasticity, which was presented in Figure 7.3.

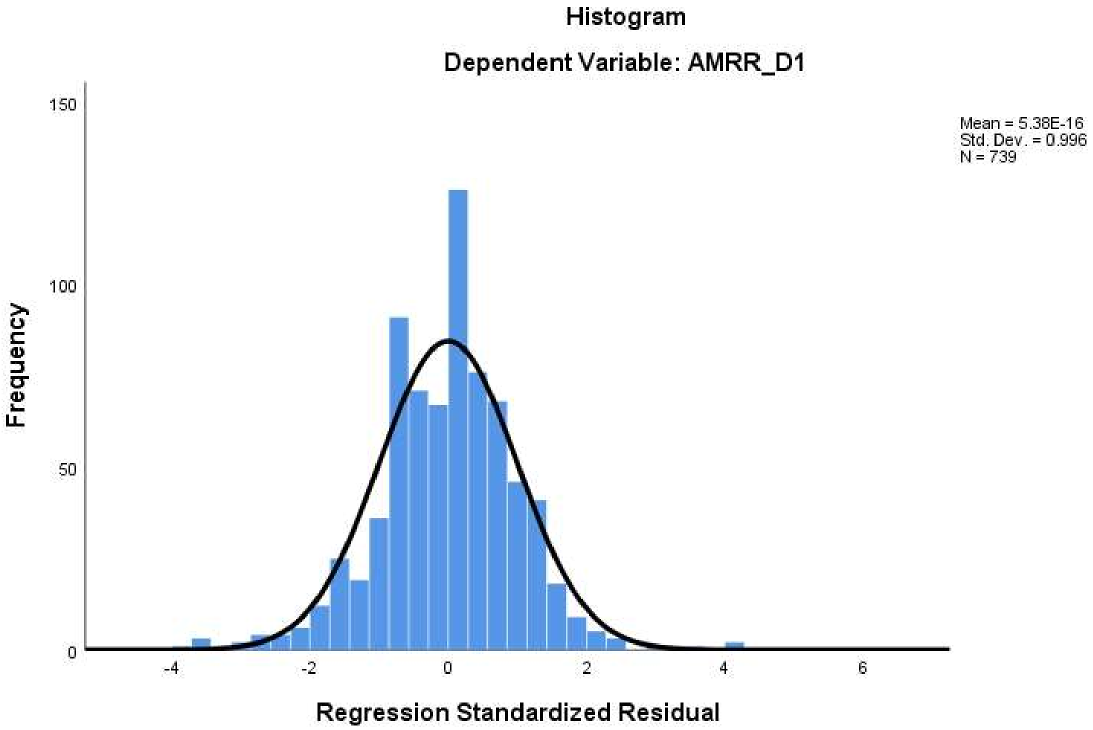

Figure 7.1: Histogram illustration of the normality of risk reduction (AMRR_D1) of the agricultural machinery

Notes: AMRR_D1 = agricultural machinery risk reduction

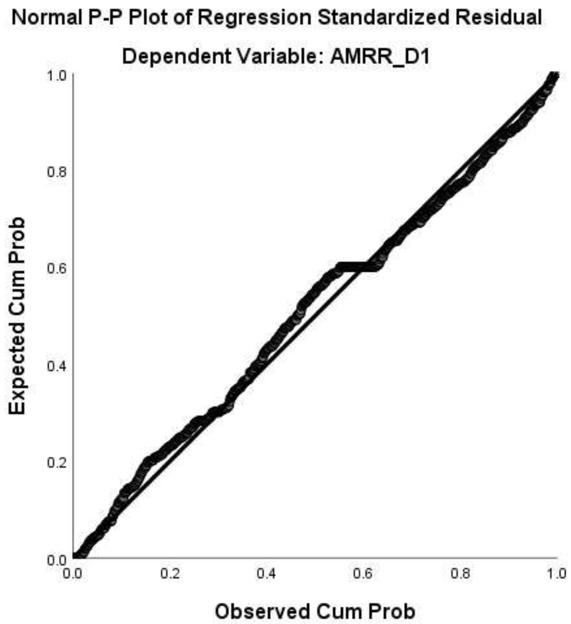

Figure 7.2: P-P Plot illustration of the normality of risk reduction of the agricultural machinery

Notes: AMRR_D1 = agricultural machinery risk reduction

On the other hand, homoscedasticity (Yang et al., 2019) refers to a condition in which the variance of the residual or error term is constant in a regression model. When the condition of homoscedasticity (equal variances) is not met, it is expected that the variance of each data point may be quite different (Barbosa et al., 2018). However, Figure 7.3 shows the homoscedasticity of risk reduction of ASS of AM fit excellently.

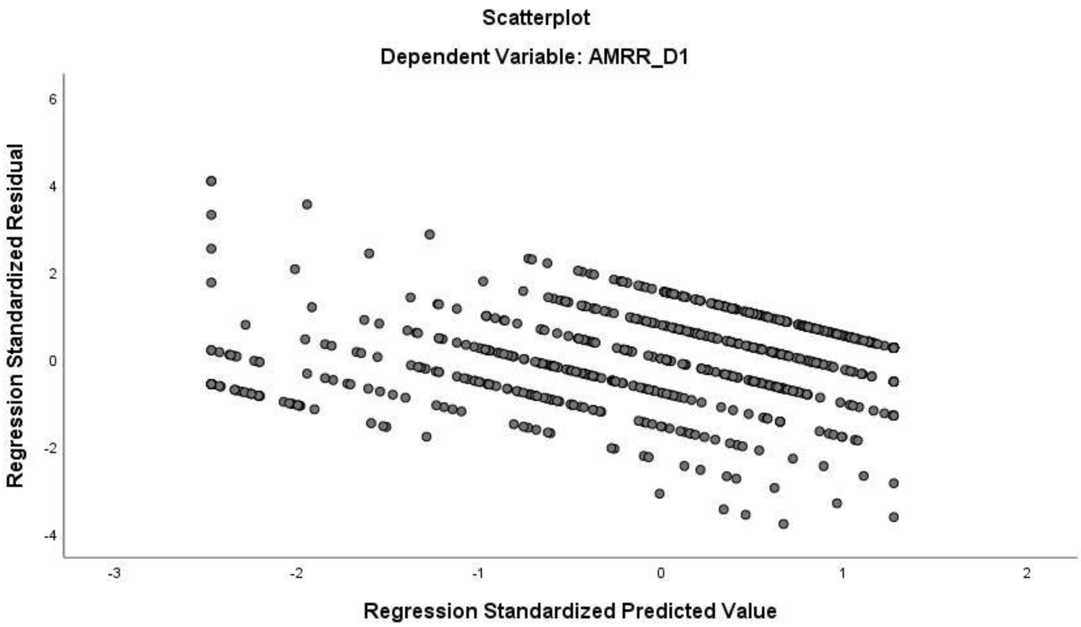

Figure 7.3: Scatterplot illustration of the homoscedasticity of risk reduction of the agricultural machinery

Notes: AMRR_D1 = agricultural machinery risk reduction

To estimate the influence of the factors that affect the risk reduction on the Chinese agricultural machinery, the standard multiple regression analysis (MRA) was performed. Multiple regression (Valaskova et al., 2018; Morrissey & Ruxton, 2018; Pallant, 2020) was a family of research techniques that can be used to investigate and determine the relationship between a dependent variable and several independent variables. In addition, it was a statistical analysis method that established the linear or non-linear mathematical model quantitative relationship between an independent variable and multiple variables and further used sample data for analysis (Pallant, 2020).

However, R^2 (Ross & Willson, 2017) measured the overall fit of the regression equation and expressed the entire relationship between the dependent variable (ASS risk reduction in this study) and the independent variables (factors that influence the ASS of AM in this study). On the other hand, Schober and Schwarte (2018) reported that the statistic that measured the goodness of fit was the coefficient of determination (R^2). R^2 is a dimensionless coefficient with a definite value range (0—1), and further, the maximum value of R^2 is 1. The closer the value of R^2 is to one, the better the fit of the regression line to the observed value is (Ross and Willson 2017; Schmidt and Finan 2018; Yang, Tu, and Chen 2019). Conversely, the smaller the value of R^2 is, the worse the fit of the regression line to the observed value is (Ross and Willson 2017; Schmidt and Finan 2018;

Yang, Tu, and Chen 2019). F-Value (Lombardo and Mai 2018; Aryafar et al. 2019) was used to test whether the overall regression model was effective and valid. Furthermore, it was necessary to check whether the significance test was effective first and then to see the size of the F-value. On the other hand, a p-value (probability value) (Dessai, Simha, and Patil 2018; Fraser 2019; Guobadia 2021) is a number explaining how likely an observed difference might have happened just by random chance. Meanwhile, the level of statistical significance was usually described as a p-value. Furthermore, the lower the p-value, the stronger the statistical significance of the observed difference or the stronger the proof to reject the null hypothesis. Usually, a p-value less than 0.05 is statistically significant. In conclusion, the F value must be used in combination with the p-value ($p < 0.05$) when the researcher decides if the overall results are significant.

Meanwhile, a standardized beta coefficient (Roth et al. 2018; Lombardo and Mai 2018) compares the effective strength and intensity of each individual independent variable to the dependent variable. Furthermore, the larger the absolute value of the beta coefficient, the stronger the influence of each individual independent variable (factors that influence the ASS of AM in this part) to the dependent variable (ASS risk reduction in this part).

Table 7.3: Factors that influence risk reduction of Chinese agricultural machinery.

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Factors	**B**	**Std. Error**	**Beta**	**t**	**Sig.**	**Tolerance**	**VIF**
(Constant)	.919	.156		5.909	.000		
Experts_B1	.130	.045	.138	2.904	.004	.293	3.416
S_Parts_B2	.183	.052	.183	3.479	.001	.240	4.166
T_Repair_B3	.281	.047	.283	5.959	.000	.294	3.397
Maintance_B4	.010	.052	.010	.191	.849	.250	4.002
Training_B5	.108	.045	.108	1.287	.009	.327	3.062
UIS_B6	.159	.033	.167	4.873	.000	.567	1.764

Notes: a. Dependent Variable: AMRR_D1

b. N= 739, CI = Confidence interval. *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$, Sr = Part coefficient, F (6; 739) = 129.004, p = .000, F^2 = 1.364 (large effect), R^2 = 0.514, and Adj R^2 = 0.510

c. S_Parts= spare parts, T_Repair= timely repair, UIS_B6= user information system

Source: Own survey data (2019-2020)

The multivariate outlier test was conducted using Mahalanobis distance (Chi-squared for the degree of freedom (df) = 6), indicating that multivariate outliers were of concern. According to the results, the independent variables do not have multicollinearity problems. In combination, all the independent variables considered in the models accounted for 51.4% of the variability of the agricultural machinery's risk reduction (R^2 =

0.514, Adjusted R^2 = 0.510, F (6, 739) = 129.004, p = 0.000). The unstandardized (B), standardized (Beta), confidence intervals, semi-partial (or part), tolerance, and VIF are reported in Table 7.3.

The results show that the independent variables included in the MRA have a large effect (F^2 = 1.364). Of all the predictor variables, the results show that maintenance has less significance at p= 0.05. It means maintenance has a relatively lower effect on ASS risk reduction of AM than others. However, all the predictor variables have a positive and vigorous effect on the risk reduction of Chinese agricultural machinery, as illustrated in Table 7.3. Meanwhile, Table 7.3 also reveals that timely repair (Beta =0.281, p =0.000) has the highest effect on the risk reduction of ASS of AM, followed by spare parts (Beta =0.183, p =0.000), user information system (Beta =0.159, p =0.000) and expert (Beta =0.130, p =0.000). The current research findings confirm that all those factors have an effective and positive impact on the ASS risk reduction of AM. In the upcoming section, the quali-data obtained from the focus-group interviews will further verify this result.

In this study, Chinese participants consider that timely repair is the most significant factor that influences the ASS of AM. This exactly has the characteristic of the Chinese element. However, in the following qualitative data analysis, some South African participants believe that spare parts are the most important factor that impacts the ASS of AM. Maybe, this is because it is very difficult for South African users to obtain Chinese spare parts timely and conveniently.

7.3 The relationship between the factors, financial resources, and the after-sale service of Chinese agricultural machinery

Table 7.4 presents the direction and size of the linear relationship between the factors, financial resources and the after-sales of the Chinese Machinery. The Pearson product-moment correlation coefficient (Zhu, You, and Liu 2019) (or Pearson correlation coefficient) is a strong measure and gauge of a linear relationship between two variables. Furthermore, it is denoted by r. Basically, it is usually employed to reflect the degree of linear correlation between two random variables. In addition, the Pearson correlation coefficient (r) demonstrates how far away all these data points are from this line of best fit. In this part, the usage of the Pearson correlation coefficient is proper and appropriate than the regression analysis method, as this analysis aims to determine the relationship among those four variables, as illustrated in Table 7.4.

Table 7.4: The means and standard deviation with correlations of the factors that affect after-sales service

Factors	Means	Standard deviation	1	2	3	4

Mechanical risk reduction (1)	4,9716	1,86771	1			
Financial resources (2)	4,4844	1,87501	.514**	1		
Risk reduction of ASS of AM (3)	4,9932	1,83498	.615**	.470**	1	
Customer risk reduction (4)	4,5413	1,84107	.678**	.496**	.503**	1

Note: a. Correlation is significant at the 0.01 level (2-tailed).**
b. ASS= after-sales service, AM= agricultural machinery
Source: Own survey data (2019-2020)

A bivariate Pearson's product-moment correlation coefficient (r) was calculated. The bivariate of all the factors under consideration was positive and ranging from medium to large. The results show that mechanical risk reduction is significantly correlated with financial resources (r (739) = 0.514, p =0.000), risk reduction of ASS of AM (r (739) = 0.615, p =0.000) and consumer risk reduction (r (739) = 0.678, p =0.000). On the other hand, financial resources correlate significantly with risk reduction of ASS of AM (r (739) = 0.470, p =0.000), and consumer risk reduction (r (739) = 0.496, p =0.000) while consumer risk reduction correlate with risk reduction of ASS of AM (r (739) = 0.503, p =0.000). Before calculating the correlation coefficients, the assumption of normality, linearity, and homoscedasticity was assessed and found to be of no effect. This relationship shows that an increase in the other factors accompanies an improvement in corresponding factors.

7.4 The factors that affect the financial resources of the after-sales service of agricultural machinery

The factors that affect the financial resources (FR-C6) of the after-sales services of the agricultural machinery are presented in Table 7.5. These factors are estimated using the standard multiple regression analysis (MRA) as indicated previously. Multiple regression (Valaskova et al., 2018; Morrissey & Ruxton, 2018; Pallant, 2020) is an extension of basic linear regression. It is a statistical technique that employs several (two or more) explanatory variables (independent variables) to predict the consequence or results of a response variable (dependent variable).

As discussed previously, the MRA's use is appropriate after the assumption of normality (Figure 7.4 and Figure 7.5), and homoscedasticity (see Figure 7.6) are met. On the one hand, Rani Das (2016) explains MRA based on one of the basic assumptions in which the observation follows normal (Gaussian) distribution (Rani Das, 2016; Littlejohn & Dutant, 2020). Generally, histograms, percent-percent (P-P) plots and quantile-quantile (Q-Q) plots are used to check the normality assumption (Rani Das, 2016). In this study, the application of histogram (Figure 7.4) and percent-percent (P-P) plots (Figure 7.5) illustrate well the normality of financial resources that influence the risk reduction of agricultural machinery.

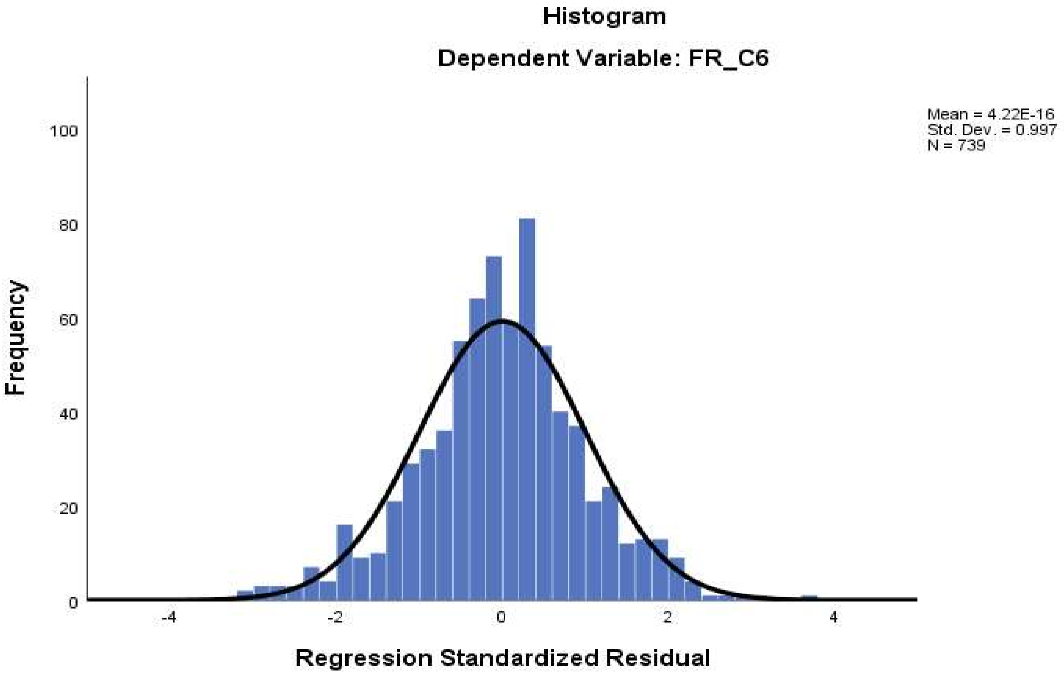

Figure 7.4: Illustration of the normality of financial resources factor using histogram

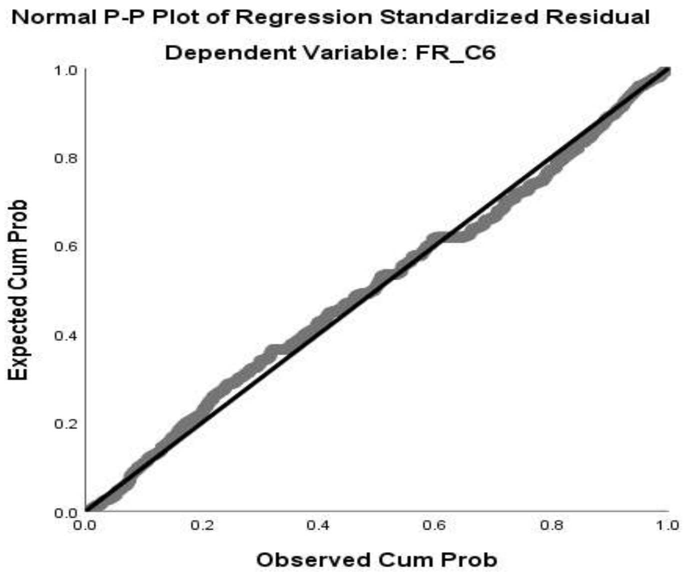

Figure 7.5: Illustration of the normality of financial resources factor using P-P Plot

On the other hand, Yang, Tu, and Chen (2019) demonstrate if all random variables in a random variable sequence have the same finite variance, the sequence is homoscedastic in the context of statistics. Furthermore, this is also called homogeneity of variance.

However, Figure 7.6 shows the homoscedasticity of financial resources fit well.

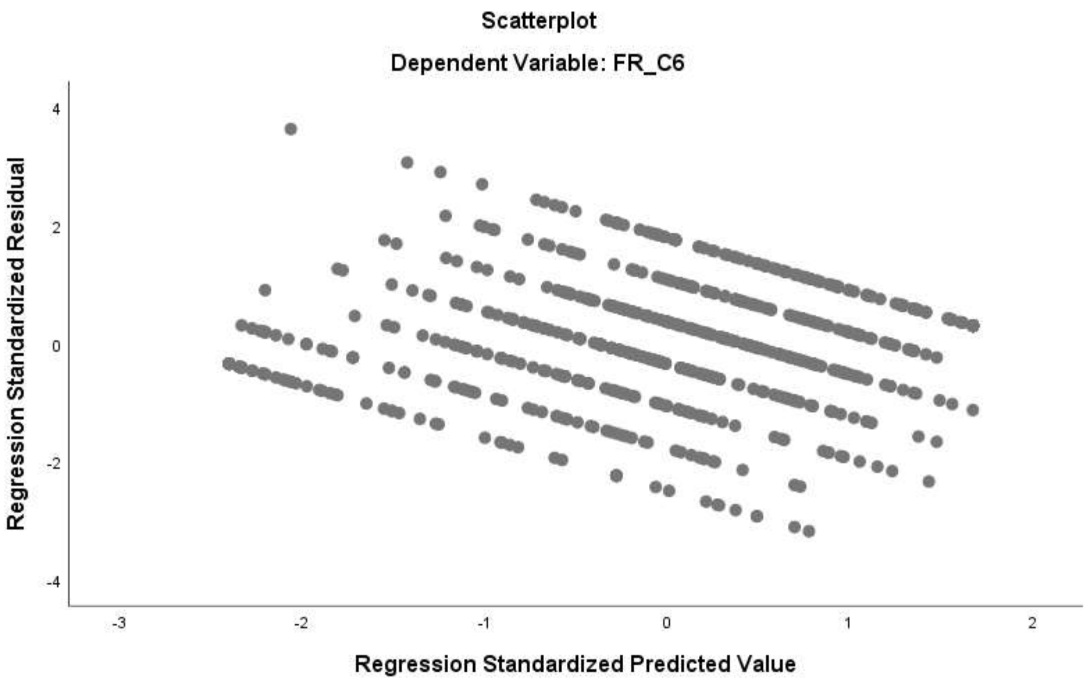

Figure 7.6: Illustration of the homoscedasticity of financial resources factor using P-P Plot

Table 7.5 reveals that the combination of the identified factors is significant [F (5, 739) = 117.437, p = 0.000], and represents 44.5% variability of the financial resources' variable [R^2 = 0.445, Adj. R^2 = 0.441]. The study also shows that combining these factors has a large effect (F^2 = 0.802). Given the beta estimates, it is revealed that grant (Beta = 0.374, p = 0.000) had the most significant impact on the financial resources of the after-sale services of the agricultural machinery, followed by sponsorship (Beta = 0.154, p = 0.000), and access to credit (Beta = 0.153, p = 0.002). On the other hand, savings and overdraft facilities were found to be insignificant at p-value =0.05. These findings are supported by Lakew and Azadi (2020), who emphasized that most businesses are growing due to access to credit facilities, grants, and sponsorship. Heyer et al. (2020) and Omondi-Ochieng (2020) reported that donation and sponsorship account for 87.5% of the enterprises' financial performance.

Table 7.5: Factors that affect the financial resources (FR_C6) of after-sales service of agricultural machinery

Factors	B	Beta	P-values	[95 % CI	]	Part (sr)	Tolerance	VIF
(Constant)	0,635		0,000	0,300	0,969			
Savings	0,071	0,071	0,053	-0,001	0,142	0,053	0,569	1,758

Overdraft	0,086	0,084	0,072	-0,008	0,180	0,050	0,348	2,876
Access to credit	0,160	0,153	0,002	0,059	0,262	0,085	0,311	3,213
Sponsorship	0,160	0,154	0,000	0,072	0,248	0,099	0,411	2,435
Grant	0,372	0,374	0,000	0,304	0,439	0,298	0,636	1,573

Dependent Variable: Financial resources (FR_C6)

a. $R^2 = 0.445$, Adj. $R^2 = 0.441$, $F(5, 739) = 117.437$, $p = 0.000$, Mahal Distance = 37.7166, $F^2 = 0.802$ (large effect)

b. Source: survey, 2020

Source: Own survey data (2019-2020)

7.5 The relationship among the risk reduction of ASS of AM, sustainable agri-enterprise and the growth of agri-economy

In this section, the Pearson correlation coefficient (r) and the basic linear regression will be employed to analyse the effect among the risk reduction of ASS of AM, sustainable agri-machinery enterprise and the growth of agri-economy. Furthermore, the assumption of normality and homoscedasticity would also be assessed and found to be no effect.

7.5.1 The relationship between the risk reduction of ASS of AM and the sustainable agri-enterprise

As demonstrated in Section 7.4, the Pearson product-moment correlation coefficient (r) (Zhu, You, and Liu 2019) is usually employed to reflect the degree of linear correlation between two random variables. Furthermore, coefficient r represents the strength of the correlation, namely the covariance degree of the two variables. Moreover, the larger the absolute value of coefficient r, the stronger the correlation.

The bivariate of those variables under consideration is positive and the score of correlation is high to some extent. The results show that agricultural machinery risk reduction of ASS is largely correlated with the sustainable agri-enterprises ($r(739)=0.754$, $p=0.000$) in Table 7.6. Wang et al. (2018) reported that reducing the risk of ASS of AM and improving the quality of after-sales service of agricultural machinery in busy seasons was conducive to cultivating users' loyalty to the agri-enterprises and improving its reputation, which can further promote the healthy and sustainable development of agricultural machinery enterprises.

Table 7.6: The mean and standard deviation with correlations of AMRR that influence SAE

		Mean	Std. Deviation	SAE_D2	AMRR_D1
Pearson Correlation	SAE_D2	4.993	1.8350	1.000	.754
	AMRR_D1	4.997	1.8391	.754	1.000
Sig. (1-tailed)	SAE_D2	4.993	1.8350	.	.000
	AMRR_D1	4.997	1.8391	.000	.

Notes: AMRR_D1 = agricultural machinery risk reduction, SAE_D2 = sustainable agricultural enterprise, N (total number) =739
Source: Own survey data (2019-2020)

The basic regression analysis is a statistical analysis method of analyzing the linear correlation between only one independent variable and one several dependent variables. Regression analysis involves only two variables, namely, independent variable x (the predictor and explanatory) and dependent variable y (the response and outcome).

In this section, AMRR (agricultural machinery risk reduction) is an independent variable, and SAE (sustainable agri-machinery enterprise) is a dependent variable. In addition, R^2 (Ross & Willson, 2017) measured the overall fit of the regression equation and expressed the entire relationship between the dependent variable (SAE in this part) and the independent variables (AMRR in this part). On the other hand, Schober and Schwarte (2018) reported that R^2, as the coefficient of determination, is utilized to measure the goodness of fit. The closer the value of R^2 is to 1, the better the fit of the regression line to the observed value. In this study, Table 7.7 reports that AMRR (agricultural machinery risk reduction) can be significantly caused by its relationship to SAE (sustainable agri-machinery enterprise) (R^2=0.569, Adj. R^2=0.569). Furthermore, this illustrates that AMRR represents 56.9% variability of SAE, as shown in Table 7.7. This means the regression model fits the observed data well.

In addition, F-value (Lombardo and Mai 2018; Aryafar et al. 2019) refers to the ratio of residual variances in a model. The F-value can be used to determine whether the test is statistically significant with a p-value ($p<0.05$). In this research, F-value is 937.866 (F=973.866, p=0.000 ($p<0.05$)) which means a large effect, as illustrated in Table 7.7. Meanwhile, because the p-value is less than 0.05, this implies that the impact of AMMR on SAE has an important statistical significance. On the other hand, a standardized beta coefficient (Roth et al. 2018; Lombardo and Mai 2018) compares the strength of the effect of the individual independent variable (agricultural machinery risk reduction of ASS of AM) to the dependent variable (sustainable agri-machinery enterprise). Table 7.7 reports that AMRR has a crucial influence on SAE (Beta=0.754, p=0.000). This is also in conformity with the study of Wang et al. (2018) in which they stated that the risk reduction of ASS of

AM and the improvement of ASS could strengthen the sustainable development of AM.

Table 7.7: Simple regression analysis of AMRR impacts on SAE

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	1.231	.128		9.586	.000
	AMRR_D1	.753	.024	.754	31.207	.000

Notes: a. Dependent Variable: SAE_D2
b. R^2=0.569, Adj. R^2=0.569, F=973.866, p=0.000
c. AMRR_D1 = Agricultural machinery risk reduction, SAE_D2 = Sustainable agricultural enterprise
Source: Own survey data (2019-2020)

Before output presentation and discussion of the basic regression analysis, normality and homoscedasticity should also be determined. On the one hand, normal distribution (Sumair et al., 2020), also known as Gaussian distribution, is a very common continuous probability distribution. In addition, normal distribution (Schober & Schwarte, 2018) is important in statistics and is also employed in natural and social sciences to represent an unknown random variable. Generally, histograms, percent-percent (P-P) plots and quantile-quantile (Q-Q) plots are used to check the normality assumption (Rani Das, 2016). In this section, the application of histogram (Figure 7.7) and percent-percent (P-P) plots (Figure 7.8) illustrate well the normal distribution of the risk reduction of ASS of AM that impacts on the sustainable agricultural enterprise.

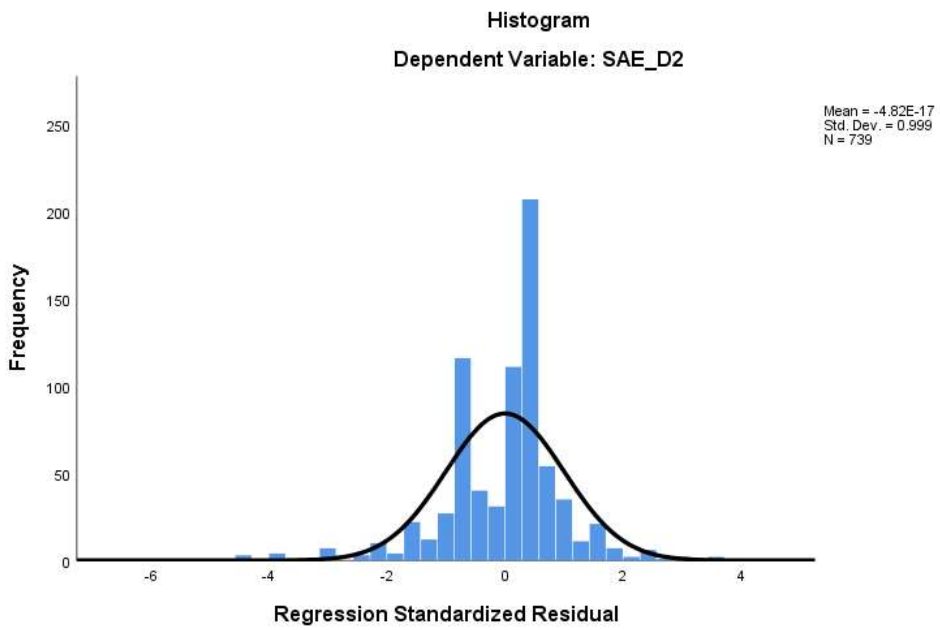

Figure 7.7: Illustration of the normality of the SAE using histogram

Notes: SAE = sustainable agri-machinery enterprise

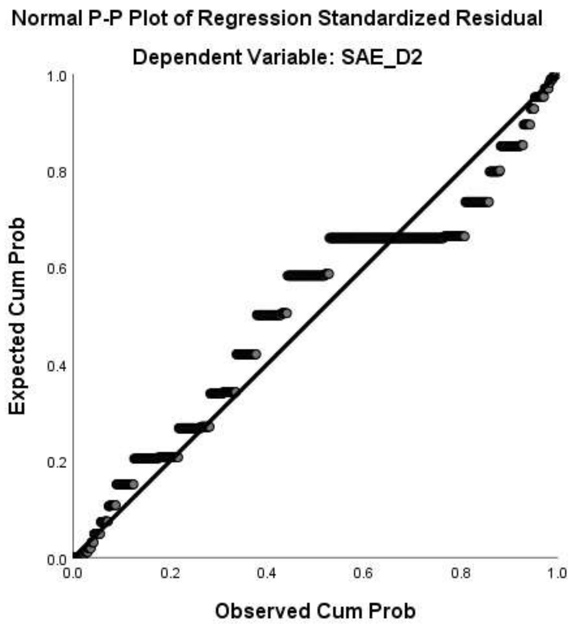

Figure 7.8: Illustration of the normality of the SAE employing P-P Plot
Notes: SAE = sustainable agri-machinery enterprise

On the other hand, Figure 7.9 also illustrates the homoscedasticity of the risk reduction of ASS of AM that impacts on the sustainable agricultural enterprise fitted well in this study.

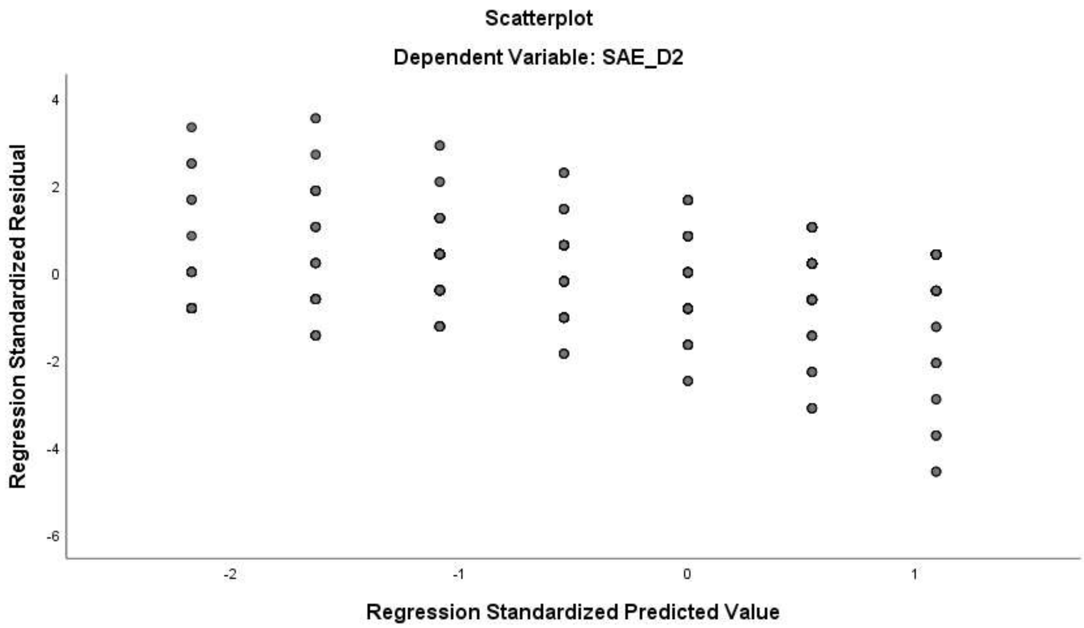

Figure 7.9: Illustration of the homoscedasticity of the SAE utilizing P-P Plot

Notes: SAE = sustainable agri-machinery enterprise

7.5.2 The relationship between the sustainable agri-machinery enterprise and the growth of agri-economy

As mentioned above, the Pearson correlation coefficient (r) (Schober and Schwarte 2018; Zhu, You, and Liu 2019) describes the degree of linear correlation between two variables. In addition, the larger the absolute value of coefficient r is, the stronger the correlation should be.

The bivariate of correlation factors under consideration is positive, and the score of correlation is high to some extent, as illustrated in Table 7.8. The results show that the sustainable agricultural enterprise is significantly correlated with agricultural economic growth (r(739)=0.743, p=0.000). This is also in conformity with the study of Sims and Kienzle (2016) and Mirčevski et al. (2018) in which they demonstrated that the healthy and sustainable agricultural enterprise played an extremely significant role in the growth of agri-economy. On the contrary, they stated that AEG (agricultural economic growth) could facilitate the development of SAE (sustainable agri-machinery enterprise) reversely.

Table 7.8: The mean and standard deviation with correlations of SAE that influence AEG

		Mean	Std. Deviation	AEG_D3	SAE_D2
Pearson Correlation	AEG_D3	4.631	1.8943	1.000	.743
	SAE_D2	4.993	1.8350	.743	1.000
Sig. (1-tailed)	AEG_D3	4.631	1.8943	.	.000
	SAE_D2	4.993	1.8350	.000	.
N	AEG_D3	4.631	1.8943	739	739
	SAE_D2	4.993	1.8350	739	739

Notes: SAE_D2=sustainable agri-machinery enterprise, AEG_D3=agricultural economic growth, N (total number) =739
Source: Own survey data (2019-2020)

As discussed in the previous section, the basic regression analysis is a statistical analysis method of analyzing the linear correlation between only one independent variable and one dependent variable. Meanwhile, the independent variable in this regression analysis is the sustainable agricultural enterprise, and the dependent variable is the agricultural economic growth.

However, Schober and Schwarte (2018) demonstrated that R^2, as the coefficient of determination, was employed to measure the goodness of fit. If the value of R^2 is closer to 1, the fit of the regression line to the observed value is better. In this study, Table 7.5

illustrates that SAE (sustainable agricultural enterprises) can be significantly caused by its relationship to AEG (agricultural economic growth) (R^2=0.552, Adj. R^2=0.552). Furthermore, this explains that SAE represents 55.2% variability of AEG. This means the regression model fits the observed data well, as shown in Table 7.5.

On the other hand, F-value (Lombardo and Mai 2018; Aryafar et al. 2019) can be used to determine whether the test was statistically significant with a p-value ($p<0.05$). In this study, F-value is 908.619 (F=908.619, p=0.000 ($p<0.05$)) which means a large effect (please see Table 7.9). At the same time, because the p-value is less than 0.05, this indicates that the influence of SAE on AEG has an important statistical significance. On the other hand, a standardized beta coefficient (Roth et al. 2018; Lombardo and Mai 2018) compares the strength of the effect of the individual independent variable to the dependent variable. In this part, they suggest comparing the strength of the influence of the sustainable agri-machinery enterprise with the dependent variable (agricultural economic growth). Table 7.9 reports that SAE has an important influence on AEG (Beta=0.743, p=0.000). According to Sims and Kienzle (2016) and Mirčevski et al. (2018), the competitive and sustainable AM played a significant role in the growth of the agri-economy.

Table 7.9: Basic regression analysis of SAE impacts on AEG

		Unstandardized Coefficients		Standardized Coefficients		
Model		**B**	**Std. Error**	**Beta**	**t**	**Sig.**
1	(Constant)	.800	.135		5.913	.000
	SAE_D2	.767	.025	.743	30.143	.000

Notes: a. Dependent Variable: AEG_D3
b. R^2=0.552, Adj. R^2=0.552, F=908.619, p=0.000
c. SAE_D2 = sustainable agri-machinery enterprise, AEG_D3 = agricultural economic growth
Source: Own survey data (2019-2020)

A similar process of determining the normality and homoscedasticity is conducted in this part before the output presentation and discussion of the basic regression analysis as well. The normal distribution (Sumair et al., 2020) is a very common continuous probability distribution in the context of statistics. In graph form, the normal distribution would appear as a bell curve. Generally, histograms, percent-percent (P-P) plots and quantile-quantile (Q-Q) plots are always used to check the normality assumption (Rani Das, 2016). In this section, the application of histogram (Figure 7.10) and percent-percent (P-P) plots (Figure 7.11) illustrate the normal distribution of the sustainable agri-machinery enterprises that impact agricultural economic growth.

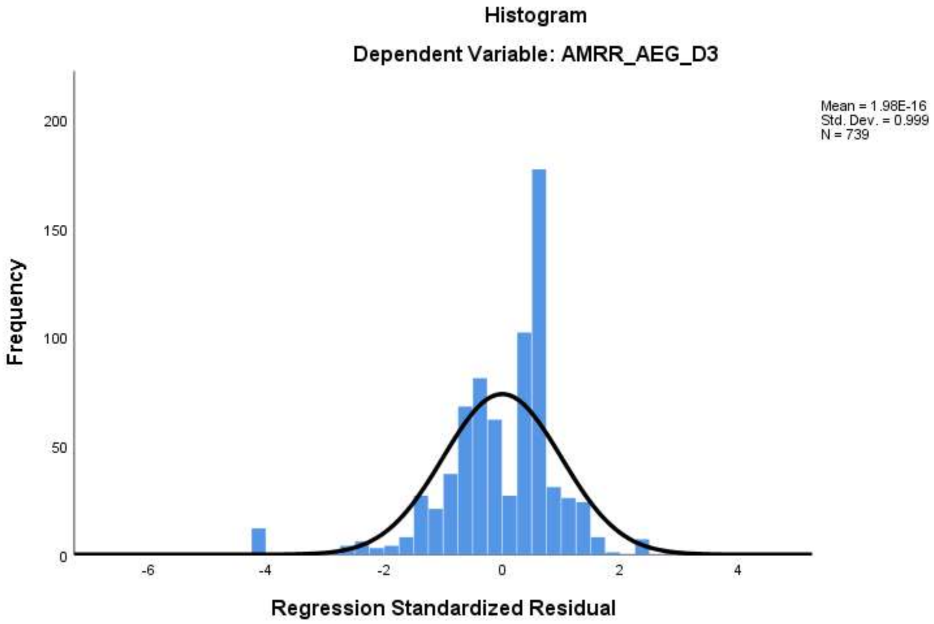

Figure 7.10: Illustration of the normality of the AEG using histogram
Notes: AEG=agricultural economic growth

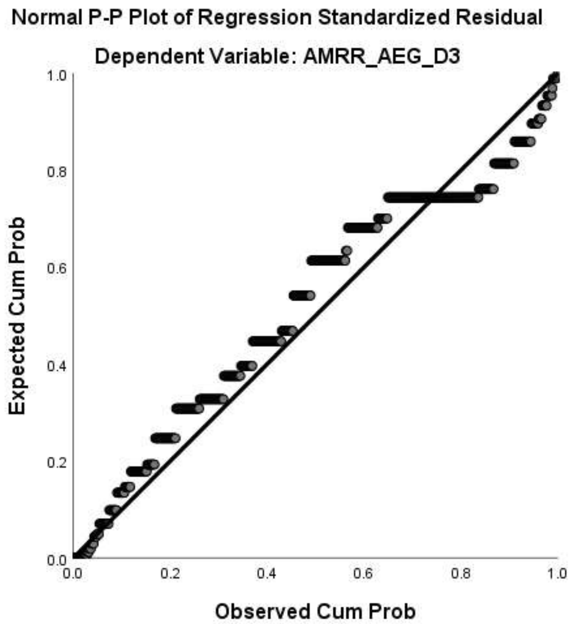

Figure 7.11: Illustration of the normality of the AEG employing P-P Plot
Notes: AEG=Agricultural economic growth

On the other hand, Figure 7.12 also demonstrated the homoscedasticity of the sustainable agri-machinery enterprises that impacts on the agricultural economic growth fitted well in this section.

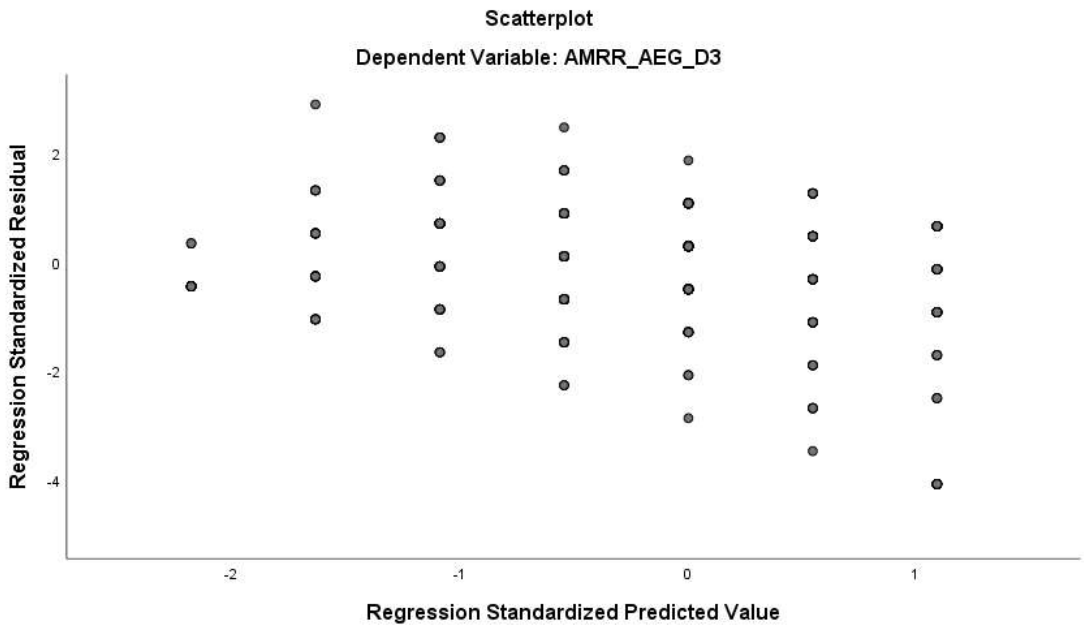

Figure 7.12: Illustration of the homoscedasticity of the AEG utilizing P-P Plot
Notes: AEG=Agricultural economic growth

In the next section, the model goodness of fit and hypotheses testing and structural model will be presented in more detail.

7.6 The development of the risk reduction model for the after-sale services of agricultural machinery.

In the previous sections, the researcher has determined the factors that influence the ASS of AM by means of the principal axis factoring and multiple regression analysis. Furthermore, the Pearson correlation coefficient was employed to ascertain by measuring of the relationship between mechanical risk reduction, customer risk reduction, financial resources and risk reduction of ASS of AM. Moreover, the five financial resources have been identified through multiple regression analysis. The relationships between the ASS risk reduction of AM, the sustainable agri-machinery enterprise and the agricultural economic growth have also been discussed via the basic regression analysis and correlation.

However, the model testing and goodness of fit of the model have not yet been evaluated. And, it is hard to test the whole model by means of a single correlation or regression. Subsequently, structural equation modelling (SEM) is a proper and suitable research implement to bridge this gap. SEM is a multivariate technique that can be used as a mixture or amalgamation of factor analysis and path analysis (Sharif et al., 2019). SEM can be employed to simultaneously determine a set of relationships between latent variables (not directly measured) and observed variables (directly measured) (Sharif et al., 2019). Furthermore, Mustafa, Nordin, and Abdul Razzaq (2020) interpret that SEM is the second generation of multivariate analysis in the research. They mention that it is very popular with researchers and academics in the context of analysing the data obtained from questionnaires (Mustafa et al., 2020).

Meanwhile, the applications and use of AMOS to undertake the SEM method are extremely proper and appropriate as the analysis tools will offer more accurate and precise research results (Mustafa et al., 2020). They further indicate that the principal standard and norm for determining the compatibility of the SEM model are to check the loading factor value whether they are ⩾ 0.50 and must be positive. In addition, the other criterion or standards proposed for this fit fitness index are as follows: for instance, the GFI, NFI, CFI and TLI values etc. should be ⩾ 0.90, while the RMSEA value should be ⩽ 0.08 (Junjun Chen 2019; Mustafa, Nordin, and Abdul Razzaq 2020).

In this study, the observed variables are the main and basic components of this SEM which are FR (financial resources), MRRI (the mechanical risk reduction indicator), CRRI (customer risk reduction indicator), AMRR (Agricultural machinery Risk reduction), SAE (sustainable agri-machinery enterprise) and AEG (agri-economic growth), as shown in Figure 7.13. All resulting factor loading values have been illustrated in Figure 7.13. Furthermore, the factor loadings between observed variables are the main values focused on by the researcher in this study. The detailed discussion will be interpreted in the following section. AMOS (SPSS) version 23 is employed to test the model structure as well as the goodness of fit in this section.

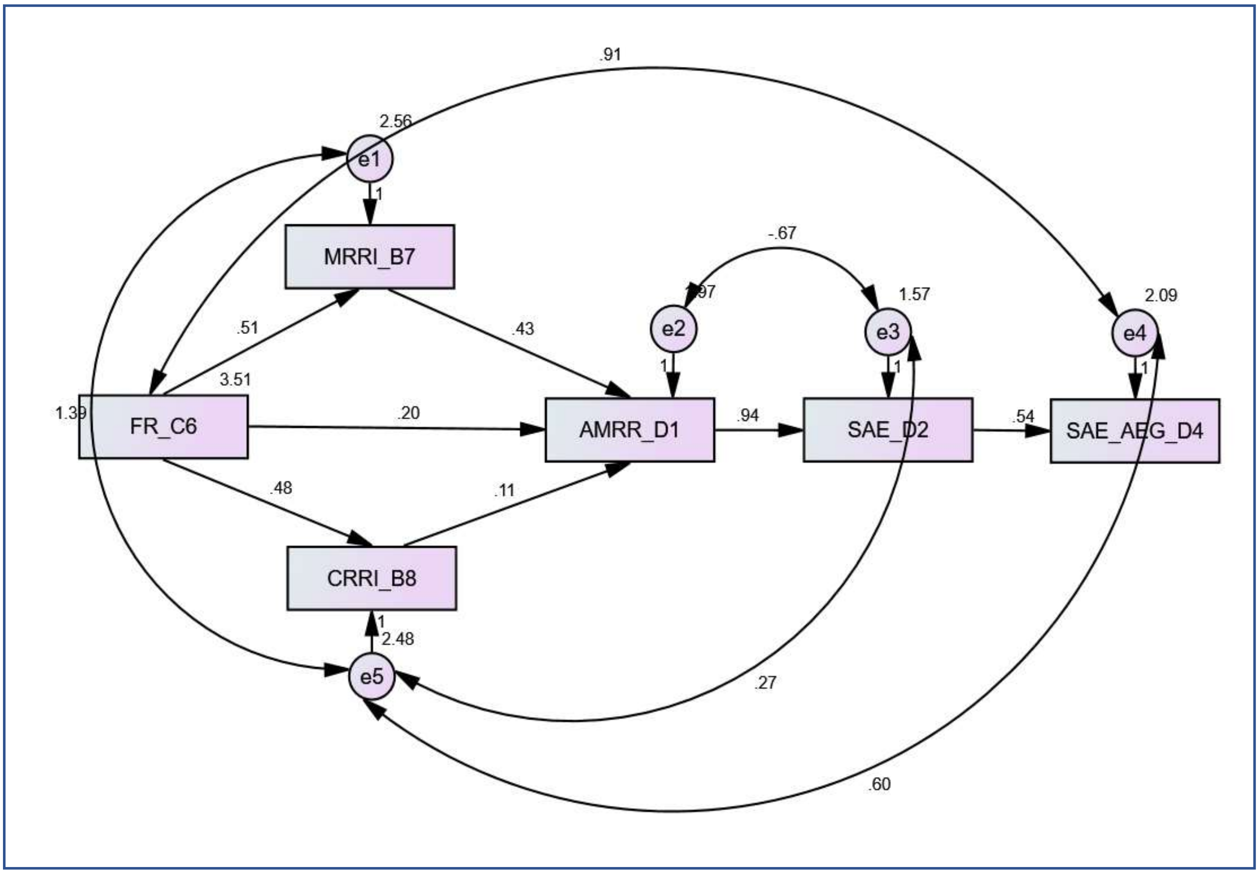

Figure 7.13: Structural Equation Model of risk reduction for the after-sale services of AM

Notes: FR_C6 = financial resources, MRRI_B7 = the mechanical risk reduction indicator, CRRI _B8= customer risk reduction indicator, AMRR_D1 = agricultural machinery risk reduction, SAE_D2 = sustainable agri-machinery enterprise, and AEG_D4 = agri-economic growth.

Source: Own survey data (2019-2020)

In this part, the focus is only on the factor loadings values between the observed variables. The values on the arrows are not in the scope of this study. The detailed explanations will be illustrated in Section 7.6.2.

7.6.1 Model goodness of fit

The goodness of fit of a statistical model depicts how favourable it suits a series of observations. Measures and gauges of the goodness of fit usually make a summary of the difference between observed values and the values expected in the model. The study assessed a model fit by using several fit indices and exponents such as chi-square/degree of freedom (χ^2/df), incremental fit index (IFI), normed fit index (NFI), the goodness of fit index (GFI), Tuckers-Lewis's index, comparative fit index (CFI), standardized root mean residual, and root means the square error of approximation (RMSEA) (see Table 7.10). The goodness of fit values has been discussed in the previous section. Furthermore, the criterion and standards proposed for this fit fitness index have also been exhibited in the former section (for instance, the GFI, NFI, CFI and TLI values etc. should be ⩾ 0.90, while the RMSEA value should be ⩽ 0.08) (Sahoo 2019; Yam and Kumcağız 2020).

Table 7.10: The model summary showing the goodness of fit

Goodness of fit	SEMs values	Recommended threshold	Remarks
Chi-square/degree of freedom (CMIN/DF)	5.34	⩽3.00	Not acceptable fit
Normed fit index (NFI)	0.993	⩾.90	Good fit
Comparative fit index (CFI)	0.995	⩾.90	Good fit
Incremental fit index (IFI)	0.995	⩾.90	Good fit
Tuckers-Lewis's index (TLI)	0.973	⩾.90	Good fit
Root mean squared error of approximation (RMSEA)	0.077	⩽.08	Acceptable fit
Goodness of fit (GFI)	0.993	⩾.95	Good fit

Source: Own survey data (2019-2020)

According to results in Table 7.10, the model yielded a chi-squared/degree of freedom that is not an acceptable fit given the sample data of $\chi^2/df = 5.34$. However, other goodness of fit index yields an acceptable and good fit. Table 7.10, shows that goodness of fit (GFI) = 0.993, normed fit index (NFI) = 0.993, Incremental Fit Index (IFI) = 0.995, Tuckers-Lewis's index (TLI)= 0.973, comparative fit index (CFI) = 0.995, and root mean squared error of approximation (RMSEA) = 0.077. In a nutshell, this study implies that the majority of conditions for overall model fit indexes under this model are met well.

7.6.2 The structural model testing

An analysis of the data employing the structural equation modelling (SEM) procedure, as illustrated in Table 7.10 and Table 7.11, demonstrates the relative contributions of better comprehension and understanding of the risk reduction model of after-sale services of AM. From the unstandardized estimates, the study from surveyed data reveals that all the relationships between observed variables are verified to be supported according to criterion (they are ⩾ 0.50 and must be positive.). Therefore, the β value of FR and CRRI is 0.484 and p-value is less than $p < 0.000$, which means it has a significant effect. Furthermore, this indicates that a unit increase in financial resources will results in 48.4%

(β = .484, p < .000) in customer risk reduction of AM. This result implies that the financial resources significantly impact the customers in averting the after-care support mechanism's risk.

Table 7.11: Results of structural equation model analysis

Relationship			Estimate	S.E.	C.R.	P	Rej/Sup
CRRI_B8	<---	FR_C6	.484	.031	15.690	***	S
MRRI_B7	<---	FR_C6	.512	.031	16.274	***	S
AMRR_D1	<---	MRRI_B7	.426	.038	11.121	***	S
AMRR_D1	<---	CRRI_B8	.110	.039	2.816	.005	S
AMRR_D1	<---	FR_C6	.197	.031	6.406	***	S
SAE_D2	<---	AMRR_D1	.939	.039	23.938	***	S
AEG_D4	<---	SAE_D2	.540	.031	17.606	***	S

Notes: SE= Standardized estimates, CR=Composite reliability, Rej = Rejected and Sup = Supported, *** = p < 0.001, ** = p < 0.01, * = p < 0.05.
Notes: FR_C6 = Financial resources, MRRI_B7 = the mechanical risk reduction indicator, CRRI _B8= Customer risk reduction indicator, AMRR_D1 = Agricultural machinery Risk reduction, SAE_D2 = Sustainable agricultural enterprise, and RREG_D3 = Economic growth.
Source: Own survey data (2019-2020)

Similarly, financial resources will affect mechanical risk reduction 51.2% (β = 0.512, p < 0.000), agricultural machineries risk reduction 19.7% (β = 0.197, p < 0.000). This means the influences of financial resources on the MRRI and AMRR are significant in this study model. However, the magnitude or degree of impact of FR on MRRI is larger than AMRR, as displayed in Table 7.11. Meanwhile, the effect of MRRI on the agricultural machinery risk reduction of after-sales service is 46.2% (β = 0.462, p < 0.000), which implies that the effect is also significant. On the other hand, customer risk reduction has a relatively small influence on ASS risk reduction of AM than MRRI, in which the β value is 0.110 and p-value is 0.005 (less than 0.05). This is because the customers need relatively little maintenance, training and user information systems than mechanical risk reduction indicators.

However, agricultural machinery risk reduction could increase sustainable agriculture by 93.9% (β = 0.939, p < 0.000) in the model. This result shows that if agricultural machinery risk reduction is affected, it will enhance sustainable agriculture, which is quite important for the economy and food security. The model also shows that sustainable agri-machinery enterprises will increase agricultural economic growth by 54.0% (β = 0.540, p < 0.000). Some findings discussed in this model were mentioned by various studies to some extent or in different regards (Samie et al. 2020; Baz et al. 2020; Balsalobre-Lorente et al. 2020). In a nutshell, these findings and results are novel and innovative in the context of the relationships between FR, AMRR, SAE and AEG.

7.7 The data discussion of focus-group interview

As interpreted in Sections 4.5.2 and 5.5.2.2, thematic content analysis (TCA) has been introduced. In this study, TCA is a proper and suitable qualitative data analysis method to analyse the data obtained from the focus-group interviews in South Africa and China. The detailed explanation and discussion will be displayed in more detail in the following sections.

7.7.1 The data discussion of South African focus-group interview

According to South African focus-group interview one, it is not difficult to find out that the participants involved in this focus-group interview basically agree with the result obtained from the quantitative data analysis, as shown in Table 7.12. Some argue that the relatively large influence factors of ASS are maintenance (B4) and training courses (B5). The least influential factor of ASS should be the user information system and centre (B6). This is because the user information system is less influence in South Africa nowadays. Others debate that maintenance has the least impact on ASS comparing to the automobile industry. All of the discussion is illustrated in Table 7.12. The participants basically agree with the results obtained from the quantitative data analysed. It is worth mentioning that the participants state that the only reason that can sustain the long-standing development of AM enterprises is after-sales service. Especially in the context of fierce competition nowadays, the AM after-sales service is very significant to an AM enterprises' long-standing sustainable development. However, the sustainable agricultural machinery company can improve the evolvement and growth of the agri-economy by means of supplying advanced machines that can enhance agri-productivity.

Table 7.12: Data discussion and analysis of South African focus-group interview one

Questions	SAFGI one
Question one	The participants involved in this focus-group interview fully agree with the result obtained from the quantitative data analysis. Furthermore, all factors that influenced the after-sales service of agricultural machinery have a positive effect on the risk reduction of agricultural machinery. However, expert/technician (B1), timely repair (B2), spare parts (B3) and maintenance (B4) had considerable influence, followed by training course (B5) and user information system (B6) by means of PAF (principal axis factoring) analysis. Some argue that the relatively large influence factors of ASS are maintenance (B4) and training course (B5). The least effective factor of ASS should be the user information system and centre (B6). Others debate that maintenance has the least impact on ASS comparing to the automobile industry.

Question two	All participants basically recognize the result that saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on the after-sales service of agricultural machinery. They approve that the factor of grant (C5) affects extremely largely, followed by the sponsorship (C4) and credit (C3). Meanwhile, saving (C1) and overdraft (C2) have the least influence. If the farmers in South Africa can get the grant from the government, the grant will be a major influential factor to ASS. In addition, they debate that grants, sponsorship and profit are much more important than other factors.
Question three	They fully agree that the FR (saving, overdraft, access to credit, sponsorship and grant) impact largely on MRRI (0.51) (technician, timely repair and spare parts) and CRRI (0.48) (maintenance, training course and user system and centre). However, some participants explained that if the AM companies and dealers get more finance, they will put the fund on the MRRI a little bit more than CRRI.
Question four	All participants fully concur with the result analysed from the quantitative data. MRRI (0.43) influences the AMRR largely than CRRI (0.11). Comparatively speaking, CRRI is less influence than MRRI from the perspectives of AM companies, the dealer as well as users.
Question five	They basically agree with the results of the quantitative data analysis. The more financial resources the AM company acquires, the more risk reduction of after-sales service. However, they argue that the magnitude or degree of influence should be a little bit higher than this result.
Question six	This result from the surveys is absolutely true. From the perspective of dealers in South Africa, the ASS of AM is very significant in terms of long-term development. The only reason that can sustain the long-standing development of the enterprise is after-sales service. Especially in the context of fierce competition nowadays, the after-sales service is very significant to an enterprise long-standing sustainable development.
Question seven	This result from the surveys is exactly affirmative. As agriculture is becoming more and more mechanized, the demand for farm equipment becomes bigger and bigger. However, a sustainable agricultural machinery company can meet this gap. Furthermore, it can improve the evolvement and growth of the agri-economy by means of providing advanced machines that can enhance productivity.

Note: SAFGI=South African focus-group interview, FR = financial resources, MRRI = mechanical risk reduction indicator, CRRI = customer risk reduction indicator, AMRR = the after-sales service of agricultural machinery risk reduction, SAE = sustainable agri-machinery enterprise, and AEG = agricultural economic growth

According to South African focus-group interview two, the participants involved in this focus-group interview fully agree with the results obtained from the 739 survey questionnaires analysis, as shown in Table 7.13. From the South African perspective, some consider that timely repair (B2) and spare parts (B3) are the most significant factors that influence the ASS of AM. The dealers and agents in South Africa explained that the user system and centre (B6) are crucial and key for the ASS of AM. On the other hand, it has less effect than others, as discussed in Table 7.13.

All participants basically recognize the results that saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on ASS of AM, as shown in Table 7.13. In Table 7.13, some also argue and provide a different viewpoint. The discussion of questions three, four, five, six and seven have also been elaborated in more detail in Table 7.13. Especially for questions six and seven, they argue that the after-sales service is very significant for the long-standing survival and development of AM enterprises, which is also the most important competing factor for surviving. Moreover, sustainable agricultural machinery enterprises, which can supply advanced and high-quality AM, has an extremely large and positive influence on the growth of the agricultural economy.

Table 7.13: Data discussion and analysis of South African focus-group interview two

Questions	SAFGI two
Question one	The participants involved in this focus-group interview fully agree with the result obtained from the 739 questionnaires analysis. In the context of South Africa, timely repair (B2) and spare parts (B3) are the most significant factors that influence the ASS of AM. From the users' perspective, the user system and centre (B6) have less effect than others. However, the user system and centre (B6) are very crucial for dealers and agents. From the professional users' perspective, they will take the spare parts seriously than others, as they know how to repair and maintenance without a training course. Commercial farmers who have higher mechanization will need more ASS, such as training courses, technicians, spare parts, and maintenance. The user system is similar to the service hotline, via which the customers can contact the experts of ASS to assist them in addressing the problem. They consider that timely repair and spare parts are much more significant than other factors.
Question two	All participants fundamentally recognize the result that saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on the after-sales service of agricultural machinery. They approve that the factor of grant (C5) affects extremely largely followed by the sponsorship (C4) and credit (C3). Meanwhile, saving (C1) and overdraft (C2) have the least influence. Some argue that, from the South African dealers or agents' perspective, the saving or profit of AM is very significant to survive in the market. In South Africa, some dealers can acquire grants and sponsorship via collaboration with banks and relevant institutions.
Question three	They fully agree that the FR (saving, overdraft, access to credit, sponsorship and grant) impact largely on MRRI (0.51) (technician, timely repair and spare parts) and CRRI (0.48) (maintenance, training course and

	user system and centre). On the other hand, the magnitude effect of FR on MRRI (0.51) and CRRI (0.48) is practically equivalently important.
Question four	All participants fully concur with the result analysed from the quantitative data. MRRI (0.43) influences the AMRR extremely largely than CRRI (0.11). From their viewpoints, they debate that MRRI has a significant influence on AMRR.
Question five	From the enterprise and South African agent perspective, they agree with this result. Maybe distinct stakeholders have different judgements regarding how much it can affect. In conclusion, they believe that it has a positive influence on ASS risk reduction.
Question six	The after-sales service is very significant for the long-standing survival and development of AM enterprise, which is also the most important competitor factor for surviving. This is the survival baseline for the dealers in South Africa. Nowadays, the company takes the bundling strategy, which means the company takes all the factors together in a bid to exert its advantage to compete with other enterprises. If the after-sales service risk is reduced through using this strategy, it should be extremely crucial for the sustainable AM enterprise as well as long-term dealers or agents of Chinese AM enterprises in South Africa.
Question seven	All of the South African participants debate that the sustainable agricultural machinery enterprise has a large and positive influence on the growth of the agricultural economy. Especially in Africa and South Africa, its effects should be much larger due to the provision of food and other agri-issues. If it can accomplish agri-mechanization in Africa and South Africa, this can heighten the quantity and provision of crop grain, vegetables, and food etc. All of this needs agricultural mechanization, which can be accomplished by the high-quality AMs manufactured and provided by sustainable AM enterprises.

Note: SAFGI=South African focus-group interview, FR = financial resources, MRRI = mechanical risk reduction indicator, CRRI = customer risk reduction indicator, AMRR = the after-sales service of agricultural machinery risk reduction, SAE = sustainable agri-machinery enterprise, and AEG = agricultural economic growth

According to South African focus-group interview three, the participants involved in this focus-group interview fully agree with the result obtained from the 739 questionnaires analysis, as shown in Table 7.14. From the South African perspective, some debate that expert/technician (B1) and spare parts (B3) are needed in South Africa for farmers and users in a bid to make the malfunction of AM to be fitted as little time as possible. According to some South African participants' perspectives, maintenance has limited influence, as shown in Table 7.14.

All participants basically recognize the result that saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on ASS of AM, as shown in Table 7.14. In Table 7.14, some also argue and provide different viewpoints. The discussion of question three, four, five, six and seven have also been elaborated in more detail in Table 7.14. Especially for questions six and seven, they argue that the after-sales service is very significant for the long-standing survival and development of AM enterprise, which is also one of the most important competing factors for AM enterprise survival and development. However, the sustainable agricultural machinery company can bridge this gap of ASS of AM. Furthermore, it can improve the growth of the agri-economy by means of providing advanced AMs.

Table 7.14: Data discussion and analysis of South African focus-group interview three

Questions	SAFGI three
Question one	The participants involved in this focus-group interview fully agree with the results analysed from the 739 questionnaires analysis. However, some South African farmers argue that timely repair (B2), training course (B5) and the user information system (B6) have a considerable effect on the after-sales service of farm equipment. On the other hand, some debate that expert/technician (B1) and spare parts (B3) are needed in South Africa for farmers and users, as the malfunction of AM can be dealt with using them as little time as possible. According to some South African participants' perspectives, maintenance has limited influence on South African farmers and users.
Question two	All participants fundamentally recognize the result that saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on the after-sales service of agricultural machinery. They approve that the factor of grant (C5) affects extremely largely, followed by the sponsorship (C4) and credit (C3). Meanwhile, saving (C1) and overdraft (C2) have the least influence. Some dispute that grants have a large influence on the ASS of AM because the customers should be able to have the money available to require the service needed. However, some argue that access to credit and sponsorship also have a significant effect on the ASS of AM, as it will determine the ability to obtain finance for farmers and users in South Africa. In addition, some participants argue that the better way to get sponsorship is to make sure the AM enterprises can have an excellent track record. Meanwhile, the AM enterprises think the saving and overdraft play a minor role in determining the ASS risk reduction of AM in South Africa.
Question three	They elementally agree that the FR (saving, overdraft, access to credit, sponsor and grant) impact largely on MRRI (0.51) (technician, timely repair and spare parts) and CRRI (0.48) (maintenance, training course and user system and centre). Some South African participants argue that it is true because the customers or users need all of the financial resources mentioned above to be able to have a good relationship with the after-sales service of AM in South Africa.
Question	All participators fully concur with the result analysed from the

four	quantitative data. MRRI (0.43) influences the AMRR much more largely than CRRI (0.11). If the AM companies or dealers can provide sufficient spare parts and timely repair, the customer will be satisfied with the products and after-sales service. This can be beneficial for them to win word-of-mouth. However, even if there is no CRRI, it can operate normally by the AM enterprises.
Question five	They basically agree with the result of the quantitative data analysis. The more financial resources the AM company acquires, the less risk of after-sales service. However, some South African participants argue that the magnitude or degree of influence should be a little bit higher than this result.
Question six	This result obtained from the surveys is exceedingly true. From the perspective of dealers in South Africa, the ASS of AM is much more significant in terms of the long-term development of AM companies. With the development of science and technology in modern society, the easy way that can sustain the long-standing development of AM enterprise is after-sales service. In conclusion, the result obtained from the quantitative data analysis is very significant for AM enterprises both in South Africa and China.
Question seven	This result is exactly affirmative. AM enterprises can supply advanced and high-quality machines for farmers and users who can employ them to improve the agri-productivity, which is further beneficial for the growth of the agricultural economy. However, sustainable agricultural machinery companies can bridge this gap. Furthermore, it can improve the growth of the agri-economy by means of providing advanced AMs.

Note: SAFGI=South African focus-group interview, FR = financial resources, MRRI = mechanical risk reduction indicator, CRRI = customer risk reduction indicator, AMRR = the after-sales service of agricultural machinery risk reduction, SAE = sustainable agri-machinery enterprise, and AEG = agricultural economic growth

According to South African focus-group interview four, the participants involved in this focus-group interview basically agree with the result obtained from the 739 questionnaires analysis, as shown in Table 7.15. From the South African perspective, some argue that expert/technician, timely repair, and spare parts are significant influential factors that impact the ASS of AM in South Africa. It is impossible to repair the AM without professional technicians. Some argue the maintenance and training are also crucial to the ASS of AM, as maintenance can guarantee the machinery operate regularly and normally, as shown in Table 7.15.

All participants fundamentally recognize the result that saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on ASS of AM, as shown in Table 7.15. Some SA participants dispute that grants are lack in South Africa than in China. Moreover, the discussion of questions three, four, five, six and seven have also been elaborated in more detail in Table 7.15.

Table 7.15: Data discussion and analysis of South African focus-group interview four

Questions	SAFGI four
Question one	The participants involved in this focus-group interview fully agree with the result collected based on the 739 questionnaires data analysis. Subsequently, all factors that influenced the after-sales service of agricultural machinery have a positive effect on the risk reduction of agricultural machinery. On the other hand, expert/technician (B1), timely repair (B2), spare parts (B3) and maintenance (B4) have considerable influence, followed by training course (B5) and user information system (B6) by means of PAF (principal axis factoring) analysis. Some argue that expert/technician, timely repair and spare parts are also significant influential factors that impact the ASS of AM in South Africa. It is impossible to repair the AM without a skilled expert. Some argue the maintenance and training are also crucial to the ASS of AM, as maintenance can guarantee the machinery operate regularly and normally. However, the training courses can ensure the user can use the AM proficiently and do simple repair and maintenance.
Question two	All participants fully recognize the result that saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on the after-sales service of agricultural machinery. They approve that the factor of grant (C5) affects extremely largely, followed by the sponsorship (C4) and credit (C3). Meanwhile, saving (C1) and overdraft (C2) have the least influence. Some dispute that grant is the lack in South Africa than in China. Credit, overdraft and saving are very significant to small-holder farmers in South Africa.
Question three	They elementally agree that the FR (saving, overdraft, access to credit, sponsor and grant) impact largely on MRRI (0.51) (technician, timely repair and spare parts) and CRRI (0.48) (maintenance, training course and user system and centre. The financial resources are very significant to the risk reduction of after-sales service of agricultural machinery in South Africa.
Question four	All participants basically concur with the result analysed from the quantitative data. MRRI (0.43) influences the AMRR largely than CRRI (0.11). If the AM companies or dealers can provide sufficient spare parts and timely repair, the customers will be satisfied with the product and after-sales service. It can be helpful for AM companies to get more customers. Compared to MRRI, CRRI is relatively less influential than MRRI, as CRRI is less important than MRRI from AM enterprises' and users' perspectives.
Question five	They fully agree with the result of the quantitative data analysis. The more financial resources the AM company acquires, the more risk reduction of after-sales service. However, some SA participants argue that if they can obtain more financial resources, they can get more AMs and services to

	reduce the risk of ASS of AM in South Africa.
Question six	This result from the survey is absolutely exact. From the dealers' perspective in South Africa, ASS is much more important in terms of the long-term development of farm equipment. However, the only reason that can sustain the long-standing development of AM enterprise is after-sales service. Especially in modern society, the after-sales service is apparently significant for AM enterprise's long-standing survival and development. The excellent ASS can guarantee the survival and development of farm equipment companies in South Africa.
Question seven	This result obtained from the survey is exactly affirmative. The agricultural machinery can provide advanced machinery to assist farmers in improving the agri-productivity in all regards. Furthermore, it can also assist farmers in getting rid of drudgery. Meanwhile, agricultural mechanization depends on advanced farm equipment offering as well. However, sustainable agricultural machinery companies can meet this gap. Furthermore, it can improve the evolvement of the agri-economy by using advanced machines.

Note: SAFGI=South African focus-group interview, FR = financial resources, MRRI = mechanical risk reduction indicator, CRRI = customer risk reduction indicator, AMRR = the after-sales service of agricultural machinery risk reduction, SAE = sustainable agri-machinery enterprise, and AEG = agricultural economic growth

In conclusion, the participants from the South African focus-group interview basically approve the results obtained from the quantitative data analysed.

7.7.2 The data discussion of Chinese focus-group interview

According to the Chinese focus-group interview one, the participants involved in this focus-group interview fully agree with the results gathered based on quantitative data analysis, as shown in Table 7.16. The factors of ASS, including expert/technician (B1), timely repair (B2), spare parts (B3), training course (B5) and user system and centre (B6) have a positive effect on risk reduction of agricultural machinery ASS.

Table 7.16 tells that all participants fundamentally recognize the results from the survey that saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on the after-sales service of agricultural machinery. The detailed discussion has been elaborated in Table 7.16. They basically agree that the FR impacts largely on MRRI and CRRI. Meanwhile, MRRI influences the AMRR much more largely than CRRI, as shown in Table 7.16. MRRI is a direct and principal factor that impacts the AMRR, because the most crucial parts of ASS of AM incorporate technician, spare parts and timely repair, which belong to MRRI in the light of the common understanding. On the contrary, CRRI (maintenance, training course and user system and centre) has an indirect and oblique impact on AMRR.

The discussion of question five, six and seven have also discoursed in more detail in Table 7.16. Especially for questions six and seven, they argue that nowadays, there are not many differences among the machines, so ASS is a key competitor factor for surviving and success for the sustainable AM enterprises. Furthermore, the sustainable agricultural enterprise can provide modern and large machinery in a bid to improve agri-productivity, which can increase the agri-economy, as demonstrated in Table 7.16.

Table 7.16: Data discussion and analysis of Chinese focus-group interview one

Questions	CFGI one
Question one	The participants involved in this focus-group interview basically agree with the result gathered based on the 739 questionnaires analysis. They mention that the training of AM is very crucial for risk reduction of ASS. If the users can operate and maintain the AM properly following the proper training course, it can avoid AM's damage. Some participants argue that maintenance has less influence; on the other hand, it can indirectly impact the risk reduction of ASS.
Question two	All participants fundamentally recognize the result from the survey that saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on the after-sales service of agricultural machinery. They approve that the factor of grant (C5) affects extremely largely, followed by the sponsorship (C4) and credit (C3). Meanwhile, saving (C1) and overdraft (C2) have the least influence. If the AM enterprise gets more finical resources, it can improve the ASS level of agricultural machinery. Furthermore, the AM company can use these financial resources to employ more technicians, store more spare parts, to offer timely repair as well as a training course. They also mention that the national policy is very important for risk reduction of ASS of AM, such as grants provided by the government, access to government credit as well as a sponsorship from governments or institutions.
Question three	They basically agree that the FR (saving, overdraft, access to credit, sponsorship and grant) impact largely on MRRI (0.51) (technician, timely repair and spare parts) and CRRI (0.48) (maintenance, training course and user system and centre). The participants discuss that both MRRI and CRRI need fund support, no matter they are saving, overdraft, access to credit, sponsor or grant. In summary, the conclusion is that FR definitely impacts MRRI and CRRI.
Question four	The participants fully concur with the result analysed by the quantitative data. MRRI (0.43) influences the AMRR much more largely than CRRI (0.11). MRRI is a direct and principal factor that impacts the AMRR, because the most crucial parts of ASS of AM incorporate technician, spare parts and timely repair, which belong to MRRI in the light of the common understanding. On the contrary, AMRR (maintenance, training course and user system and centre) has an indirect and oblique impact

	on AMRR.
Question five	Obviously, the FR is very significant to AMRR. The participants basically agree with the impact of FR on AMRR. However, they are not very definite about the degree of influence. On the other hand, they argue that if the AM enterprises get more FR, they can provide better and high-quality ASS, customer care etc., so that the FR has a positive influence upon AMRR.
Question six	According to the quantitative result, AMRR impacts extremely largely on SAE (0.94). Because the technology, hardware facilitates, equipment, AM have been evolved equivalently, ASS is a key competitive factor of survival and success for sustainable AM enterprises. In China, AM companies rely on after-sales service to occupy marketing. If the companies provide excellent ASS to farmers, they are satisfied with the services and will further introduce more customers to purchase AM, which can become a benign circulation.
Question seven	The sustainable agricultural enterprise has an exceeding influence upon the agricultural economy's growth (0.54) in light of this quantitative result. The sustainable agricultural enterprise can provide modern and large machinery in a bid to improve productivity which can facilitate the agri-economy.

Note: CFGI=Chinese focus-group interview, FR = financial resources, MRRI = mechanical risk reduction indicator, CRRI = customer risk reduction indicator, AMRR = the after-sales service of agricultural machinery risk reduction, SAE = sustainable agri-machinery enterprise, and AEG = agricultural economic growth

According to Chinese focus-group interview two, the participants involved in this focus-group interview fully agree with the results based on quantitative data analysis, as shown in Table 7.17. Some participants believe that timely repair (B2), technician (B1) and spare parts (B3) influence the ASS risk reduction largely. Meanwhile, they argue that maintenance (B4) has an energetic influence on ASS risk reduction. Nevertheless, farmers in China do not take maintenance seriously, as most of them do not know how to maintain it.

Table 7.17 states that all participants basically recognize the result that saving (C1), overdraft (C2), access to credit (C3), sponsor (C4) and grant (C5) have a positive influence on the after-sales service of agricultural machinery. Moreover, they argue that the saving effect the ASS of AM largely as the enterprise profit is crucial for its development, as illustrated in Table 7.17.

The discussion of question three, four, five, six and seven have also been expounded in more detail in Table 7.17. They basically agree that the FR impact largely on MRRI and CRRI. Meanwhile, there is no big discrepancy of effect on MRRI and CRRI, as shown in Table 7.17. The participants fully concur that MRRI (0.43) influences the AMRR largely than CRRI (0.11), as technicians, timely repair, and spare parts are more significant than others comparatively. They agree the financial resources have a positive impact on ASS risk reduction of AM. However, they dispute that the magnitude should be larger than this result.

All participants unanimously approve that AMRR affects sustainable AM enterprises largely, as discussed in Table 7.17. Meanwhile, Table 7.17 argues that the sustainable agricultural enterprise influences the growth of the agricultural economy (0.54), as the future of Chinese agriculture depends on the agricultural modernization and mechanization. This should be accomplished by offering advanced AMs manufactured by sustainable AM enterprises.

Table 7.17: Data discussion and analysis of Chinese focus-group interview two

Questions	CFGI two
Question one	The participants involved in this focus-group interview basically agree with the results based on the qunati-data analysis. Moreover, some participants believe that timely repair (B2), spare parts (B3) influence the ASS risk reduction largely. The timely repair can guarantee to provide seasonable service in a bid not to delay the usage of AM. They also believe that expert/technician (B1) is strongly determinant to ASS risk reduction. Meanwhile, they argue that maintenance (B4) has an energetic influence on ASS risk reduction, as AM needs maintenance of hydraulic system, engine oil, and important parts cleaning. Some participants debate that timely repair (B2), expert/technician (B1) and spare parts (B3) are the most important factors due to the busy farming season. Nevertheless, farmers do not take maintenance seriously in China, as most of them do not know how to maintain it.
Question two	All participants basically recognize the result that saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on the after-sales service of agricultural machinery. They approve that the factor of grant (C5) affects extremely largely, followed by the sponsorship (C4) and credit (C3). Meanwhile, saving (C1) and overdraft (C2) have the least influence. Undoubtedly, the financial factor that impacts largely on ASS is a grant (C5) in China. Moreover, they argue that the saving affects the ASS of AM largely as the enterprise profit is crucial for its development as well as an after-sales service offering.
Question three	They basically agree that the FR (saving, overdraft, access to credit, sponsorship and grant) impact enormously on MRRI (0.51) (technician, timely repair and spare parts) and CRRI (0.48) (maintenance, training course and user information system). There is not much big discrepancy of effect on MRRI and CRRI.
Question four	The participators principally concur with the result analyzed via the quantitative data. MRRI (0.43) influences the AMRR much more largely than CRRI (0.11), as technicians, timely repair and spare parts are much more significant than others comparatively. MRRI is the apparent matter

	that farmers have the problem that needs MRRI to solve. However, CRRI is an invisible and imperceptible issue that is not extremely urgent or imperative for AM users. Accordingly, CRRI has a lower percentage, as ASS will deal with the imperative issue firstly.
Question five	All participants agree the financial resources have a positive impact on ASS risk reduction of AM. However, they dispute that they are not the exact magnitude of the influence. On the other hand, they consider the magnitude influence should be much larger than this result. The situation is that if the AM enterprises get more FR, they can put more inputs on ASS in a bid to cut down the risk of ASS of AM.
Question six	All participants unanimously approve that AMRR affects sustainable AM enterprises largely. The participants debate that the users trust the AM enterprises because the AM enterprises provide excellent and high-quality ASS. Compared to the quality and price of AM, the customers would prefer that the enterprises or dealers can supply spare parts or repair timely once they have any problem. Once the problem is met by AM enterprises, they will buy more machinery and recommend their friends and relatives to purchase, which can lead to the company's prosperity and sustainability.
Question seven	The sustainable agricultural enterprise's view exceedingly influencing the growth of the agricultural economy (0.54) has been accepted basically by all participants. The future of Chinese agriculture depends on agricultural modernization and mechanization supported by advanced AMs manufactured by sustainable AM enterprises. The SAE impacts largely on AEG. On the contrary, AEG can facilitate sustainable agricultural company development reversely. AM can promote agri-productivity exceedingly so that it can incur the huge heightening of the agricultural economy.

Note: CFGI=Chinese focus-group interview, FR = financial resources, MRRI = mechanical risk reduction indicator, CRRI = customer risk reduction indicator, AMRR = the after-sales service of agricultural machinery risk reduction, SAE = sustainable agri-machinery enterprise, and AEG = agricultural economic growth

According to Chinese focus-group interview three, the participants involved in this focus-group interview basically approve all of the results obtained from quantitative data analysis, as shown in Table 7.18. From the perspective of small and medium AM enterprises, the maintenance and training courses are much more important factors than others, as some of the farmers do not know how to operate and maintain the AM, as discussed in Table 7.18. Meanwhile, Table 7.18 debates that the AMs of small and medium AM enterprises are cheap in China. If it is broken, the users would rather buy a new one than repair or maintain the machines.

Table 7.18 states that all participants basically recognize the result that saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on the after-sales service of agricultural machinery. Moreover, some of the participants argue that the grant has the most significant influence on the ASS risk reduction. On the contrary, some debate that grant's influence on ASS is minimal, as shown in Table 7.18.

The discussion of questions three, four, five, six and seven have also been expounded explicitly in Table 7.18. They basically agree that the FR impacts largely on MRRI and CRRI. In addition, they state that if the farmers or users get more profit from the crop or vegetable product, they will purchase AM, vice versa. Table 7.18 states that once the tractor, irrigation system and plough have broken, the farmers need a skilled technician to repair the machinery promptly and timely with spare parts. Comparingly, training, maintenance and user system seem not that crucial as MRRI. However, it is challenging for small and medium AM enterprises to get grants, profit, and credit.

Table 7.18 explains that it is certain that ASS impacts largely on the sustainable agricultural enterprise. ASS plays a very significant and conclusive role in the sustainability of AM enterprise. If the AM company can supply high-quality farm equipment and excellent ASS to farmers and users, it can improve agricultural productivity. The farmers will get more profits from these agricultural products. Furthermore, they can afford more funds and taxes to benefit the government. Thereupon, the government will provide AM firms with more grant and policy support. In conclusion, this is beneficial for agricultural economic growth.

Table 7.18: Data discussion and analysis of Chinese focus-group interview three

Questions	CFGI three
Question one	The participants involved in this focus-group interview basically agree with the result analysed from the quanti-data analysis. From the perspective of small and medium AM enterprises, the maintenance and training courses are much more significant factors than others, as some of the farmers do not know how to operate and maintain the AM. However, older-age farmers in China have no knowledge regarding how to maintain agricultural machinery. The AMs of small and medium AM enterprises are cheap in China. If it is broken, the users would like to buy a new one, so it is unnecessary to repair or maintain the machine.
Question two	According to quantitative result, the factors that impact the financial resource, including saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on the after-sales service of agricultural machinery. All participants more or less recognize the result, as mentioned above. The factor of grant (C5) affects extremely largely, followed by the sponsorship (C4) and credit (C3). Saving (C1) and overdraft (C2) have the least influence. All participants fully agree with this conclusion. Some participants argue that the grant has the most significant influence on ASS risk reduction. However, in terms of the small farm equipment, the grant's influence on ASS is minimal. Moreover, there is another issue for medium and small AM

	enterprises. This issue is that they are afraid to apply for credit, sponsorship or overdrafts, as they are frightened that they cannot pay those funds back.
Question three	They basically agree with the results analysed from the quantitative data. They state that if the farmers or users get more profit from the crop or vegetable product, they will purchase AM, vice versa. If the farmers purchase more farm machinery, the government and AM enterprises can get more taxes and funds. Furthermore, the AM enterprises will put more funds on MRRI and CRRI.
Question four	The interviewees fully concur with the result analysed by the quantitative data. MRRI (0.43) influences the AMRR much more largely than CRRI (0.11). Someone provides the information that once the tractor, irrigation system and plough are broken, the farmers need professional technicians to repair the machinery promptly and timely with sufficient spare parts. Comparingly, training, maintenance and user system seem not that crucial as MRRI.
Question five	From the perspective of medium and small AM enterprises, it is challenging for them to get grants, profit, and credit. In addition, the AM enterprises need a large amount of capital in China to support the ASS. Consequently, the results show that FR has a positive influence on ASS risk reduction of AM in China.
Question six	It is certain that ASS impacts largely on the sustainable agri-machinery enterprises. ASS plays a very significant and conclusive role in the sustainability of AM enterprises. Finally, the AM enterprises cannot survive for long-term growth and evolvement without excellent ASS providing.
Question seven	The participants explain that if the AM companies can supply high-quality farm equipment and amazing ASS to farmers and users, it can improve agricultural productivity. The farmers will get more profit from these agricultural products. Furthermore, they can afford more funds and taxes to benefit the government. Thereupon, the government will provide AM firms with more grants and sponsorship accordingly. In conclusion, this is beneficial for agricultural economic growth.

Note: CFGI=Chinese focus-group interview, FR = financial resources, MRRI = mechanical risk reduction indicator, CRRI = customer risk reduction indicator, AMRR = the after-sales service of agricultural machinery risk reduction, SAE = sustainable agri-machinery enterprise, and AEG = agricultural economic growth

According to Chinese focus-group interview four, the participants involved in this focus-group interview basically approve all of the results obtained from quantitative data analysis, as demonstrated in Table 7.19. Some participants debate that technician (B1), timely repair (B2), spare parts (B3) have an exceedingly large influence on ASS of AM followed by training course (B5) and user system and centre (B6). Table 7.19 elaborates that the factor of maintenance (B4) is precisely the least one to impact the ASS of AM.

Table 7.19 states that all participants basically recognize the result that saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on the after-sales service of agricultural machinery. Moreover, the grant is very significant to farmers who buy and use agricultural machinery in China.

The discussion of question three, four, five, six and seven have also been expounded explicitly in Table 7.19. They basically agree that the financial resources would affect the MRRI and CRRI largely. In China, the AM drivers, who have long-standing utilization experience of AM, usually know how to maintain and operate the AM. The mature and experienced user information system is inadequate and scanty in China, so it leads to a situation of less influence. Accordingly, MRRI is much more significant than CRRI, as discussed in Table 7.19.

Absolutely, if the AM enterprises can get more finance and fund, it would be beneficial and favourable to the ASS of AM. Furthermore, AMRR has a large impact on the sustainable agricultural enterprise, as shown in Table 7.19. Sustainable AM enterprises can supply high-quality and exceptional farm equipment, which can promote the productivity of agricultural products. Finally, it can accelerate the improvement and enhancement of the agricultural economy.

Table 7.19: Data discussion and analysis of Chinese focus-group interview four

Questions	CFGI four
Question one	The participants involved in this focus-group interview basically agree with the results obtained from the 739 questionnaires analysis. The maintenance factor (B4) is exactly the least one to impact the ASS of AM. In the current Chinese AM market, the user system and centre (B6) denote a simple bridge to connect the dealers or AM enterprises and customers in a bid to provide the information and maintenance etc. However, some AM customers in China are professional and skilled operators, so a training course is apparently not much crucial for tractor operators. Absolutely, maintenance has the least influence in China nowadays, as tractor drivers in China can do the maintenance by themselves, for instance, to change engine oil or replace the oil filter.
Question two	According to quantitative result, the factors that impact the financial resource, including saving (C1), overdraft (C2), access to credit (C3), sponsorship (C4) and grant (C5) have a positive influence on the after-sales service of agricultural machinery. All participants basically recognized the result, as mentioned above. The factor of grant (C5) affects extremely largely, followed by the sponsorship (C4) and credit (C3). Saving (C1) and overdraft (C2) have the least influence. The participants principally agree with this conclusion. The grant is very significant to farmers who buy agricultural machinery in China. Furthermore, the AM enterprises can get more profit and funds following

	the AM sales, and then they will invest more in the ASS accordingly.
Question three	Certainly, the financial resource would affect the MRRI and CRRI to a large extent. However, the magnitude influence is indistinguishable. All of the participants accepted and consented to the result obtained from the quantitative data analysis.
Question four	Certainly, MRRI affetctng AMRR much more larger than CRRI. However, the magnitude influence is large. All of the participants accepted and consented to the result obtained from the quantitative data analysis. In China, the AM drivers, who have long-standing utilization experience of AM, usually know how to maintain and operate the AM. The mature and experienced user information systems and centres are inadequate and scanty in China.
Question five	Absolutely, if the AM enterprises can get more finance and fund, it would be beneficial and favourable to the ASS of AM. Once the AM company has more ways to obtain finance, the money inputs on the ASS are more. On the other hand, if the company takes advantage of finance to improve the quality of farm equipment, it can indirectly reduce the glitches and problems of machinery, reducing the cost of after-sales service.
Question six	The AMRR has a large impact on sustainable agri-machinery enterprises. All participants agree a hundred percent with this conclusion. Some participants explained that the risk reduction of AM and excellent AM providing determine the survival of AM enterprises. Nowadays, there is not much more difference in terms of the quality of products with the advancement and development of technology. The most significant factor for enterprises' sustainability, prosperity and stableness is excellent after-sales service providing. It is a decisive and life-and-death factor to SAE.
Question seven	The sustainable AM enterprises can supply high-quality and exceptional farm equipment, such as tractors, ploughs, harvesting machines, planters as well as irrigation systems etc. All these high-tech and professional machinery can promote the productivity of agricultural products. However, agricultural modernization is the precondition of agricultural improvement. Only sustainable AM companies can supply high-quality and advanced farm equipment to meet the users' demand. This can further achieve agricultural mechanization and facilitate agricultural productivity. Finally, it can accelerate the improvement and enhancement of the agricultural economy.

Note: CFGI=Chinese focus-group interview, FR = financial resources, MRRI = mechanical risk reduction indicator, CRRI = customer risk reduction indicator, AMRR = the after-sales service of agricultural machinery risk reduction, SAE = sustainable agri-machinery enterprise, and AEG = agricultural economic growth

In conclusion, the participants from the Chinese focus-group interview basically approve the results obtained from the quantitative data analysed. In the next part, the lesson learned from this data analysis will be demonstrated.

7.8 Lesson learnt

The results of both descriptive and inferential analysis, as demonstrated in Table 6.6 and 6.7, present critical lessons to the agricultural and engineering sector. From the descriptive analysis, it could be learned that working-age of 30-39 years old, with most of them being the youths, are attracted to this type of enterprise. This lesson goes against a general belief that agricultural enterprises attract only older adults, and youths do not like to be involved in these enterprises. On the other hand, the descriptive analysis, especially looking at the respondents' age, shows that youths are interested in agricultural machinery compared to the production side of agriculture.

Although youths are attracted to these enterprises, the study shows that males are still highly dominant participants, with women being subordinated in decision-making. Of central concerns, this study also illustrated that women are relatively lower educated, implying that they had very low-risk management and agricultural expertise compared to their male counterparts. The female also had low sales and business experiences, which are critical indicators of business capacity. This study advises the focus should also be on women's involvement in the context of agriculture and provide more opportunities to women both in China and South Africa.

On the empirical side, the study revealed that spare parts, timely repairs, training, and user information systems play a significant role in reducing the risk of agricultural machinery. On the other hand, this study showed that for these enterprises to be financially resourced, access to credit, sponsorship and grants need to be increased. According to the literature review, the quantitative and qualitative data analysis, the South African market is largely significant for the Chinese agri-machinery. This study advises Chinese AM enterprises, especially international companies, to treat after-sales service seriously in terms of ASS factors and financial factors. For instance, they should pay more attention to skilled technicians, timely repair, and spare parts. Financial resources also play an important role in sustaining the development of AM enterprises. No matter Chinese government and South African government should introduce the relevant policies to facilitate sustainable AM enterprises, such as financial support, government funds etc.

In addition, the factors of ASS of AM have a positive influence on the risk reduction of after-sales service. The risk reduction of after-sales service can affect positively and vigorously the sustainable agri-enterprises and the growth of the agri-economy. Furthermore, the quali-data has also been used to test the results analysed in the previous section.

7.9 Summary and conclusion

Given the current findings of this study, it is clear that without a well-coordinated dealership that provides ASS of AM to the users, the use of the Chinese machinery will be risky to use in the agricultural sector. This observation may apply mainly in the case of other countries where such resources have to be established.

The factors that impact the ASS risk reduction of AM have been determined via the principal axis factoring (Table 7.2) and multiple regression analysis (Table 7.3). The six factors are expert, spare parts, timely repair, maintenance, training and user information system. Meanwhile, Table 7.3 also revealed that timely repair (Beta =0.281, p =0.000) has the highest effect on the risk reduction of ASS of AM, followed by spare parts (Beta =0.183, p =0.000), user information system (Beta 0=0.159, p =0.000) and expert (Beta =0.130, p =0.000).

Subsequently, the relationships between FR (financial resources), MRRI (consumer risk reduction indicator), CRRI (consumer risk reduction indicator) and AMRR (agricultural machinery risk reduction of ASS) have been verified by means of Pearson correlation coefficient, as shown in Table 7.4 in Chapter 7.3. The results show that mechanical risk reduction is significantly correlated with financial resources (r (739) = 0.514, p =0.000), AMRR of ASS (r (739) = 0.615, p =0.000) and consumer risk reduction (r (739) = 0.678, p =0.000).

On the other hand, financial resources correlate significantly with AMRR of ASS (r (739) = 0.470, p =0.000), and consumer risk reduction (r (739) = 0.496, p =0.000) while consumer risk reduction correlate with AMRR of ASS (r (739) = 0.503, p =0.000), as illustrated in Table 7.4 of Section 7.3. In addition, MRA has also been employed to evaluate the financial factors (saving, overdraft, access to credit, sponsorship and grant) that influence the ASS of AM. Through the beta estimates, it is revealed that grant (Beta = 0.374, p = 0.000) has the most significant impact on the financial resources of the after-sale services risk reduction of the agricultural machinery, followed by sponsorship (Beta = 0.154, p = 0.000), and access to credit (Beta = 0.153, p = 0.002), as illustrated in Table 7.5.

Soon afterwards, the Pearson correlation coefficient (r) and the basic linear regression have been employed to analyse the effect among the risk reduction of ASS of AM, sustainable agri-enterprise and the growth of agri-economy. The results show that the effects are positive and significant, as demonstrated in Table 7.6, Table 7.7, Table 7.8 and Table 7.9 (please see Section 7.5). Moreover, the goodness of model fit and the structural model analysis have been discussed in Section 7.6.

Section 7.7 mainly introduced the thematic content analysis and further interpreted and discussed the detailed results from the focus-group interviews which were conducted both in South Africa and China. These results and discussions have been further verified and evidenced by the quali-data obtained from focus-group interviews.

The following chapter will aim to display the conclusion, limitations, recommendations as well as future work for further research. The explicit demonstration of the above-mentioned will be displayed in the final chapter.

Chapter 8: Conclusion, limitation and recommendations for future research

8.1 Introduction

In the previous chapter, the research results and data discussions have been explained in a bid to demonstrate the research outcomes and findings. This chapter aims to display the conclusion, limitation, recommendation as well as future work. The findings regarding research questions answered and study objectives met will be shown and briefly discussed in the following sections. Furthermore, a revised risk reduction model of after-sales service on agricultural machinery resulting from the explanatory method will be presented in this chapter as well. Meanwhile, the limitations of this research will be addressed, and recommendations for future study will be explained. In the prospective study, the combination of agri-mechanization, poverty and rural revitalization should be much more beneficial for agri-stakeholders. This may bridge the gap in terms of poverty as well as rural sustainability.

8.2 Research questions answered

In this part, the research questions will be answered in relation to the research objectives that have been accomplished as well. The explicit explanations will be elaborated in more detail as follows:

8.2.1 Research questions answered

Following data analysis in this study, the research questions proposed in Chapter 1 should now be answered in this section as follows:

- **What are the factors that influence the risk reduction of after-sales service on agricultural machinery?**

According to the literature review, the aspects of after-sales service of AM are technician, timely repair, spare parts, maintenance, training course as well as user information system, as elaborated in Section 2.4.4. Chapter 7.2 on some empirical results gathered also stated that technician, timely repair, spare parts, training course as well as user information system have a positive effect on risk reduction of AM while maintenance has the least influence on it.

However, all the predictor variables (technician, timely repair, spare parts, training course as well as user information system) have a positive and vigorous effect on the risk reduction of Chinese agricultural machinery, as illustrated in Table 7.3. Furthermore, these results have also been supported by quali-data collected via focus-group interviews from both South Africa and China by means of the thematic content analysis.

- **What is the relationship between financial resources and mechanical risk reduction indicator, customer risk reduction indicator and the after-sales service risk reduction of agricultural machinery?**

The research results inferred from empirical data collected and discussions in Chapters 7.3 and 7.7 showed that the financial resource and mechanical risk indicator have a strong correlation, so do the financial resource and customer risk indicator. Meanwhile, the results show that mechanical risk reduction is significantly correlated with financial resources (r (739) = 0.514, p =0.000), AMRR of ASS (r (739) = 0.615, p =0.000) and consumer risk reduction (r (739) = 0.678, p =0.000). On the other hand, financial resources correlate significantly with AMRR of ASS (r (739) = 0.470, p =0.000), and consumer risk reduction (r (739) = 0.496, p =0.000) while consumer risk reduction correlate with AMRR of ASS (r (739) = 0.503, p =0.000), as illustrated in Table 7.4 of Section 7.3. So, the research results and discussions in Chapter 7.3 showed that mechanical risk indicators are significantly correlated with a risk reduction of after-sales service of agricultural machinery (so does the customer risk reduction). Subsequently, the focus-group interviews (conducted in South Africa and China) have verified and supported this research result by means of qualitative data analysis (using the thematic content analysis).

- **What are the factors that affect the financial factors of after-sales service on agricultural machinery?**

The financial resources included in this research are saving, overdraft, access to credit, sponsorship and grant. In addition, these financial resources are also based on some information extracton from the previous study, as discussed in Section 3.3.2. Through the beta estimates, it is revealed that grant (Beta = 0.374, p = 0.000) has the most significant impact on the financial resources of the after-sale services risk reduction of the agricultural machinery, followed by sponsorship (Beta = 0.154, p = 0.000), and access to credit (Beta = 0.153, p = 0.002), as illustrated in Table 7.5. Section 7.4 further verified that all those factors have a positive and significant influence on the after-sales service of agricultural machinery. Furthermore, these results have also been evaluated and verified by quali-data gathered via focus-group interviews from both South Africa and China by means of the thematic content analysis (please see Section 7.7).

- **What is the relationship between ASS risk reduction of agricultural machinery, sustainable AM enterprises and agri-economic growth in this model?**

Chapter 7.5 reported that risk reduction of after-sales service of agricultural machinery impacted largely on sustainable AM enterprises. Through Pearson correlation coefficient (r) and the basic linear regression, the results showed that agricultural machinery risk reduction of ASS is outstandingly correlated with the sustainable agri-enterprises (r(739)=0.754, p=0.000) in Table 7.6 (in Section 7.5.1). Meanwhile, Table 7.7 (in Section

7.5.1) reported that AMRR has a crucial influence on SAE (Beta=0.754, p=0.000). On the other hand, the results interpreted that the sustainable agricultural enterprise is significantly correlated with agricultural economic growth (r(739)=0.743, p=0.000) (see Section 7.5.2). And Table 7.9 (in Section 7.5.2) reported that SAE has a crucial influence on AEG (Beta=0.743, p=0.000).

In Section 7.7, the focus-group interviews supported and enhanced the interpretation of results obtained and analyzed from quantitative data. On the other hand, Chapter 7.5 elaborated that sustainable AM enterprises impacted largely on the growth of the agri-economy. Moreover, in Section 7.7, the focus-group interviews strengthened and supported the results obtained and analyzed from quantitative data by means of the thematic content analysis.

8.2.2 Research objectives addressed

According to the data discussion and explanation being undertaken previously, the primary and principal research objective stated in Chapter 1 has been addressed in this section as follows:

- ◆ **This study's main and principal objective is to formulate the model of risk reduction of after-sales services of Chinese agricultural machinery in South Africa.**

The development of the risk reduction model for after-sales service of agricultural machinery has been introduced, analysed and illustrated in Chapter 3.3 and Chapter 7.6. The modified model supported by the literature survey and inductive reasoning is displayed as follows in Figure 8.1.

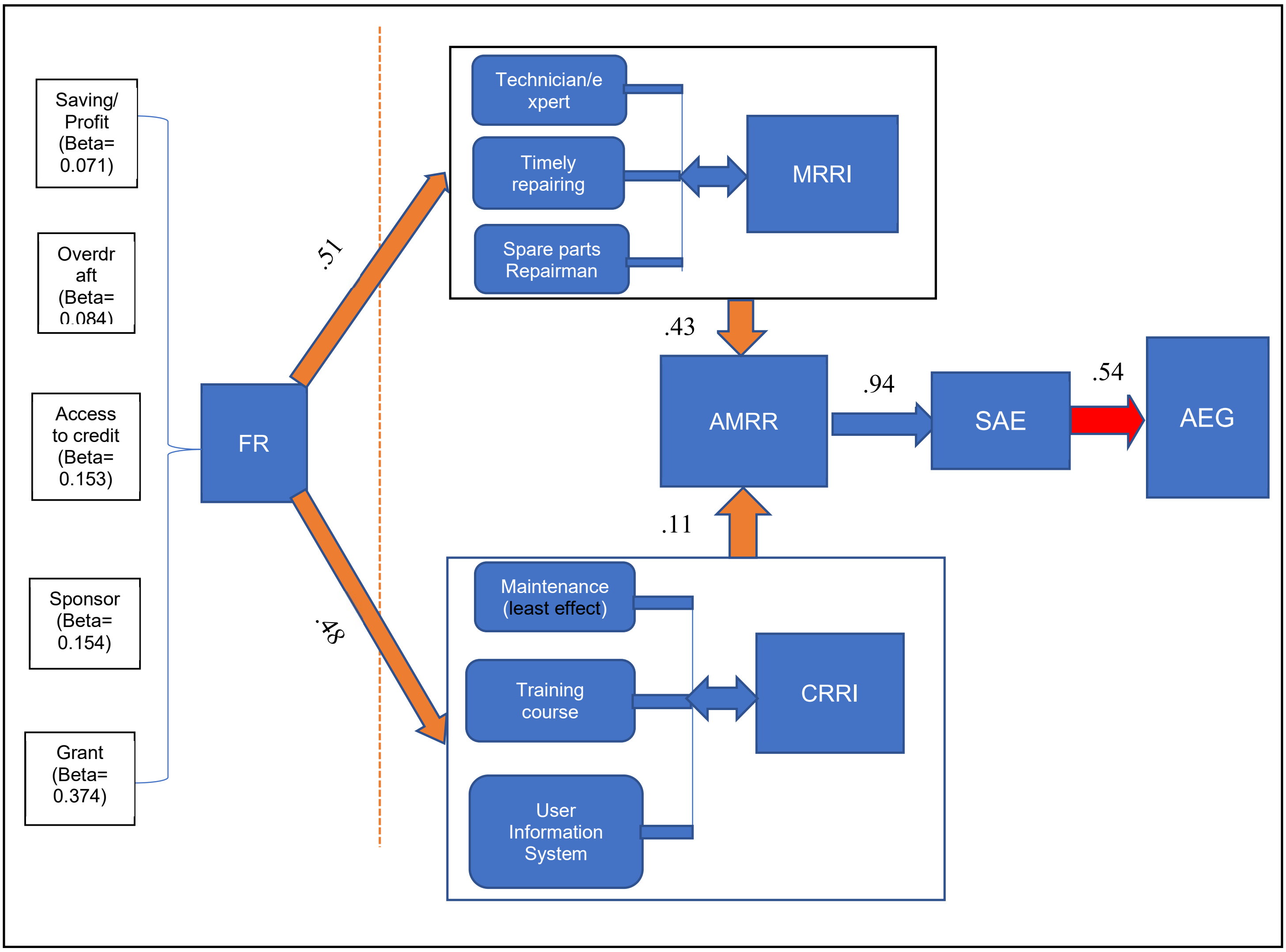

Figure 8.1: The risk reduction model for the after-sales service of agricultural machinery

Note: FR = financial resources (saving, overdraft, access to credit, sponsor and grant), MRRI = mechanical risk reduction indicator (technician, timely repair and spare parts), CRRI = customer risk reduction indicator (training course and user system and centre), AMRR = the after-sales service of agricultural machinery risk reduction, SAE = sustainable agri-machinery enterprise, and AEG = agricultural economic growth;

b: The values between the variables are the factor loading values used to examine the relationship between independent variables and dependent variable

The specific goals of the research, proposed in Chapter 1, are addressed in this research as follows:

- **To determine the after-sales service factors that influence the risk reduction of after-sales service on agricultural machinery**

This objective has been met partly in the literature review and in relation to the research questions discussed in the previous section. The factors that influence after-sales service of AM are technician, timely repair, spare parts, maintenance, training course, and user information system, as elaborated in Section 2.4.4. However, all the predictor variables (technician, timely repair, spare parts, training course as well as user information system) have a positive and vigorous effect on the risk reduction of Chinese agricultural machinery, as illustrated in Table 7.3 from the empirical results sections. Meanwhile, Table 7.3 also reveals that timely repair (Beta =0.281, p =0.000) has the highest effect on the risk reduction of ASS of AM, followed by spare parts (Beta =0.183, p =0.000), user information system (Beta =0.159, p =0.000) and expert (Beta =0.130, p =0.000). Furthermore, these results have also been supported by quali-data collected via focus-group interviews from both South Africa and China by means of the thematic content analysis.

- **To judge the relationship among financial resources and mechanical risk reduction, customer risk reduction and risk reduction of agricultural machinery**

As discussed in Chapter 7.3 from the empirical results sections, the correlation value of financial resources with mechanical risk reduction was 51.4% ($\beta = 0.514$, $p < 0.000$) and customer risk reduction was 49.6% ($\beta = 0.496$, $p < 0.000$) respectively. It meant the FR has a large effect on MRRI and CRRI. In Section 7.7, the focus-group interviews conducted in South Africa and China subsequently support the above consequence. Furthermore, some participants argued that if the farmers purchased more farm machinery, the government and AM enterprises could get more tax and funds. Furthermore, the AM enterprise may put more funds on MRRI and CRRI. On the other hand, some participants explained that if the AM companies and dealers got more finance, they should put the funds on the MRRI a little bit more than CRRI.

However, the correlation value of mechanical risk reduction with the agricultural machinery risk reduction was 61.5% ($\beta = 0.615$, $p < 0.000$) while customer risk reduction with the agricultural machinery risk reduction was 50.3% ($\beta = 0.503$, $p < 0.000$) as deliberated in Section 7.3. In Section 7.7, the focus-group interviews conducted in South Africa and China basically concur with the above outcome. In Section 7.7, some contested that MRRI was a direct and principal factor that impacts the AMRR because the most crucial parts of ASS of AM incorporate technician, spare parts and timely repair, which belonged to MRRI. On the contrary, CRRI (maintenance, training course and user system and centre) had an indirect and oblique impact on AMRR. Meanwhile, some debated that MRRI was the apparent matter that farmers had the problem that needed MRRI to solve. However, CRRI was an invisible and imperceptible issue that was not extremely urgent or imperative for AM users. Accordingly, CRRI has a little bit lower percentage than MRRI, as ASS deals with the imperative issue firstly.

- **To determine the financial factors that influence the risk reduction of after-sales service on agricultural machinery**

In the light of the literature review, the financial factors that influenced the risk reduction of ASS on AM consist of saving, overdraft, access to credit, sponsor and grant, as discussed in Section 2.3.5. Chapter 7.4 reported that grant (Beta = 0.374, p = 0.000) has the most significant impact on the financial resources of the after-sale services of the agricultural machinery, followed by sponsorship (Beta = 0.154, p = 0.000), and access to credit (Beta = 0.153, p = 0.002). In the data discussion of the focus-group interviews, the participants basically approved the outcomes got from the questionnaires. However, some argued that the grant was not that significant in South Africa, as it was difficult for the farmers and users to acquire the grants. If there were enough grants in South Africa, it would be very important for the ASS of AM. Some Chinese agri-policy makers debated that sponsorship and credit were less influence on the ASS of AM.

- **To judge the relationship between the risk reduction of agricultural machinery, the sustainable AM enterprises and agri-economic growth**

As demonstrated in Chapter 7.5.1, agricultural machinery risk reduction of ASS could increase sustainable agriculture by 75.4% ($\beta = 0.754$, $p < 0.000$). All participants basically approved that AMRR affected sustainable AM enterprises tremendously and remarkably. From the perspective of dealers in South Africa, the ASS of AM was tremendously significant in terms of long-term development. The only reason that can sustain the long-standing of the enterprise was after-sales service. Especially the competition was so fierce today, and the after-sales service was apparently very significant for the enterprise's long-standing survival and development. Nowadays, the company takes the bundling strategy, which means the company takes all the factors together in a bid to exert its advantage to compete with other enterprises. If the after-sales service risk was reduced with this strategy, it should be extremely crucial for the sustainable AM enterprises in South Africa, as discussed in Section 7.7. In China, the AM company relied on the after-sales service to occupy the market. If the company provides the amazing ASS to farmers, they are satisfied with the service and further introduce more customers to purchase AM. This can become a benign circulation. Furthermore, the company can maintain long-term development and offer a better ASS. Nowadays, the most significant factor for enterprises' sustainability, prosperity and stableness is excellent after-sales service providing. In a nutshell, it is a decisive and life-and-death factor to SAE, as elaborated in Section 7.7.

As discussed in Chapter 7.5.2, the sustainable agriculture would increase agri-economic growth by 74.3% ($\beta = 0.743$, $p < 0.000$). This result had been accepted basically by all participants. Moreover, if agriculture can accomplish the mechanization in Africa and South Africa, it can remarkably heighten the quantity of crop grain, vegetables and food etc. If the stakeholders want to accomplish the agricultural mechanization, the high-quality AM should be produced and provided by sustainable AM enterprises. Nowadays, the company takes the bundling strategy, which means the company handles all the factors together in a bid to exert its advantage to compete with other enterprises. If the after-sales service risk is reduced by using this strategy, it should be very crucial for the sustainable AM enterprises in South Africa, as explained in Chapter 7.7. Furthermore, only the sustainable AM company can supply the high-quality and advanced farm equipment to meet the users' demand in order to achieve agricultural mechanization and improve extraordinarily outputs and productivity of agriculture. Finally, it can accelerate the improvement and enhancement of the agricultural economy, as stated in Chapter 7.7.

8.3 Contributions and recommendations of this research

This research provided some unique contributions to the ASS risk reduction influence of China's AM on China and South Africa. Furthermore, the contributions and recommendations will be illustrated in more detail as follows:

- **The new model of ASS risk reduction of AM**

This study aims to formulate the risk reduction model of after-sales services of Chinese agricultural machinery in South Africa. Firstly, the original model has been formulated in Section 3.3.3 using a fundamental reasoning based on a deep literature review. Through the data collection and data analysis in Chapter 6 and Chapter 7, this novel model has been validated and verified accordingly. Subsequently, the main contribution of this study is to provide the novel ASS risk reduction model fundamentally based on proper survey data collected for two unique regions: South Africa and China who have bilateral and intertwined unique relations. This novel model may be introduced to stakeholders in agricultural machinery enterprises, lawmakers or policy-makers or officials in the department of agriculture who can benefit from this study. The outcomes and impact of this study can have a far-reaching influence on South Africa and China because it may lead to efficient and effective sustainable agri-enterprises as well as the growth of the agricultural economy to some extent. In addition, this novel risk reduction model is in the scope of risk management and project management (Purdy, 2010).

According to the quantitative and qualitative data analysis, the South African market is largely significant for the Chinese agri-machinery. This study advises the relevant Chinese and South African governments to make relevant policies to facilitate sustainable AM enterprises and financial support, so this can further reduce the risk reduction of AM companies and facilitate the sustainable development of AM enterprises using the novel model in this study.

- **The factors that impact the ASS of AM and the relationship between them**

Another novel contribution is to identify the factors that influence the ASS of AM. These factors are firstly derived from the literature reviews in Section 2.4.4. The pilot test further determined these six factors, namely experts, spare parts, timely repair, maintenance, training, and user information system. Furthermore, the influence of these six factors on

ASS risk reduction of AM has been validated and verified via the principal axis factoring and multiple regression analysis in Section 7.2. In Section 7.7, the effect of these factors on the ASS of AM has been further evaluated via quali-data analysis. This contribution is beneficial for agricultural machinery enterprises and stakeholders to adjust their strategies and plans according to these research results obtained from the surveys. The emergence of these factors as well as the relationship between factors and the ASS risk reduction of AM, summarized and valuated in this study, can facilitate the relevant AM enterprises 1) to take timely repair seriously; 2) to provide sufficient and ample spare parts; 3) to employ more experienced and skilled technicians; 4) to strengthen the training courses provided in a bid to improve the technicians' skills and users capabilities; 5) to establish the user information system to provide necessary services and communication with customers; and 6) to provide maintenance service or teach users how to maintain their machines.

- **The financial factors that affect the ASS of AM and the relationship between them**

The third unique contribution in this study is to determine the factors of the financial resources impacting after-sales service of agricultural machinery. Through the finalization of the multiple regression analysis, the socio-economic status of financial resources, including saving, overdraft, access to credit, sponsorship and grant, has been discussed using quantitative and qualitative data analysis in Chapters 7.4 and 7.7, respectively. The interaction of the financial resources and after-sales service of agricultural machinery have also been elaborated in Sections 7.3 and 7.7.

This research is remarkably beneficial for AM enterprises no matter in South Africa or in China. Financial resources are very significant to the sustainable development of AM company. In China, it is much easier for farmers and users to acquire grants from the government. However, it is difficult to obtain credit and sponsorship from the government, so profit is very important for farmers to acquire in Africa and South Africa. From small and medium AM enterprises, it is very hard to get ACT, sponsorship and overdraft, so the profit is extraordinarily crucial for AM enterprise's survival. According to this study, the results advise the South Africa government, agricultural departments, and relevant organizations to guarantee financial resources to lean to AM enterprises and dealers in South Africa.

- **The effect of ASS of AM on the sustainable AM enterprises and agri-economic growth**

The fourth extraordinary contribution in this research is to evaluate the relationship between the ASS of AM and the sustainable AM enterprise and the agri-economic growth, as illustrated in Section 7.5 and Section 7.7. The risk reduction of after-sales service of agricultural machinery is very significant to the sustainable AM enterprises. Nowadays, the most significant factor for enterprises' sustainability, prosperity and stableness is excellent after-sales service providing. It is a decisive and very important factor to SAE (sustainable agricultural economy). In this research, the researcher strongly advises AM enterprises to focus on the after-sales service of AM and invest more in it, based on the solid novel empirical survey data collected and analysed.

Moreover, the sustainable AM company can supply high-quality and advanced farm equipment in a bid to achieve agricultural mechanization and improve agricultural mechanization and productivity. Finally, it can accelerate the improvement and enhancement of the agricultural economy, so this research advises the stakeholders to take the study results seriously in a bid to promote agri-economic growth, which can accordingly meet the issues of poverty, unemployment as well as inequality etc.

Furthermore, the results and discussion of quali-data analysis (Section 7.7) can further verify the influence of AMRR on SAE and AEG in a bid to make these results more persuasive and eloquent. In a nutshell, the results and findings of this study can be employed to assist 1) the agri-machinery enterprises in formulating an appropriate after-sales service strategy in a bid to service the sustainability of their enterprises; 2) the stakeholders (including the dealers and sales managers, even customers) in paying more attention to ASS of AM; 3) the investors in emphasizing the ASS of AM; and 4) the policymakers in regulating the subsidiaries and grants and other supporting policies in order to coordinate the relationship between AMRR and SAE both in South Africa and China; and 5) Chinese government and South Africa government in introducing the relevant incentives and policies to benefit users, AM enterprises and the relevant stakeholders in a bid to further promote the growth of the agricultural economy.

- **The socio-economic significance and policy-making implications**

The unique contribution of this study is to offer the socio-economic significance as well as policy-making implications in the context of the novel model of ASS risk reduction of AM analysed in this research. Firstly, from the perspectives of the users or customers, it will be beneficial if the AM enterprises and government regulate their strategies and policies according to this study's results. Secondly, the AM companies can introduce much beneficial and stronger policies and regulations of ASS of AM (in line with this research findings) in a bid to satisfy their customers and promote the sustainable development of enterprises. Moreover, the after-sales service is also one type of project management under the department of service in AM enterprises. The leadership or managers can use the theories of project management and risk management (Nicholas & Steyn, 2020) used in this study to enhance corporate performance and reduce or meet the risk of ASS of AM. Finally, this study results and discussion can further facilitate the policy-makers to introduce favourable policies to benefit the customers, stakeholders, and AM enterprises to stimulate agri-economic growth.

In addition, this study also used the novel risk reduction model and data analysis (including quanti- and quali- data analysis) to assist Chinese AM enterprises in finding out the factors that influence the ASS of AM as well as the financial resources. The AM enterprise can employ this model to regulate their after-sales service directions, strategies, and plans in South Africa in a bid to keep sustainable development in the much more fiercely competitive business environment.

In conclusion, the contributions of this study are also illustrated and summarised concisely in Table 8.1.

Table 8.1: Contributions of this study

Item	Content
Contribution 1	The main contribution of this study is to provide this novel ASS risk reduction model.
Contribution 2	This thesis has identified the factors that influence the ASS of AM using fundamental reasoning based on a deep literature review.
Contribution 3	The third unique contribution in this study is to determine the factors of the financial resources impacting the after-sales service of agricultural machinery based on empirical data collected and analysed from two unique regions: South Africa and China.
Contribution 4	The fourth extraordinary contribution in this research is to evaluate the relationship between the ASS of AM and the sustainable AM enterprise and the agri-economic growth. Furthermore, this was validated by using a mixed-method research approach in two unique regions: China and South Africa.
Contribution 5	The final contribution of this study is to offer the socio-economic significance as well as policy-making implications in the context of the novel model of ASS risk reduction of AM analysed in this research. This is also beneficial for the relevant stakeholders in South Africa and China.

8.4 Limitations of research

The study's main limitation is the limited number of participants in the questionnaires and focus-group interviews because of a lack of access to resources and a lack of time and fundings. Due to the Covid-19 outbroke in China and South Africa consecutively, there are approximately 200 questionnaires that cannot be collected in South Africa for quantitative data analysis and comparison with the quantitative data collected from China. It is much better if the researcher can collect the questionnaires from South Africa and make a comparison between China and South Africa in future.

This study focuses on the risk reduction of ASS of Chinese agricultural machinery in South Africa. Maybe in the future, the focus should be on the ASS of farm equipment in Sub-

Saharan Africa or the agri-mechanization in Africa as well as rural revitalization etc. It is more valuable if this research can further provide valuable advice and suggestions by means of conducting in-depth research in a bid to solve social issues, such as starvation, poverty, unemployment, climate change as well as rural revitalization etc.

8.5 Future research

This study focuses on formulating the risk reduction model of after-sales services of Chinese agricultural machinery in South Africa. There are also many other factors that influence sustainable AM enterprises and agri-economic growth. Nowadays, the competition of agricultural machine enterprises is severe in China. However, this is also a problem in South Africa, where there are fewer AM enterprises. It is exceedingly crucial in China to draw up the criterion and standards of marketing threshold by the Chinese government. In South Africa, the relevant institutions should provide the financial resources to support the after-sales service and AM companies and dealers. How to protect AM enterprises and how to make the outstanding policies to support the farmers in a bid to enhance the agri-economy are future research directions and endeavours that may be considered.

Nowadays, poverty and rural revitalization are also extremely significant research viewpoints and topics in the context of agricultural and management research. In the future study, the interdisciplinary combination of agri-machinery, agri-mechanization, agri-economy, poverty alleviation, rural revitalization, management science, big data, climate change, Internet of Things and blockchain will also be beneficial for agri-stakeholders which can bridge the gaps in terms of agri-productivity, poverty mitigating, employment increasing, rural sustainability and revitalization as well as agri-economic growth. This will be an interesting and valuable research in the future.

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APPENDIX 1: QUESTIONNAIRE

Questionnaire of factors impacting on after-sales service of agricultural machinery

No: ·····································.

A. Basic information （Please tick✔）

A1. Age

<20	20-29	30-39	40-49	⩾ 50

A2. Gender

Male	1	
Female	2	

A3. Position

CEO	1	
Manager	2	
Director	3	
Staff	4	
Farmer	5	
Others	6	

A4. Degree of education

High school	1	
College	2	
Bachelor	3	
Postgraduate	4	
Others	5	

A5. Major

Agriculture	1	
Economic	2	
Management	3	
Engineering	4	
Mechanical / Electrical	5	
Others	6	

A6. Working Years (Unit is the year)

0-10	11-20	21-30	>30

B. To some extent impacting on after-sales service of agricultural machinery （Please tick✔）

（1—5：from “lowest degree” to “largest degree”，to decide if belongs to after-sales service of agricultural machinery）

	lowest degree				largest degree
B.1: Technician…… to some extent impacting on after-sales service of agricultural machinery	1	2	3	4	5
B.2: Spare part…… to some extent impacting on after-sales service of agricultural machinery	1	2	3	4	5
B.3: Repair timely …… to some extent impacting on after-sales service of agricultural machinery	1	2	3	4	5
B.4: **Maintenance……**to some extent impacting on after-sales service of agricultural machinery	1	2	3	4	5
B.5: **Training……** to some extent impacting on after-sales service of agricultural machinery	1	2	3	4	5
B.6: User data and information service centre…. to some extent impacting on after-sales service of agricultural machinery	1	2	3	4	5

C. Other factors and contents of the after-sales service of AM

Other factors and contents of the after-sales service of AM

Thanks

APPENDIX 2: QUESTIONNAIRE

农机售后服务影响因素的调查问卷

调查问题卷序号: …………………………………….

B. 基本资料 （请打✔）

A1. 您的年龄

<20 岁	20-29	30-39	40-49	≥ 50 岁

A2. 您的性别

男	1	
女	2	

A3. 您的职位

董事长/CEO	1	
经理	2	
主管/主任	3	
一般工作人员	4	
农民	5	
其他	6	

A4. 您的教育程度

高中	1	
大专	2	
本科	3	
研究生	4	
无	5	

A5. 您的专业

农业	1	
经济	2	
管理	3	
工程	4	
机械/机电	5	
其他	6	

A8. 您的工作年限（以年为单位）

0-10	11-20	21-30	>30

B. 多大程度上属于农机售后服务的范畴（请打✔）
（1—5：分别从“程度最低”到“程度最大”，是否属于农机售后服务的程度由底到高）

	程度最低				程度最大
B.1: **技工/维修工**…… 技工在多大程度上属于农机的售后服务的范畴	1	2	3	4	5
B.2: **配件**…… 配件在多大程度上属于农机的售后服务的范畴	1	2	3	4	5
B.3: **维修**…… 维修在多大程度上属于农机的售后服务的范畴	1	2	3	4	5
B.4: **保养**…… 保养在多大程度上属于农机的售后服务的范畴	1	2	3	4	5
B.5: **培训**……培训在多大程度上属于农机的售后服务的范畴	1	2	3	4	5
B.6: **用户数据库及信息管理中心**…. 用户数据库及信息管理中心在多大程度上属于农机的售后服务的范畴	1	2	3	4	5

C. 其他农机售后服务的因素/内容

其他农机售后服务因素/内容

感谢您的填写

APPENDIX 3: QUESTIONNAIRE

DEVELOPMENT OF RISK REDUCTION MODEL OF AFTER SALES SERVICES QUESTIONAIRE

Questionnaire number: **…………………………………**

You have been recommended to participate in this doctoral survey regarding "the development of risk reduction model of after-sales service on Chinese agricultural machinery in South Africa" due to your experience or relevant experience from another source shared with you. Please complete this questionnaire below which can take you around 10 minutes. Your valuable contributions to this research are highly appreciated. Anonymity will be maintained.

A. BIOGRAPHIC INFORMATION （Please tick）

A1. Please indicate your age

<20 years	20-29	30-39	40-49	≥ 50 years

A2. Indicate your continent

Africa	1	
Asian	2	

A3. Indicate your country

South Africa	1	
China	2	
Other African countries	3	

A4. Please indicate your gender

Male	1	
Female	2	

A5. Please indicate the level of the position.

CEO	1	
Senior Manager	2	
Manager	3	
Specialist	4	
Other	5	

If you choose other, please indicate your position____________

____

A6. Please indicate your educational achievements?

Senior certificate	1	
Diploma	2	
Bachelor Degree	3	
Masters	4	
PhD	5	
Post-graduate	6	
None	7	

A7. What is your educational background?

Agriculture	1	
Science	2	
Management	3	
Engineering	4	
Humanities	5	
Other	6	

If you choose other, please indicate your educational background________________________

A8. Please indicate your business experience (in years)

0-5	6-10	11-15	16-20	21-25	26-30	>30

A9. Please indicate your sales experience (in years)

0-5	6-10	11-15	16-20	21-25	26-30	>30

B. RISK REDUCTION FOR AFTER SALES – AGRICULTURAL MACHINERY (Please tick)

B: Rate the importance of the following indicators of risk reduction for agricultural machinery:

To no extent to a very large extent

Mechanical Risk reduction Indicators							
B1 Experts…To what extent does expert availability impact on the risk of after-sales service of agricultural machinery?	1	2	3	4	5	6	7
B2 Spare parts…Is the sufficient spare parts influence significant to reduce the risk of after-sales service of agricultural machinery?	1	2	3	4	5	6	7
B3 Timely repair…To what extent does timely repair availability impact on the risk of after-sales service of agricultural machinery?	1	2	3	4	5	6	7
Customer risk Reduction indicators							
B4 Maintenance…To what extent does maintenance impact on the risk of after-sales service of agricultural machinery?	1	2	3	4	5	6	7
B5 Training…To what extent does training availability impact on the risk of after-sales service of agricultural machinery?	1	2	3	4	5	6	7

B6 User Information System/Agrihub…To what extent does feedback availability/user information system impact on the risk of after-sales service of agricultural machinery? (**Note:** User system/Agrihub means all relevant information on users, agricultural machinery and getting feedback, related information and assistance via the system.)	1	2	3	4	5	6	7
Total Relationship							
B2.7 Mechanical Risk reduction Indicators To what extent does Mechanical Risk reduction Indicators (**B2.1-B2.3**) impact on the risk of after-sales service of agricultural machinery?	1	2	3	4	5	6	7
B2.8 Customer risk Reduction indicators To what extent does Customer risk Reduction indicators (**B2.4-B2.6**) impact on the risk of after-sales service of agricultural machinery?	1	2	3	4	5	6	7

C. FINANCIAL RESOURCES

C: Indicate whether these resources could influence risk reduction indicators **(Please tick)**

	No influence					highly influential	
C1: Savings/deposit…. Do you think saving impacts on the financial resource which is influential in reducing risks for agricultural machinery?	1	2	3	4	5	6	7
C2: Overdraft…. Do you think overdraft impacts on the financial resource which is influential in reducing risks for agricultural machinery?	1	2	3	4	5	6	7
C3: Access to credit ….. Do you think access to credit impacts on the financial resource which is influential in reducing risks for agricultural machinery?	1	2	3	4	5	6	7
C4: Sponsorship…… Do you think sponsor impacts on the financial resource which is influential in reducing risks for agricultural machinery?	1	2	3	4	5	6	7
C5: Grant…. Do you think grant impacts on the financial resource which is influential in reducing risks for agricultural machinery?	1	2	3	4	5	6	7

C6: Financial Resource/Fund Do you think financial resource (C2.1-2.5) is influential in risk reduction of after-sales service of agricultural machinery?	1	2	3	4	5	6	7

D. REPAIR INSTITUTION （Please tick）

	Not important						very important
D1: Agricultural Machineries Risk reduction…. Do you think the risk reduction of after-sales service on agricultural machinery is important?	1	2	3	4	5	6	7
D2: Sustainable agricultural enterprise…. Do you think risk reduction of after-sales service on agricultural machinery is important for the sustainability of the agricultural machinery enterprises?	1	2	3	4	5	6	7
D3: Economic growth…. Do you think risk reduction of after-sales service on agricultural machinery is important for the agricultural economic growth of South Africa and China?	1	2	3	4	5	6	7
D4: Economic growth…. Do you think the sustainability of the agricultural machinery enterprises is important for the agricultural economic growth of both South Africa and China?	1	2	3	4	5	6	7

THANK YOU VERY MUCH

APPENDIX 4: QUESTIONNAIRE

中国农机在南非售后服务的风险管理的研究

调查问题卷序号: …………………………………….

由于您自身的经验或者您从其他渠道了解到的关于农机售后服务的相关信息，您被推荐为南非比勒陀利亚大学博士论文“中国农机在南非售后服务的风险管理”填写调查问卷，这大约花费 10 分钟左右的时间。非常感谢您参与此调查问卷，并为中国农机在南非以及将来在非洲售后服务的提高贡献一份力量。本调查问卷匿名，不需要提供您的姓名、电话、邮箱等敏感信息。最后，再次感谢您的配合及协助。

A. 基本资料 （请打✔）

A1. 您的年龄

<20 岁	20-29	30-39	40-49	≥ 50 岁

A2. 您的所在地

非洲	1	
亚洲	2	

A3. 您所处的国家

南非	1	
中国	2	
其他非洲国家	3	

A4. 您的性别

男	1	
女	2	

A5. 您的职位

董事长/CEO	1	
部门经理	2	
部门主管	3	
一般工作人员	4	
其他	5	

如果您选择其他，请写明您的职位________________________________

A6. 您的教育程度

高中	1	
大专	2	
本科	3	
硕士研究生	4	
博士研究生	5	
博后	6	
无	7	

A7. 您的专业

农业	1	
经济	2	
管理	3	
工程	4	
人文	5	
其他	6	

如果您选择其他，请写明您的专业________________________________

____

A8. 您的工作年限 **(以年为单位)**

0-5	6-10	11-15	16-20	21-25	26-30	>30

A8. 您的销售或者售后服务的年限 (以年为单位)

0-5	6-10	11-15	16-20	21-25	26-30	>30

B. 农机售后服务的风险因素 （请打✔）

B2: 农机售后服务的风险因素的影响的程度（1—7：分别从 “无影响”到 “影响程度最大”，影响程度由底到高）

无影响 影响程度最大

机械风险降低的指标（B2.1-2.3）							
B1 **技工/维修工**…技工影响农机售后服务的程度	1	2	3	4	5	6	7
B2 **配件**…配件影响农机售后服务的程度	1	2	3	4	5	6	7
B3 **及时的维修**…及时的维修影响农机售后服务的程度	1	2	3	4	5	6	7
顾客风险降低的指标（B2.4-2.6）							
B4 **保养**…保养影响农机售后服务的程度	1	2	3	4	5	6	7
B5 **培训**…培训影响农机售后服务的程度	1	2	3	4	5	6	7
B6 **用户信息系统/农机中心**…用户信息系统/农机中心影响农机售后服务的程度 (Note: 用户信息系统/农机中心：用户信息系统/农机中心指的是所有与用户、农机、信息反馈等相关的系统及呼叫中心）	1	2	3	4	5	6	7

整体关系							
B7 机械风险降低的指标 机械风险降低的指标 (B2.1-B2.3) 影响农机售后服务的程度	1	2	3	4	5	6	7
B8 **顾客风险降低的指标** 顾客风险降低的指标 (B2.4-B2.6) 影响农机售后服务的程度	1	2	3	4	5	6	7

C. 金融因素：金融因素影响风险降低的程度（**请打✔**）
（1—7：分别从“无影响”到“影响程度最大”，影响程度由底到高）

	无影响						影响程度最大
C1: **储蓄/利润**……储蓄/利润对农机企业资金来源的影响程度	1	2	3	4	5	6	7
C2: **银行贷款**……银行贷款对农机企业资金来源的影响程度	1	2	3	4	5	6	7
C3: **融资**……融资对农机企业资金来源的影响程度	1	2	3	4	5	6	7
C4: **赞助/资助**……赞助/资助对农机企业资金来源的影响程度	1	2	3	4	5	6	7
C5: **补贴**……补贴对农机企业资金来源的影响程度	1	2	3	4	5	6	7
C6: **农机企业资金来源（C1-5）：** 农机企业资金来源 (C1-5) 影响农机售后服务的程度	1	2	3	4	5	6	7

D. 它们之间的相互影响关系（请打✔）

	无影响						**影响程度最大**
D1: **农机售后服务的风险降低是否重要**	1	2	3	4	5	6	7
D2: **持续发展的农机企业**……农机售后的风险的降低，对农机企业可持续发展的影响程度	1	2	3	4	5	6	7
D3: **农业经济的增长**……农机售后的风	1	2	3	4	5	6	7

险的降低，对农业经济增长的影响程度							
D4: **农业经济的增长**……农机企业可持续发展，对农业经济增长的影响程度	1	2	3	4	5	6	7

感谢您的填写

APPENDIX 5: FOCUS-GROUP INTERVIEW IN SOUTH AFRICA

The questions for the focus-group interview are as follow:

Discussion 1

1. According to our data analysis, all factors that influenced the after-sales service of agricultural machinery have a positive effect on risk reduction of agricultural machinery. However, maintenance (B4) has the least influence to ASS of AM through regression analysis. On the other hand, Table 6.29 shows that Expert/technician (B1), Timely repair (B2), spare parts(B3) and Maintenance (B4) have considerable influence followed by Training course (B5) and user information system (B6) by means of PAF (principal axis factoring) analysis.

The effect on risk reduction of agricultural machinery	
Considerable Influence	Expert/technician (B1), Timely repair (B2), spare parts(B3) and Maintenance (B4)
Large Influence	Training course (B5) and user information system (B6)

Table 1: The effect on risk reduction of agricultural machinery

What is your opinion?

2. Due to our quantitative data, saving (C1), overdraft (C2), access to credit (C3), sponsor (C4) and grant (C5) (the factors that impact on the financial resource) have a positive influence on the after-sales service of agricultural machinery.

Table 2: The financial resource influence on the after-sales service of agricultural machinery

The financial resource influence on the after-sales service of agricultural machinery	
Considerable Influence	Grant (C5)
Large Influence	Access to credit (C3) and sponsor (C4)
Little Influence	saving (C1) and overdraft (C2)

What is your view of the point?

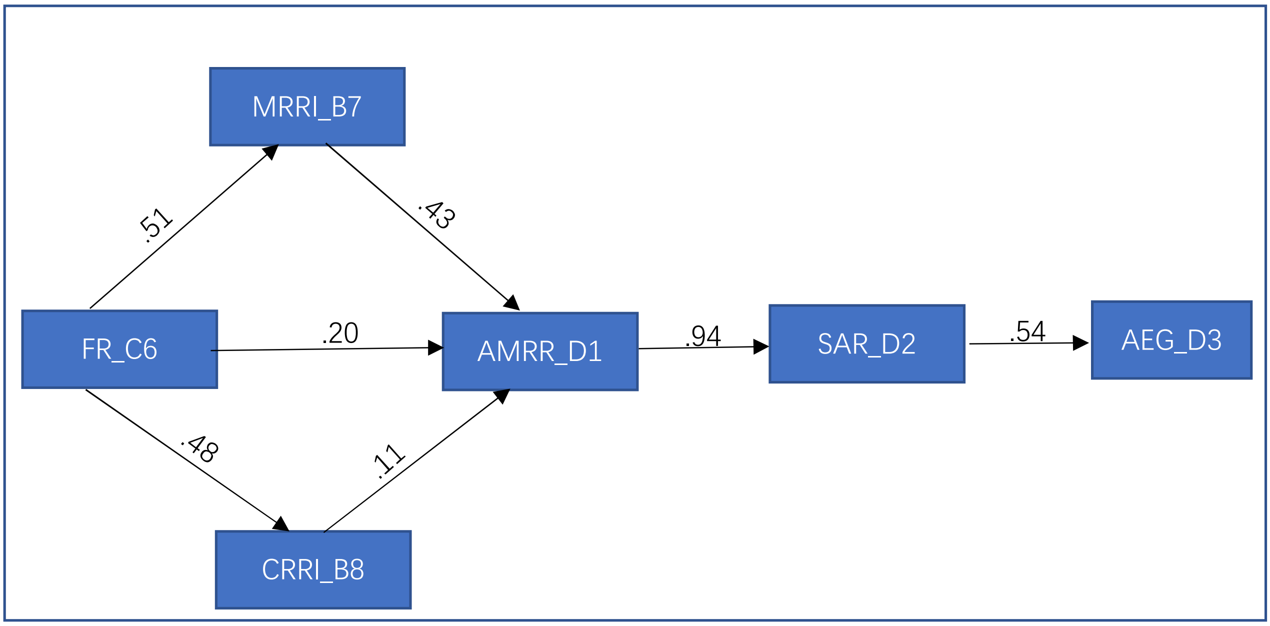

Figure 1: The risk reduction model for the after-sales service of agricultural machinery (result from quantitative data analysis)

Note: FR_C6 = Financial Resources, MRRI_B7 = Mechanical Risk Reduction Indicator, CRRI_B8 = Customer Risk Reduction Indicator, AMRR_D1 = The After-sales Service of Agricultural Machinery Risk Reduction, SAE_D2 = Sustainable Agricultural Enterprise, and AEG-D3 = Agricultural Economic Growth

Discussion 2

1. According to our result, the impact of FR (saving, overdraft, access to credit, sponsor and grant) on MRRI (0.51) (technician, timely repair and spare parts) and CRRI (0.48) (training course and user system and centre) is large.
What is your view of the point?

2. According to our result, the impact of MRRI (0.43) (technician, timely repair and spare parts) on AMRR is larger than CRRI (0.11) (Training course and user system and centre) on it, so what is your view?

3. What do you think of the relationship between FR (Saving, overdraft, access to credit, sponsor and grant) and AMRR in Figure 1?

4. What is your opinion of the AMRR influencing SAE (0.94) in Figure 1?

5. What is your view regarding the relationship between SAE and AEG (0.54) based on the result in Figure 1?

Thank you very much

APPENDIX 6: FOCUS-GROUP INTERVIEW IN CHINA

讨论 1

解释: 在此次研究中, 影响农机售后服务的因素包含技工(B1)、及时维修(B2)、配件(B3)、保养(B4)、培训(B5)及用户信息系统及服务中心(B6); 影响农机企业的金融因素包含利润(C1)、贷款(C2)、融资(C3)、资助(C4)及补贴(C5)。

问题 1: 通过对我们 739 份调查问卷的分析, 技工(B1)、维修(B2)、配件(B3)、保养(B4)、培训(B5)及用户信息系统及服务中心(B6)都对农机售后服务风险的降低有积极的影响。同时, 如下表所述, 请问各位对上述分析结论的意见是什么?

表 1: 农机售后服务的影响因素

农机售后服务的影响因素	
影响最大	技工(B1)、维修(B2)、配件(B3) 、保养(B4)
影响大	培训(B5)、用户信息系统及服务中心(B6)

问题 2: 通过对我们 739 份调查问卷的分析, 农机企业利润(C1)、贷款(C2)、融资(C3)、资助(C4)及补贴(C5)对农机售后服务风险的降低(服务水平的提高)的影响如下表格所示, 请问在座各位的意见是什么?

表 2: 农机企业的金融因对对农机售后服务风险的降低

农机企业的金融因对对农机售后服务风险的降低	
影响最大	补贴(C5)
影响大	资助(C4)、融资(C3)
影响小	农机企业利润(C1) 、贷款(C2)

讨论 2

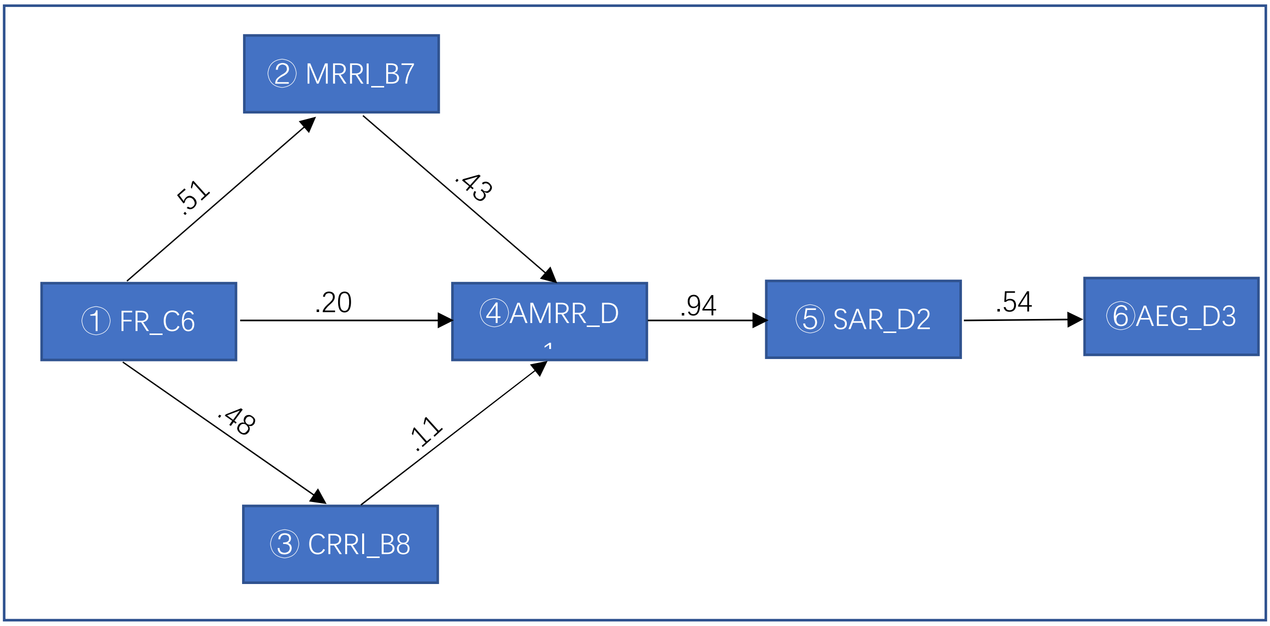

表 3：农机售后服务风险降低的模型（通过分析所收集的调查问卷而获得研究结果）

Note: ① FR_C6 = 金融资源
② MRRI_B7 = 机械风险降低指标
③ CRRI_B8 = 顾客风险降低指标
④ AMRR_D1 = 农机售后服务风险降低
⑤ SAE_D2 = 农机企业可持续发展
⑥ AEG-D3 = 农业经济的增长

问题 1：根据我们的结论，金融因素（农机企业利润 C1、贷款 C2、融资 C3、资助 C4 及补贴 C5）对机械风险降低指标（技工 B1、及时维修 B2、配件 B3）（0.51）和顾客风险降低指标（保养 B4、培训 B5、用户信息系统及服务中心 B6）（0.48）的影响的区别并不大，在座各位的意见是？

问题 2：根据我们的结论，机械风险降低指标（技工 B1、及时维修 B2、配件 B3）（0.43）和顾客风险降低指标（保养 B4、培训 B5、用户信息系统及服务中心 B6）（0.11）对农机售后服务的影响不同，您的观点是什么？

问题 3：根据我们的结论，金融因素（农机企业利润 C1、贷款 C2、融资 C3、资助 C4 及补贴 C5）对农机售后服务的影响（20%）如图 1 所示，您的观点是什么？

问题 4：结合图 1 的结果，您的观点与建议关于农机售后服务与农机企业的可持续发展的关系？

问题 5：结合图 1 的结果，关于农机企业的可持续发展与农业经济的增长，您的观点是什么？

感谢您的回答！

APPENDIX 7: THE ORIGIN OF FOCUS-GROUP INTERVIEW QUESTIONS

The questions of focus-group interviews are generated from the quanti-data (the questionnaire data from China's side) analysis. The origin of focus-group interview questions conducted both in China and South Africa will be demonstrated in the following part.

Question 1: According to the quanti-data analysis, all factors that influence the after-sales service of agricultural machinery have a positive effect on the risk reduction of agricultural machinery. However, maintenance (B4) has the least influence on the ASS of AM through regression analysis. Table 1 (according to the quanti-data analysis in Chapter 7.2) shows that Expert/technician (B1), Timely repair (B2), spare parts (B3) and Maintenance (B4) have considerable influence followed by Training course (B5) and user information system (B6) by means of PAF (principal axis factoring) analysis in Chapter 7.2. Based on the above mentioned, what is your opinion?

Table 1: The effect on risk reduction of agricultural machinery

The effect on risk reduction of agricultural machinery	
Considerable Influence	Expert/technician (B1), Timely repair (B2), spare parts (B3) and Maintenance (B4)
Large Influence	Training course (B5) and user information system (B6)

Question 2: Due to the quantitative data in Chapter 7.4, saving (C1), overdraft (C2), access to credit (C3), sponsor (C4) and grant (C5) (the factors that impact the financial resource) have a positive influence on the after-sales service of agricultural machinery. Table 2 (generated from the quanti-data analysis obtained on China' side; please see Chapter 7.4) illustrates that grant (C5) has considerable influence, followed by access to credit (C3) and sponsor (C4). Saving (C1) and overdraft (C2) have the least influence on the ASS of AM. What are your viewpoints?

Table 2: The financial resource influence on the after-sales service of agricultural machinery

The financial resource influence on the after-sales service of agricultural machinery	
Considerable Influence	Grant (C5)
Large Influence	Access to credit (C3) and sponsor (C4)
Little Influence	saving (C1) and overdraft (C2)

On the other hand, the questions regarding the relationship among FR (financial resource), MRRI_B7 (Mechanical Risk Reduction Indicator), CRRI (Customer Risk Reduction Indicator), AMRR (After-sales Service of Agricultural Machinery Risk Reduction), SAE (Sustainable Agricultural Enterprise) and AEG (Agricultural Economic Growth) are illustrated in Figure 1. Regarding the variables and values displayed in Figure 1, please see Section 7.6. The explicit questions are listed in the following part.

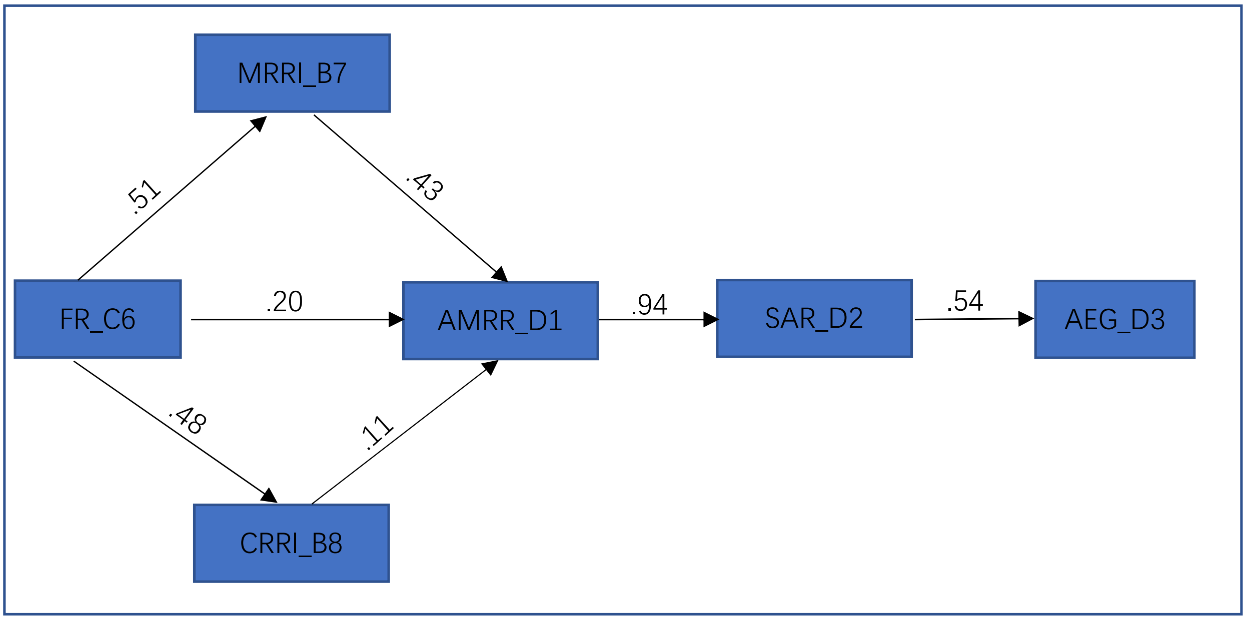

Figure 1: The risk reduction model for the after-sales service of agricultural machinery (result from quantitative data analysis in Section 7.6)

Note: FR_C6 = Financial Resources, MRRI_B7 = Mechanical Risk Reduction Indicator, CRRI_B8 = Customer Risk Reduction Indicator, AMRR_D1 = The After-sales Service of Agricultural Machinery Risk Reduction, SAE_D2 = Sustainable Agricultural Enterprise, and AEG_D3 = Agricultural Economic Growth

Question 3: According to the survey results, the impact of FR (saving, overdraft, access to credit, sponsor and grant) on MRRI (0.51) (technician, timely repair and spare parts) and CRRI (0.48) (training course and user system and centre) is large. What is your viewpoint?

Question 4: According to the survey results, the impact of MRRI (0.43) (technician, timely repair and spare parts) on AMRR is larger than CRRI (0.11) (training course and user system and centre) on it, so what is your perspective?

Question 5: What do you think of the relationship between FR (saving, overdraft, access to credit, sponsor and grant) and AMRR in Figure 1?

Question 6: What is your opinion of the AMRR influencing SAE in Figure 1?

Question 7: What is your view regarding the relationship between SAE and AEG based on the result in Figure 1?

The company classification involved in the quali-data collection is also explained and demonstrated in this part. Furthermore, the standard and criteria of company classification are also illustrated in Table 3.

Type of company	Sale amount per year	The number of employees (Unit: person)
Mega company	⩾1 billion CNY ($ 150 million)	⩾10,000
Large company	50 million to 1 billion CNY ($ 7.5 to $ 150 million)	300 to 10,000
Medium company	5 million to 50 million CNY ($ 0.75 to $ 7.5 million)	50 to 300
Small company	⩽5 million CNY ($ 0.75 million)	⩽50

Table 3: Company classification involved in qualitative data collection

Meanwhile, in this study, the participants from four types of agricultural machinery enterprises were involved in the focus-group interview. If the company of participants has more than 1 billion CNY ($ 150 million) sales and the number of employees is more than 10,000, it belongs to the mega company's classification, as shown in Table 3. A large company in this research means agricultural machinery sales are between 50 million and 1 billion CNY ($ 7.5 to $ 150 million); meanwhile, the number of employees is from 300 to 10,000. The medium AM company refers to the sales of it being between 5 million and 50 million CNY ($ 0.75 to $ 7.5 million), while the number of employees is from 50 to 300, as shown in Table 3. If the company has less than five million CNY ($ 0.75 million) as well as the total of employees is less than fifty, it should be classified as a small firm in this study.

APPENDIX 8: T-test analysis between the group of China and South Africa

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
B1-Technician	Equal variances assumed	.261	.612	-3.831	46	.000	-.875	.228	-1.335	-.415
	Equal variances not assumed			-3.831	45.930	.000	-.875	.228	-1.335	-.415
B2-Spare parts	Equal variances assumed	6.457	.014	.660	46	.512	.125	.189	-.256	.506
	Equal variances not assumed			.660	39.366	.513	.125	.189	-.258	.508
B3-Repair	Equal variances assumed	.321	.574	-2.055	46	.046	-.458	.223	-.907	-.009
	Equal variances not assumed			-2.055	45.997	.046	-.458	.223	-.907	-.009
	Equal variances assumed	1.527	.223	-1.546	46	.129	-.333	.216	-.767	.101

B4-Maintenance	Equal variances not assumed			-1.546	45.722	.129	-.333	.216	-.767	.101
B5-Training	Equal variances assumed	.032	.859	-.961	46	.342	-.208	.217	-.645	.228
	Equal variances not assumed			-.961	43.636	.342	-.208	.217	-.645	.229
B6-ISC	Equal variances assumed	.654	.423	.184	46	.855	.042	.227	-.415	.499
	Equal variances not assumed			.184	45.964	.855	.042	.227	-.415	.499