CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

The agricultural sector is an important component of Nigerian economy with over 70% of the population engaged in agriculture and agricultural - related activities (Obasoro, 2015). The sector is almost entirely dominated by small-scale, resource poor farmers living in rural areas. Agriculture is the main pillar of any economy because of the many significant roles it plays. It is a major source of food for the population, provides employment opportunities, earns foreign exchange, as well as serves as sources of raw materials for the nation's industries.

Increasing agricultural production can increase food availability and enhance access to rural incomes and rural welfare. Rural areas are home to 75 percent of Africa's population, most of who count agriculture as their major source of income. Fortunately, Africa has experienced continuous agricultural growth during the last few years. Rahman and Rahman (2008) noted that the principal solution to increased food production lies in raising the productivity of land given the existing varietal mix. In most countries, future sustainable agricultural growth will require a greater emphasis on productivity growth, as suitable area for new cultivation declines, particularly given growing concerns about deforestation and climate change.

Egwu (2014) noted that agriculture still retains its position as the bulk work upon whose solid foundation the economy of Nigeria is based (Adebo and Ewuola, 2006). Growth in agriculture has been linked to development in other sectors which invariably contributes to poverty alleviation (Khan,1999). Thirtle, Lin and Piesse (2003) observed that development in agricultural sector has a powerful impact on poverty because it helps majority of poor people, compared with other development sectors of the economy. It is paramount, therefore, that the enterprises in the agricultural sector in Nigeria keep up with the current developments in the world.

Sustainable agricultural technology for Nigeria is important for the country's effort at achieving food security and increasing food production. (Ladebo, 2004). Generations of

agricultural research technologies are meaningful only when they are adopted at the farm level (Oyolu, 1983). It is partly justified to say that farmers are sometimes poor because they have not been able to adopt agricultural technologies fast enough to keep pace with change in the new knowledge of agricultural development. The farmers should be adequately informed in this connection, trained in new innovation and be provided with the modern equipments and tools to enhance adoption and as a result, increase production. Adoption of new technologies was found to be dependent on the interaction of a number of factors and organized delivery of inputs and outputs, provision of technical advices, stable price and credit for participating farmers are all important determinants of farmers' adoption of innovation. (Ladebo, 2004). In the view of Onyenweaku (1991), profitability and advice from change agents were the major reasons for adoption, while the characteristics of the innovation itself "relative advantage, costs, complexity, visibility, divisibility and compatibility" are the major factors that affect the adoption of any innovation. Mgbada, (2010), Rogers (1962) and Van Den Ban and Hawkins (1996) further observed that an innovation or technology to be adopted must pass through process of adoption which involves awareness, interest, evaluation, trial and adoption.

Research has shown that investments in agricultural research and extension have large impacts on agricultural productivity and poverty. Recent debates in the growth-poverty nexus point to the fact that the poor are likely to benefit from growth if such growth occurs in sectors in which a large proportion of the poor actively participate and derive their livelihoods. Agricultural technology is changing fast from conventional methods and techniques to modern scientific methods and techniques.

Farid *et al.,* (2014) noted that several factors may have influence on the extent of adoption of farm practices such as characteristics of farm practice; the adopters; the change agent; and the socio-economic, biological, and physical environment in which the technology take place. Socio-psychological trait of farmers also plays an important role in technology adoption. The age, education attainment, income, family size, tenure status,

credit use, value system, and beliefs are usually positively related to adoption. From the existing literature it is evident that adoption of technologies in farming practices is affected by certain factors (Ziervogel *et al*., 2005; Hansen *et al.,* 2007; Salehin *et al.,* 2009). The farmer's attitude towards change, land, sources of information, membership of farmer's organizations, educational level, farm income, farmer's exposure, are the important socio-economic factors influencing adoption of farm innovations (Rousan, 2007). Factors that trigger adoption of new technologies comprise of age, education, sex, higher income level, risk orientation and decision making ability of farmers (Feder and Slade, 1984). Factors limiting adoption of new farm technology includes conservative lifestyle, illiteracy, and belief system.

Agricultural production is the term given to the output of agriculture in terms of the inputs such as the capital and labour. Therefore, as a fairly general comment, this could be defined as the efficiency of the farm. This varies in different parts of the world, and this can be put down mainly to the amount of capital the farm owner has. Although there are other factors involved, a lot of them are dependent on the amount of capital available. Capital in this respect does not only consist of finance, but also include all other resources that can increase efficiency of production. In developed economies, a lot of farms are owned by wealthy people who can afford to buy machinery. This enables the farm to run more efficiently as the processes on the farm can be completed at a quicker rate and, therefore, the labour efficiency becomes better as one person can perform more work in one day than if no machinery was available. This in turn saves the employee money as less staff will be hired. Therefore, the wage bill is lower.

On the other hand, in many developing economies, many farms are used to provide food for the family of the owner, and not primarily to create a profit (although this may occur during a good harvest). Therefore, so long as the farmer has enough labour and land to grow enough food for his family, he will not try to increase the productivity. (World Bank, (2007); McCalla, 2001).

Agricultural cooperatives are organized to help farmers gain market power by joining together to market their crops, increase their bargaining power by achieving economies of scale, processing their commodity to add value, and/or to purchase supplies and services. Benefits and profits gained from the cooperative are distributed equitably to member-farmers on the basis of use of the cooperative. Agricultural co-operatives are agricultural-producer-owned cooperatives whose primary purpose is to increase member producers' production and incomes by helping better link with finance, agricultural inputs, information, and output. The purpose of agricultural cooperatives is to help farmers increase their yields and incomes by pooling their resources to support collective service provisions and economic empowerment. Given their primary role to contribute to smallholder farmer production, agricultural cooperatives are seen as critical in achieving the government's development targets in the Growth and Transformation Plan (African Development Bank, 2005; CBN, 2003).

Agricultural cooperatives encourage members to engage in joint cultivation of food and cash crops, among others. In view of the low financial capacity and high level of underdevelopment, an individual farmer cannot achieve the desires for large-scale production. It is, therefore, in the farmers' interest that resources are pulled together so as to gain a tremendous collective advantage and thus widen the industrial base of the economy and the management techniques of the farmers (Enikaselu *et al*, 2005).

Successive governments in Nigeria recognize that cooperative societies are essential for the development of the agricultural sector. This laudable goal was supported by the establishment of the Agricultural Development Programmes (ADPs) and the River Basin and Rural Development Authorities (RBRDAs). Both ADPs and RBRDAs always organize farmers under their programmes into cooperative groups for better co-ordination of the farmer's activities. The cooperatives approach to group action has been effectively utilized by these two programmes. Although, the primary objective of forming group farming cooperatives in ADPs and RBRDAs is to increase agricultural production, it has been possible to get them involved in marketing of their produce as well.

1. 2 Statement of the Problem

Agricultural sector employs about 60% of Africa's workforce, yet one quarter of the world's undernourished and hungry people live in Africa. Despite impressive economic growth rates across Africa, many of the continent's people remain food insecure. Africa's food insecurity is growing worse with population estimations at 2.4 billion in 2050. With vast land on the continent, famine and starvation should be a thing of the past. Major reason adduced for this situation is the use of outdated and ineffective farming methods. All over the globe, both for agricultural cooperative farmers and non-agricultural cooperative farmers, the methods of agriculture have changed considerably, with problems of diseases, unreliable rainfall and climate resulting in floods and drought.

There is an urgent need to employ modern innovative technologies to help optimize yields and increase production. Unlike in other regions of the world, productivity of agriculture in Nigeria is poor (Obasoro, 2015). This has resulted to increase emphasis on agricultural transformation using agricultural innovation. This shift towards an innovation systems orientation was precipitated by the realization that despite stronger national research systems, agricultural productivity remained low as a result not only of the lack of appropriate technologies and the lack of access to those technologies, inputs, credit and access to markets and rural infrastructure, but also because of gaps in information and skills that prevented rural producers from effectively utilizing and adopting technologies (Sanginga *et al*., 2009).

Several factors may have influence on the extent of adoption of farm practices such as characteristics of farm practice; the adopters; the change agent; and the socioeconomic, biological, and physical environment in which the technology take place. Socio-psychological trait of farmers also plays an important role in technology adoption. The age, education attainment, income, family size, tenure status, credit use, value system, and beliefs are usually positively related to adoption.(Farid *et al,* 2014). From the existing literature, it is evident that adoption of technologies in farming practices is affected by certain factors (Ziervogel *et al.,* 2005; Hansen et al., 2007; Salehin *et al.,* 2009).

However, these factors may vary from one context to another signaling the need to determine the factors that are peculiar to the farmers in the area of study.

Modern agronomy, irrigation, selective breeding, post-harvest technology, value chain agriculture, market linkage, use of improved gadgets, improved seedlings and ease of technology transfer are all innovative ways of boosting agricultural yields. There is the need for agricultural innovations that will help reduce post-harvest losses, produce resistant varieties of crops and livestock, and also optimize yields. In general terms, there is critical need for agricultural innovations that could boost agricultural productivity. These innovations and initiatives in agriculture will help make the sector more attractive to youths.

Raising the productivity of agriculture can make a critical contribution to economic growth and alleviation of poverty by generating the surpluses that can be used for investment in agricultural and non-agricultural activities. In the past, effort of government on agriculture was centered on export crops to the neglect of food production and hence low productivity in the area of food crops and there are other factors that could account for this low productivity since after independence. Among this is the "oil boom" of the seventies which resulted in the migration of labour from agricultural sector to other parts of the economy rendering many indigenous land owners landless and in some cases a reduction in the acreage farmed.

The research found out that agricultural yields have also been level or falling for many crops in the study area. Significantly, yields of most important food grains, tubers and legumes (maize, sorghum, yam, cassava, groundnuts, and palm fruits) in the country are no higher today than in 1980. This is as a result of some challenges these rural farmers are encountering and this includes: production problems which are as a result of lack of improved technologies and facilities for the farmers. Production problem is majorly the problem these farmers are facing in rural farming and it's majorly the problem this work wants to address in order to increase food production in the country. Low productivity has seriously eroded the competitiveness of our country's agricultural products on world

markets. The resultant low productivity has led to low investment in all the factors that contribute to agricultural production and effective use of available resources. To correct the problem, there is need to significantly increase investment in agriculture. This can be achieved by introducing improved farm practices to farmers, improving on the sources of information of these improved farm practices, passed to the farmers, educating them on the new methods of adopting these improved farm practices and finally addressing and finding a lasting solution to the factors influencing adoption of these farm practices by the farmers. The role of cooperatives in agricultural technology adoption has also been inconclusive in the literature. . However, notwithstanding the positive trend, Egbuna (2001) noted that "Nigeria is neither food self-sufficient nor food secure".

The research also found out that the extent to which these farmers adopt new innovation in the study area is low. There is, therefore, the need to evaluate the extent to which the claim that cooperatives play critical roles in technology adoption can be accepted.

To the best of the researcher's knowledge, there are few empirical studies in the literature that specifically assessed the effects of agricultural innovation systems on improving production of rural farmers in Nigeria context. Unfortunately, in the few studies that do exist, the analytical methods employed were mainly qualitative. This study is apt not only because it came at the time when the government is doing all it could to transform agriculture but also because of the need to capture the increasing role of cooperative societies in knowledge transfer. There is the need to understand the level of awareness and adoption of these agricultural innovations among cooperative and non-cooperative farmers. There is also the need to empirically determine the effect of agricultural innovation adoption on productivity of cooperative and non-cooperative farmers in the study area.

1.3 Objectives of the Study

The main objective of the study is to examine the effect of agricultural innovation adoption on agricultural production in Imo State, Nigeria.

Specific objectives are to:

i. To determine the socio economic characteristics of the respondents.
ii. compare adoption level of agricultural innovation among cooperative and non-cooperative farmers.
iii. examine level of use of different agricultural innovation among cooperative and non-cooperative farmers.
iv. determine the influence of socio-economic characteristics of farmers on the adoption behaivour.
v. iv. Determine the perception of cooperative and non-cooperative farmers on the effect of agricultural production.

1.4 Research Questions

The following research questions provided guide for the study

1. What is the level of adoption among cooperative and non-cooperative farmers in your locality?
2. What is the extent of utilization of agricultural innovations among cooperative farmers and non-cooperative farmers?
3. What is the influence of socio-economic characteristics of farmers on adoption behavior?
4. What is the perception of cooperative and non-cooperative farmers on the effects of innovation on agricultural production?

1.5 Research Hypotheses

1. H_0: There is no significant difference in the level of awareness of agricultural innovation among cooperative and non-cooperative farmers.
2. H_0: Agricultural innovation are not extensively used by agricultural cooperative societies.
3. H_0: Adoption of agricultural innovations has no significant effect on agricultural productivity by the farmers.
4. H_0: There is no significant difference in the level of agricultural innovation adoption by cooperative and non-cooperative farmers.

1.6 Significance of the Study

A number of institutions, groups and individuals have so much to benefit from this study.

To cooperative members

This study will help cooperatives to understand the reason for their performance in improving agricultural production and implement the acquired knowledge towards improving their productivity. Cooperative as a socio-economic entity will learn from this study the essence of collective activity which will help them improve on their agricultural activities and their standard of living.

To the general public: The general public will learn from this study the need and the benefits of joining a cooperative society and the extra benefits they enjoy from the services of the extension workers that come around to educate them on how best they can improve in their activities and the benefits they stand to gain as members of cooperative societies. Cooperative societies are the largest employers of labour in countries like Indian, Israel, and many of its citizens identify with them to improve their lifestyle.

To the government: The saying that cooperative society is an agent of development even to the grassroot level is a true assertion. Cooperative society is the only business that has the interest of their members as its main objective. The government will understand better the contributions of cooperative societies in national development and encourage them in providing and extending some incentives and agricultural facilities to these cooperatives since they contribute their own quota towards national development. In some counties, and even Nigeria, cooperatives produce some export goods which help in increasing the country's national income.

Also these will help the government to understand the various challenges that cooperatives encounter and ways of assisting them in solving these problems, thereby helping them to improve in their agricultural productivity.

To the extension workers: This project has tried to bring out the contributions of the agricultural extension workers and the part they play in educating these farmers on the best agricultural practices to be employed in achieving high productivity. Therefore the roles of these extension farmers in achieving increased agricultural productivity cannot be under estimated.

To the students: This research will act as a base for students carrying out research on similar topics.

1.7 Scope of the Study

i. This study is restricted to farmers in Imo State. It compares the extent of awareness and adoption of agricultural innovations among cooperative and non cooperative farmers. The unit of analysis is the farmers who have been in the occupation for over four years and also the farmers who registered with cooperatives and registered farmers with Imo, Agricultural Development Programme. The period scope (four years) was chosen because it is generally agreed that it takes about four farming seasons for the impact of a particular innovation to be felt. This will definitely give the researcher the basis to generalize her findings. The researcher is exploring the extent of adoption of agricultural innovation since 2014. Apart from having a comparative element of cooperative and non-cooperative farmers, the study focuses specifically on the influence of socio-economic characteristics of farmers on the adoption behaivour.

1.8 Limitations of the Study

Researcher faced a lot of limitations in embarking on this research but, the major one was the attitude of the respondents to disclose information needed for this research, even though we liaised with friends from the region who were conversant with the terrain to administer the copies of the questionnaire.

However, data were generated and a good number of the respondents were however skeptical about divulging their personal information as they thought such information will not be treated confidentially. They actually became more relaxed since their names were not taken as part of the information needed.

CHAPTER TWO

2.0 REVIEW OF RELATED LITERATURE

Relevant literature and studies were reviewed in order to understand the influence of agricultural innovation on agricultural productivity of cooperatives. The section is arranged as follows: Conceptual framework, followed by review of empirical studies and theoretical framework. Thematic issues discussed in conceptual review include the concept of agriculture, the concept of production, cooperative, agricultural innovation and the linkage between cooperative, agricultural innovations and productivity

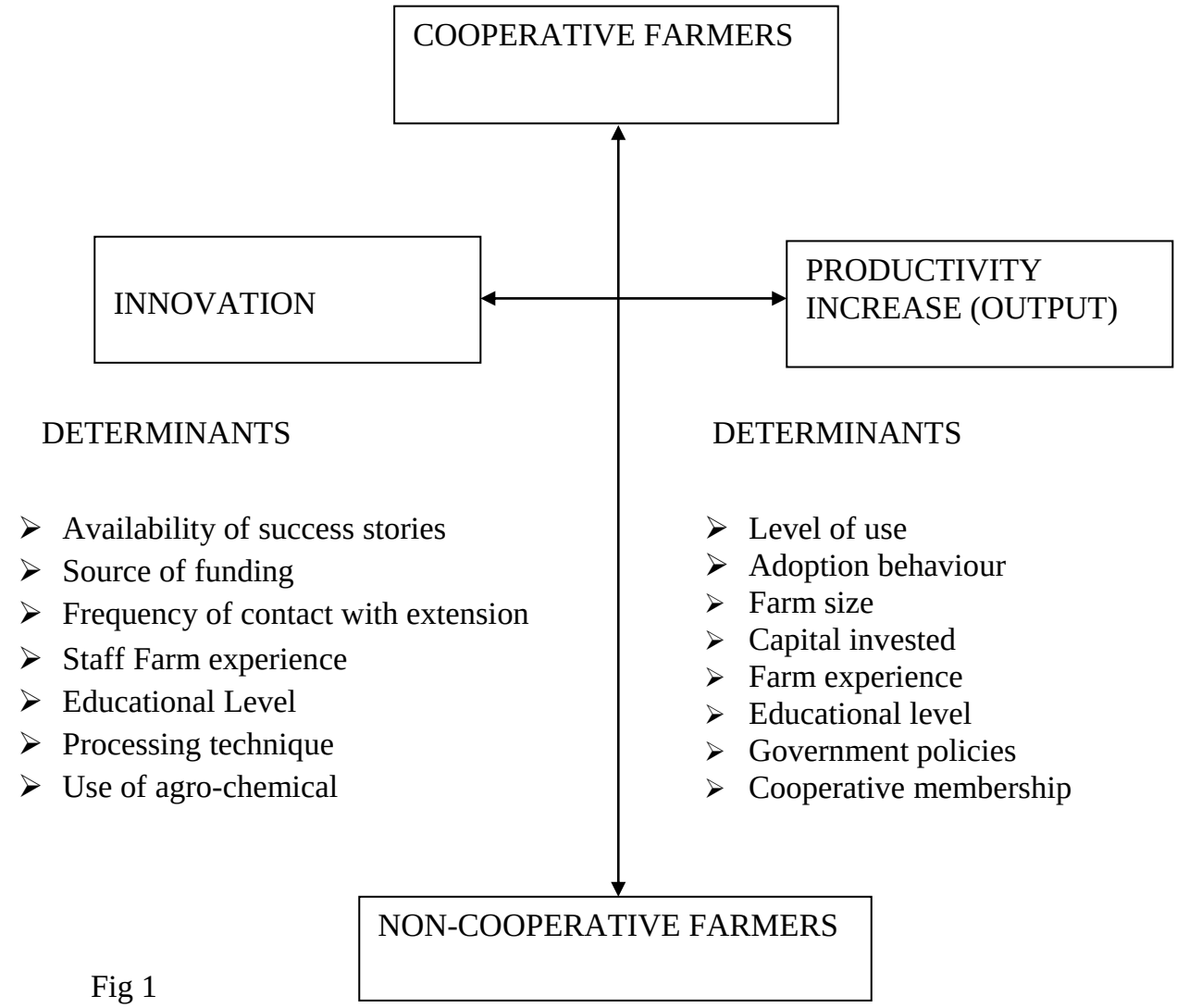


Fig 1
Conceptual model of the literature
Source: Researcher's Concept

2.1 Conceptual Review

2.1.1 Concept of Agricultural Innovations

Agricultural innovations cover "the new or developed inputs and methods used in agricultural production process". These are technical practices increasing production or yield (Tatlıdil, 1997). The adoption and spread of agricultural innovations help to speed up technology transfer and make technological production more useful. One of the most prominent features of today's world is the rapidly changing technology. The techniques and methods of production improve constantly. In every stage of agricultural production, countless technological innovations are presented to the farmers. Adoption to changing conditions is only possible through rapid application of these innovations. Introduction to technology and the spread of new technologies are the aspects that improve living standards in the rural areas and enhance agricultural improvement. Agricultural improvement is generally referred as the level of technology that farmers adopt to increase production. Agricultural progress is the process in which technical information and innovations are directed to and adopted by farmers. In short, it is the positive reaction of farmers to change (Tatlıdil, 1997).

The introduction of agricultural innovations to farmers and their adoption can be facilitated by agricultural extension activities. Agricultural extension is one of the most important tools for the survival of agriculture. In addition, agricultural extension services play important roles in increasing the agricultural productivity and developing the sector. It is not easy to persuade the farmers about adopting and practicing the proposals offered to them through extension activities (Byerlee & Lopez, 1994).

2.1.2 Agricultural Production and Productivity in Nigeria.

2.1.3. Nature of Agriculture

Agriculture is simply defined as the production of crops and livestock. Crops may be food crops or cash crops. While food crops and most times livestock are for direct

consumption, cash crops and sometimes livestock are normally for further production, as industrial inputs and for export to generate revenue. There is no gainsaying the fact that food is the most important need of man. The ability to produce or make available sufficient amount of food items for the populace is usually a thing of concern to every government and citizen. In other words, there is always the desire to ensure food security in any society. The issue of food security in Nigeria has been topical for some time now. Food security is an essential part of economic development of any nation. Hungry people cannot be productive and they cannot contribute significantly to the development of a nation

Agriculture is a typical example of what Pavitt (1984) would classify as a supplier dominated sector, a sector that is dependent upon supplying industries for its innovations and its technical progress. The sector consists of numerous small firms, most of which produce a relatively homogeneous output used as input in the food processing industries. These sector characteristics are little conducive to entrepreneurial behaviour and innovation. The individual farming operation usually lacks both the means and the scale of operations to appropriate the benefits of investments in rural development (R&D) and, therefore, has little incentive to develop the necessary capabilities. Consequently, technological change in agriculture has mostly been described as a process of adoption of "on shelf" innovations produced elsewhere, be it by commercial suppliers of farm equipment or of inputs like seeds and fertilizers, or by public research and development facilities.

International Fund for African Development noted that agriculture plays a unique role in reducing poverty through the use of new technologies. Partly, this reflects the sheer number of poor people engaged in it. Agriculture is an important livelihood source for about 75% of people surviving on less than $1 a day – the internationally agreed definition of absolute poverty line in rural areas (IFAD, 2001). It was observed by Maxwell (2001) that 70% of Sub- sahara African's labour force and 67% of South Asians work in agriculture or are employed by agriculture. The argument in favour of agriculture

as the poverty alleviating sector per excellence rest on more than population statistics. Improvement in agricultural productivity has a powerful knock–on effect to the rest of the economy like food processing through input supply and increasing the supply of affordable food which stimulates and support economic growth and development. Technology change in agriculture began at least 10,000 years ago when the first cultivated selected wild plants were experimented with different growing environments (Egwu, 2003). Earlier in civilization, the technical performance of agriculture in the great civilization remained roughly equivalent for centuries until the middle of the nineteenth century, where principally in Europe and North America with the introduction of new machinery into agricultural activities.

The spread and improvement in agricultural technologies has since then been very impressive, particularly in improved "modern varieties" (MVS) of grains. In 1990 modern varieties (MVS) represented an estimated 75% of rice, 70% wheat and 57% of the maize growth in the developing world. Although these figures reflected part in the Green Revolution package of seed, fertilizer, irrigation and a substantial proportion of these MVS grown with low or no external inputs (Byerlee & Lopez, 1994). The story is not just confined to cereals or to the development of yield maximizing varieties alone, new technologies have also been developed for non- cereals and many MVS have been developed principally for their resistance to pests and diseases in other areas outside cereals. A very good example is the improved cassava varieties which spread rapidly in part of West Africa (Nweke & Akorhe, 2002).

2.1.4. Modernization in Agriculture:

Low productivity of small-scale farmers in developing countries is often attributed to lack of innovation and low- or non-adoption of improved agricultural technologies. One of the major reasons easily associated with the literature on non-adoption and low productivity is the unavailability of technologies to farmers and lack of innovation culture among small-scale farmers. Thus, the question posed is whether this is due to the low extension

agent contribution to educating the farmers on new technologies which makes it difficult to deliver technologies to small-scale farmers or the small farmer being too risk averse to want to try out new technologies. (Byerlee *et al*., 2007). However another reason is the linear top-down method of technology development and transfer in which the farmers are regarded as spectators in the development process. (Hall *et al,* 2003). The linear top-down extension delivery is restrictive in nature and this hinders its ability to stimulate the much needed breakthrough to promote innovation and adoption among farmers by disregarding other non-traditional knowledge source especially the private sector (Byerlee *et al.*, 2007).

However, the supply and demand of improved technologies involves a multi-faceted interaction among different actors both in the public and private sector, with each playing significant roles to stimulate and trigger innovation to development and adoption (Egyir *et al.*, 2001; Hall *et al.,* 2003). When technologies are developed in isolation with regards to the final users (farmers), this may serve as a hindrance for adoption when the technology is finally introduced to them. Another possible reason may be the low or general lack of innovation spirit among small farmers due to asymmetry information relating to market and improved technology, lack of technical-know-how and the infrastructural platform relevant to increasing yields (Byerlee *et al.*, 2007; World Bank, 2006).

To help address the issue of the apparent disconnection between researchers and farmers as envisaged in the linear top-down model, empirical work on the development of improved innovations, dissemination and use in recent times has gradually shifted to a more encompassing and interactive agricultural innovations system that draws both public and private institutions into the innovations process. Many proponents of this shift argue that this type of system is conducive for knowledge sharing and interactive learning in the process of technology development that may stimulate innovation in the long run (the system of complex actor interactions), rather than focusing solely on the creation and use of technology (top-down linear approach). With the recognition of the farmer as part

of the process, it is further believed that it may serve as an incentive to promote adoption of any technology that is developed through this process (World Bank, 2006).

Many actors that traditionally have not been included in the top-down approach to innovations process such as private sectors, input dealers and NGOs have become important in the innovation process triggering demand for improved farming technologies (Spielman, 2006). While acknowledging the roles of many actors in the innovation system framework, it can be argued that just increasing the number of actors in the innovation process alone may not motivate or trigger innovations or technology development in the agricultural sector, especially among small-scale farmers. For example, Matuschke and Qaim (2009) in their study of social relations and influence concluded that how interactive the network and power is distributed among actors in the network will significantly determine the level of innovativeness of actors either as a collective body or individually. In this regard, if power is concentrated mainly in the research institutions relative to extension agents and local farmers, this may be a disincentive for innovation on the part of farmers.

Agricultural Innovations System (AIS) may be helping to change the mind set of researchers and policy makers by encouraging them to consider new and unconventional actors and relationships in technology development and dissemination. Its overall influence on effecting innovation and adoption in developing countries is still not well understood and documented. The most important empirical question that remains to be answered is how the social network framework, as introduced into the concept of agricultural innovations system, has influenced innovation culture of actors among small-scale farmers (Spielman, 2006; Hall *et al*, 2003; World Bank, 2006).

2.1.5 Agricultural Productivity

Many researchers considered agricultural productivity as the overall efficiency with which a production system works, while others defined it as a ratio of output to resource

expended separately or collectively. This term has also incorrectly and interchangeably been used with production. In reality, production refers to the volume of output, while productivity signifies the output in relation to resources expended. The quantum of production can be increased by employing more resources without increasing productivity and productivity per unit terms can be increased without increasing production by employing less input for the same production level. It is commonly agreed that productivity is the ability of a production system to produce more economically and efficiently. Therefore, agricultural productivity can be defined as a measure of efficiency in an agricultural production system which employs land, labour, capital and other related resources (Benson, 2004; Calkins and Ngo, 2005).

Veerakumaran (2005) has expressed the connotation of productivity in these words, "productivity is defined in economics as the output per unit of input, the art of securing an increase in output from the same input or of getting the same output from smaller inputs"." He further suggests that increases in productivity, whether in industry or agriculture, are generally the result of a more efficient use of some or all the factors of production, viz., land, labour and capital. Benson (2004) considers productivity as a physical relationship between output and input, which gives rise to that output.

Increase in productivity of land and of labour often go hand in hand. When, crop yield is increased or the pattern of cropping is intensified, there is usually - although not always - an increase in output per man. (Idachaba, 2005). Similarly, when improved methods are adopted to increase efficiency and raise labour productivity and farm income, there is often, as a secondary result, an increase in land productivity and total output. In countries with agricultural surplus problems, this may be embarrassing, and increased labour productivity may then have to go hand in hand with measures to limit the area under cultivation. As Omotosho et al (2009) observed, factors considered to be important in determining agricultural productivity include quantifiable factors such as technical change, relative factor product prices, input use, education, agricultural research and extension, market access and availability of credit. Other factors include weather, farm

production policies, land ownership patterns, inadequate involvement of beneficiaries in decision-making, insecurity and the legal and regulatory environment.

2.1.6. Nature of Agricultural production in Nigeria

Agricultural production in Nigeria is usually facing the challenge of increase in population. As could be seen in Table 1, despite increase in food production, rapid population growth is capable of dwarfing such effort.

Table 1: Agricultural Production and population growth in Nigeria (1981 – 2015)

Year	Local Food Production (million tonnes)(staples)	Population (million) (Growth rate 3.3%)	Food Production per capita
1981	15.70	64.32	0.24
1982	16.45	66.44	0.25
1983	14.24	68.64	0.21
1984	29.55	70.90	0.42
1985	31.60	73.24	0.43
1986	32.51	75.66	0.43
1987	37.11	78.15	0.47
1988	47.02	80.73	0.58
1989	52.77	83.40	0.63
1990	55.96	86.15	0.65
1991	67.58	88.99	0.76
1992	75.09	91.93	0.82
1993	78.69	94.96	0.83
1994	81.80	98.09	0.83
1995	84.29	101.33	0.83
1996	88.08	104.67	0.84
1997	90.82	108.12	0.84
1998	93.40	111.69	0.84
1999	96.77	115.38	0.84
2000	102.65	119.14	0.86
2001	88.27	123.07	0.72
2002	91.93	127.13	0.72
2003	98.57	131.33	0.75
2004	104.70	135.66	0.77

2005	111.78	140.14	0.80
2006	115.77	144.76	0.80
2007	123.53	149.54	0.83
2008	132.67	154.47	0.86
2009	142.35	159.57	0.89
2010	152.74	164.64	0.93
2011	163.89	170.08	0.96
2012	175.85	175.69	1.00
2013	188.69	181.49	1.04
2014	202.46	187.48	1.08
2015	217.24	193.67	1.12

Sources: i. CBN Annual Report and Statement of Accounts (analysis)

ii. NBS Annual Abstract of Statistics, for 2015 situation.

Table 1 shows that, as a result of the various agricultural policies and programmes, local food production has been on the increase. While the nation's population grows at an average of 3.3 percent per annum, local food production grows at an average of about 7.3 percent per annum. As a result, local food production per capita has been increasing overtime. However, as shown in Table 1, the food needs of the populace has been on the increase beyond the capacity of local production necessitating increased importation. For instance, local food production per capita, which was 0.24 in 1981, rose to 0.65 in 1990 and 0.86 in 2000. By 2010, it had risen to 0.93 and by end of 2015, it was 1.12. This implies that various agricultural policies and programmes of the governments have yielded some positive results, although not as much as expected.

2.1.7. National Efforts at Improving Agricultural Production

The desire of Nigeria is to be both food self-sufficient and food secure. The nation, just like any other nation, desires to be able to adequately feed its population and if possible export to other countries. As a result, efforts have been made, since pre-independence to develop and boost agricultural production in the country. Specifically, since 1970, the

nation has initiated over 15 agricultural programmes aimed at boosting food production, in addition to diversifying the revenue base on the nation. These programmes include:

- National Accelerated Food Production Programme (NAFPP) in 1973
- Operation Feed the Nation (OFN) in 1976 (OFN)
- The Green Revolution in 1979 (GR)
- Structural Adjustment Programme in 1986 (SAP)
- National Agricultural and Land Development Authority(NALDA)
- Agricultural Development Programme (ADP)
- River Basin Development Authority (RBDA)
- Better Life Programme for Rural Women in 1988 (BLP)
- Family Economic and Advancement Programme (FEAP) in 1996
- Poverty Alleviation Programme in 2000 (PAP)
- Directorate of Food, Roads and Rural Infrastructure (DFRRI) etc

All these efforts yielded little success. Egbuna (2001) pin-pointed inconsistent government policies, increasing population, traditional farming system, subsistence farming, lack of infrastructural facilities like schools, health facilities, communication etc in the rural areas and environmental problems like erosion, bush burning etc. as being responsible for the failure of the agricultural programmes to achieve their objectives. Eyo (1996) expressed his displeasure with the pricing policy of the government. Eyo (1996) and Afolabi(1999) are of the opinion that it was the oil boom that led to the neglect of most other hitherto viable sectors. Obinyan (1999) blamed the agricultural technologies used in Nigeria for the woes. He observed that the use of fertilizers, agrochemicals and mechanization is very low. In the view of Kuye (1999), government needed to invest reasonably in research and extension services. Although Ogunfiditimi (1996) noted that there is a dearth of an in-depth empirical analysis of the problems facing agricultural

production in Nigeria, he classified the constraints to increased agricultural output into seven:

- Capital-oriented problems - credit facilities, farm infrastructure, transport services, wages and high cost of production
- Management-oriented problems-land and water management, crop management, energy management, post-harvest management and farming systems management
- Nature-oriented problems-drought, desert encroachment and pest and disease
- Land –oriented problems-land tenure system and soil fertility
- Labour-oriented problems-labour scarcity, extension service staff ratio and Women-in-Agriculture
- Technological problems
- Inconsistent and unsustainable government agricultural policies.

He also identified discrimination against small-scale agriculture, inappropriate policies, institutional proliferation, population, and neglect of irrigated agriculture and instability in the prices of agricultural products and the role of the middlemen as additional constraint militating against increased agricultural production in Nigeria.

First, the adoption of agricultural technology can make a limited contribution to reducing the vulnerability of the small-scale farmers who are mostly poor. Examples include the adoption of drought resistance varieties as TMS 4(2) 1425 TMS 30555 and TMS 3000L that reduce the risk of crop failure due to drought. Cassava occupies a unique position in the world food economy especially its survival ability where other crops fail. Secondly, it gives a satisfactory yield on a wide range of soil types including acid soils. There can be tradeoffs between growth through agricultural technologies and risk since taking up a new agricultural technology is in itself risky. While improved productivity through agricultural technology can lead to increase in income, adoption is associated with capital and transaction cost that poor farmers may not be able to afford. Despite the allocation of

fund by the Federal government to agricultural sector over the years and the technical assistance from IFAD, evidence has shown that the agricultural industry does not command the respect or maintain the pride of the place it was in the Gross National Product (GNP) of the Nigeria economy in the 1970s. Increase in cassava productivity will greatly improve per capita income of the individuals and the National income in the country. To achieve this is not without some constraints leading to dwindling farmer's performance in the production. While some of these constraints are imposed by the government ability to live up to expectation, the other is imposed by the very complex nature of the society with respect to culture or other signs.

Research conducted to investigate into factor related to the adoption of improved farm practices in Kogi State has shown that technology adoption was positively and significantly associated with the followings; Characteristics of farmers in terms of age, level of education and social status. Characteristics of farmers in terms of agro- climate condition, location, sizes, credit etc. Characteristics of the improved technology itself in terms of relative advantage, compatibility, complexity and availability. Participation of voluntary organization and Characteristics of change agents in terms of their personal attributes techniques of communication and the use of traditional culture.

2.1.8 Some Agricultural innovations used in Nigeria

Agricultural innovations include improved gadgets, inputs, processes and methods that increase farmer's technical efficiency. They include:

- Improved application of fertilizer: Apart from using foliar fertilizer, application rate of fertilizer has also improved. A fertilizer that gives comparative amount of nitrogen, phosphorous and potassium has to be chosen in order to match the soil type. Soil test is conducted in order to identify the right kind of fertilizer to apply.

- Use of agrochemicals. This refers to various chemicals used by farmers. They include pesticides, herbicides and fungicides. They also include synthetic fertilizers, hormones and other chemicals used to store raw materials.
- Improved management technique. This includes all processes and method used in making decision about the use of money, machines and human capital. This aspect of management involves making and implementing of the decisions involved in organizing and operating a farm for maximum production and profit.
- Planting and processing technique. New planting methods include line planting of rice and use of irrigation pumping. Other popular technologies employed by farmers include use of mechanized implements such as tractors, harvesters, and electronic processing implements.

2.1.9. Adoption Process of Agricultural Innovation

Adoption process for agricultural innovations consists of information seeking and information processing activities, where an individual is motivated to reduce uncertainty about the advantages and disadvantages of an innovation. According to Rogers (2003), there are five steps in the innovation decision process. They include: knowledge, persuasion, decision, implementation, and confirmation. These stages are arranged in sequential manner and must be followed orderly.

Knowledge stage

This is the beginning stage in the process when an individual learns about the existence of an innovation and seeks information about the what, how and why of the innovation. This is the stage where information on how and why the innovation is sought. This stage generates three forms of knowledge: awareness knowledge, how to knowledge and principles knowledge.

Persuasion Stage

This stage involves formation of positive or negative attitude towards an innovation. Persuasion stage, unlike knowledge stage, is more affective. This is when the individual forms an attitude about the innovation through interaction with others. The degree of uncertainties about the innovation is reinforced or corrected by others. Whereas the information is readily available from many sources, individuals prefer to seek them from trusted people.

Decision stage

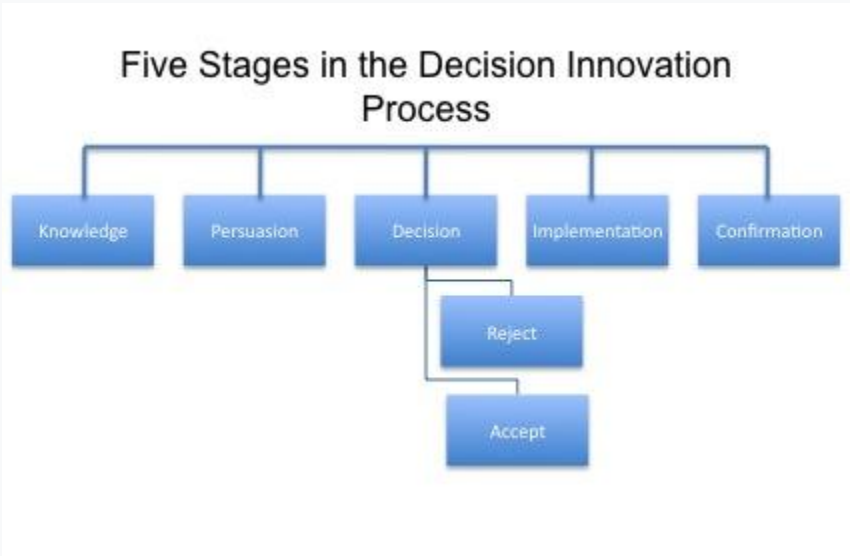
According to Rogers (2003), this is the stage where the individual makes the decision about whether to accept or reject the innovation. If an innovation has a partial trial basis, it is usually adopted more quickly since many individuals would like to try it first before coming to adoption decision. In fact, vicarious trial usually speeds up adoption process. There are two types of rejection: active and passive rejection. In active rejection, the individual tried to adopt an innovation but later changed his mind, while passive rejection is when he rejects the innovation from the outset.

Implementation stage

This is where the innovation is put into use. Despite bringing some degree of uncertainties, the individual is expected to overcome the initial hurdles. This is also where reinvention takes place. This occurs when an innovation is changed or modified by a user in the process of its adoption and implementation.

Confirmation Stage

This is when the individual looks for support to his decision. In this stage, the decision earlier taken can be reversed if the individual kept getting conflicting opinions. This is when attitudes become more crucial. Discontinuance may occur during this stage in two ways: the first is when the individual adopts a better innovation to replace it. The second is when an individual rejects the innovation because he is dissatisfied with the performance.



Five stages of the adoption process

Stage	Definition
Knowledge	The individual is first exposed to an innovation, but lacks information about the innovation. During this stage the individual has not yet been inspired to find out more information about the innovation.
Persuasion	The individual is interested in the innovation and actively seeks related information/details.
Decision	The individual takes the concept of the change and weighs the advantages/disadvantages of using the innovation and decides whether to adopt or reject the innovation. Due to the individualistic nature of this stage, Rogers notes that it is the most difficult stage on which to acquire empirical evidence.[11]
Implementation	The individual employs the innovation to a varying degree depending on the situation. During this stage the individual also determines the usefulness of the innovation and may search for further information about it.
Confirmation	The individual finalizes his/her decision to continue using the innovation. This stage is both intrapersonal (may cause cognitive dissonance) and interpersonal, confirmation the group has made the right decision.

Figure 2: **Five stages of the adoption process**
Source: (Rogers, 1995).

2.1.10 Information Communication Technology (ICT) as Important Agricultural Innovation

The use of modern ICTs in agricultural extension service delivery has enhanced the efficiency of Research-Extension-Farmer In-Put-Linkage System (REFILS) much greatly. ICTs have ushered in the much desired advantage of reaching a wider audience (Obinne, 1994), by creating awareness on recommended farm practices in most rural households in Nigeria.

Several authors have conceptualized ICT. Heeks (1999) defined ICTs as electronic devices for capturing, storing, processing, and communicating information. Also ICTs is defined as technologies that facilitate communication through processing and transmission of information by electronic means. However, ICTs in a broader sense, refers to sets of tools, equipment, applications, and services that are utilized to produce, capture, store, disseminate and exchange information (Raji, 2008).

In the light of these definitions, ICT tools that have great potential for application in agricultural extension communication for rural development include: Radio and Television, Telephones, Short Message Services, The Web, Search engines, Cameras, Video, E-mail, Computers, CD-ROM, DVD, Web publishing, Printed materials, Photographs, meetings and Workshops. All these are sources of agricultural information available for farmers worldwide.

In most of sub-Saharan African countries, conventional media, for example, Radio, Newspapers and Television have played key roles in rural development. Agricultural innovations are disseminated to rural farmers through these media. Despite the crucial role of ICTs in meeting information needs of rural households, social, economic and cultural conditions such as poverty, illiteracy, and poor rural infrastructural base have limited the capacity of farmers in making wide range of choices using ICTs in most rural economies. However, Yaghoubi- Farani , Gholinia, & Movahedi (2011) noted that ICTs must first be well adopted for livelihood of rural communities.

Diffusion is the "process by which an innovation is communicated through certain channels over a period of time among the members of a social system". An innovation is "an idea, practice, or object that is perceived to be new by individual or other units of adoption". "Communication is a process in which participants create and share information with one another to reach a mutual understanding" (Rogers, 1995).

2.1.11 The Concept of Agricultural Cooperatives and Roles in Agricultural Production.

Agricultural cooperatives are established to enable farmer members to engage in business together, thus helping one another in times of crisis, as well as gaining a better livelihood. (Adefila and Madaki, 2014). Agricultural cooperatives are generally organized among people earning their livings in agriculture, with varying kinds and degrees of need, thus resulting in various agricultural cooperative types.

According to ICA (2012), agricultural cooperatives play an important role in supporting small agricultural producers and marginalized groups such as young people and women. They empower their members economically and socially and create sustainable rural employment through business models that are resilient to economic and environmental shocks. Cooperatives offer small agricultural producers opportunities and a wide range of services, including improved access to markets, natural resources, information, communications, technologies, credit, training and warehouses. They also facilitate smallholder producers' participation in decision-making at all levels, supporting them in securing land-use rights, and negotiating better terms for engagement in contract farming and lowering prices for agricultural inputs such as seeds, fertilizer and equipment. Through this support, smallholder producers can secure their livelihoods and play a greater role in meeting the growing demand for food on local, national and international markets, thus contributing to poverty alleviation, food security and the eradication of hunger (Birchall, 2005).

The International Cooperative Alliance (ICA, 2005) defines a cooperative as "an autonomous association of persons united voluntarily to meet their common economic, social, and cultural needs and aspirations through a jointly-owned and democratically-controlled enterprise". The seven internationally recognized cooperative principles are: voluntary and open membership; democratic member control; member economic participation; autonomy and independence; provision of education, training and information; cooperation among cooperatives; and concern for the community. In 1987, the United States Department of Agriculture (USDA) adopted just the first three principles of user ownership, user control and user benefit following arguments that cooperatives operating in global markets, particularly agricultural marketing and supply cooperatives, cannot afford to internalize the ICA values and principles but must focus on fewer, more self-centred principles just to survive (Birchall, 2005).

The other principles, it could be argued, are also held by other organizations. Essentially then, a cooperative is a user-owned and user-controlled business that distributes benefits equitably on the basis of use or patronage (Barton, 2000). Thus, a farmer member who accounts for 5% of the volume of agricultural products delivered to the cooperative would receive 5% of the net earnings derived from the handling, processing and marketing of those products. "Such patronage dividends help to boost the income of farmers directly or by reducing the effective cost of the goods and services provided". This principle is often referred to as "business-at-cost". The United States (US) National Cooperative Business Association (NCBA, 2005) also emphasizes the unique characteristics of cooperatives relative to other (investor-oriented) businesses:

Cooperatives are owned and democratically controlled by their members (i.e., those that use the cooperative's services or buy its goods) and not by outside investors. Members elect their Board of Directors from their ranks. Major policy decisions are based on the one-member, one-vote principle, regardless of each member's investment in the cooperative. As Chambo (2009) observed, Cooperatives return surplus income (revenue over expenses and investment) to members in proportion to their use or patronage of the

cooperative, and not proportionate to their investment or ownership share. Cooperatives are motivated not by profit, but by providing a service to satisfy members' requirements for affordable and quality goods or services.

In general, agricultural cooperatives can be classified into three broad categories according to their main activity, namely, marketing cooperatives (which may bargain for better prices, handle, process or manufacture, and sell farm products), farm supply cooperatives (which may purchase in volume, manufacture, process or formulate, and distribute farm supplies and inputs such as seed, fertilizer, feed, chemicals, petroleum products, farm equipment, hardware, and building supplies), and service cooperatives (which provide services such as trucking, storage, ginning, grinding, drying, artificial insemination, irrigation, credit, utilities, and insurance) (USDA, 2004). These cooperatives usually vary greatly with regard to functions performed, and can also vary greatly in size. Most of the agricultural cooperatives are relatively small businesses.

Cooperatives exist solely to serve their members. The NCBA (2005) argues that cooperatives "are formed by their members when the market place fails to provide needed goods and services at affordable prices and acceptable quality. Cooperatives empower people to improve their quality of life and enhance their economic opportunities through self-help". The NCFC (2005) echoes these sentiments by providing the following reasons why cooperatives were, or are being formed: to strengthen bargaining power; maintain access to competitive markets; capitalize on new market opportunities; obtain needed products and services on a competitive basis; improve income opportunities; reduce costs; and manage risk. Essentially, farmers form(ed) cooperatives with the objective of generating greater profits, (1) by obtaining inputs and services at lower costs than they could obtain elsewhere or that were not available, and (2) by marketing their products at better prices or in markets that were previously not accessible (Barton, 2000).

As Omotosho (2007) observed, agricultural cooperatives are generally formed to meet the members' needs such as: to provide loans to members for productive and providential

purposes at affordable interest rates, to encourage members' thrift through savings and deposits; provide agricultural products and daily necessities for sale to members at reasonable prices; promote appropriate farm practices and disseminate technical expertise aimed to help members reduce production costs and obtain higher yields. With government assistance, members are introduced to proper cropping techniques, as well as the use of fertilizers and insecticides. Another service is in the form of farm equipment (e.g. tractors, water pumps, etc.) made available to members at reasonable charges. Adefila and Madaka (2014) also observed that agricultural cooperatives are formed to enable members to market products together, thereby obtaining higher prices for their products and maintaining fairness in terms of weights and measures. At present, agricultural cooperatives engage in various types of business in responding to their members needs. Generally, the five main areas are loans, savings and deposits, sale of consumer and farm supplies, joint marketing, and agricultural extension services.

2.1.12 Cooperatives and Their Roles in Innovation

The increased complexity of knowledge processes, which are the backbone of new technologies and innovations, leads organizations to search beyond their own boundaries for valuable knowledge and skills, in order to complement their own capabilities (Becker and Dietz, 2004). Since the 1980s, the increasing instability of the competitive environment, with shorter product and technological life cycles, has forced organizations to reconsider their innovation strategy in order to widen their technology base (Nijssen *et al.,* 2001).

In this context, cooperation has gained an important role in the innovation process at the organizational level, Cooperation activities with other firms or institutions are opportunities to access complementary technological resources (such as skill sharing), which can contribute to faster development of innovations, improved market access, economies of scale and scope, cost sharing and risk spreading (Ahuja, 2000; Cassiman and Veugelers, 2002; Hagedoorn, 2002; López, 2006).

Since cooperative innovation agreements favor the accumulation of knowledge that is likely to be converted into new technological and organizational innovations, firms' decision to cooperate opens the range of their technological options (Mowery et al., 1998; Caloghirou et al., 2003).

In other words, and as argued by Gomes-Casseres *et al.* (2006), firms enrolled in cooperation activities or alliances are involved in denser knowledge flows than are non-allied firms. Since the mid-1990s, and as described by Rosenfeld (1996), not only multinational firms but also small and medium-sized firms are establishing more and tighter relationships with other companies in order to achieve economies of scale, market strength, or to exploit new opportunities. Firms have started to engage, both formally and informally, in joint activities such as co-marketing, co-production, shared resources, or joint development (Bönte and Keilbach, 2005). The boundaries of innovation are shifting from a situation where firms perform rural development. (R&D) activities mainly internally (Mowery, 1983; Nelson, 1990)

Although innovation is a source of growth and a determining factor for the achievement of competitive advantages, creating it requires the coordination of the efforts of numerous participants, as well as the integration of tasks or activities related to different specialized functions (Van de Ven *et al.,* 1996). As advocated by some author (Legnick-Hall, 1992;), organizations, through innovation, will be able to generate sustainable competitive advantages. However, this will be achieved to the extent that innovation is internalized within the organization itself so as to complement and enhance competencies related to other configurational elements, such as organizational culture. This way, the continuous search for improvement and innovation brings organizations closer to excellence approaches, since it implies qualitative advances in aspects such as quality and processes (Porter & Tanner, 2004). These characteristics are achieved through the preparation and participation of workers in order to obtain competitive advantages that guarantee success Innovation, therefore, is one of the key aspects to business success and excellence (Porter & Tanner, 2004)

Key challenges in driving innovation

The major challenges highlighted by cooperatives in driving innovation over the next five years are prioritizing the right ideas, developing ideas, and funding the right ideas. The three major challenges relate to a previously identified obstacle prioritizing the right ideas. This underlines the importance of having a rigorous innovation process – from generating ideas to selecting the right ideas and funding them. Another challenge identified by cooperatives is managing external collaborations. This can be explained by the decentralized form of their organization. Therefore, in order to achieve innovation dissemination, cooperatives rely on partnership, both internally and with external partners.

Four innovation logics

We have defined four innovation logics based on the two dimensions,

Reinvention: Launching innovations aimed at transforming the business model and based on internal organizational structures.

• Extension: Development of products and services connected to the existing business model. This category includes initiatives aimed at expanding the business model, based on internal organizational structures.

• Seeding: Investment in external structures to support the development of new initiatives. This category includes innovations aimed at the development of the business model and based on external organizational structures. At a later stage, some external structures may gradually be integrated, especially through acquisition, due to their growing importance.

• Open Innovation: Participation in the development of technological innovations likely to have a significant impact on existing business models. This category encompasses innovations aimed at transforming the business model, based on external organizational structures.

2.1.13 Factors Affecting Farmers' Adoption of Agricultural Innovations

There is a large volume of literature on the adoption of agricultural technologies (Rogers, 2003; Sunding and Zilberman, 2001; Feder and Umali, 1993). There is agreement that the adoption of agricultural technology depends on a range of personal, social, cultural and economic factors, as well as on the characteristics of the innovation itself (Pannell et al., 2006). A meta level analysis of this type of research undertaken by Prokopy et al (2008) shows that characteristics of adopters include educational levels, technical skill, attitude towards change, attitude towards risk, income level, farmers exposure, years of farming experience and land tenure system. Characteristics of innovation include: capital, farm size technical appropriateness, simplicity of application and complexity. Cultural factors include belief, norm and taboo. Characteristics of change agent include access to information, confidence, credibility, competency, confidence. Environmental factor include positive environmental attitudes and environmental awareness. Governmental policies are generally positively associated with the adoption of best management practices. Narrowing the disciplinary focus, the Agricultural Economics literature on technology adoption emphasizes the role of fixed and variable costs and heterogeneity, whether in terms of structural farm factors such as size or land quality, or the characteristics of farmers in terms of human capital (Sunding and Zilberman, 2001). Focusing on factors outside the farm gate, Fulginiti and Perrin (1993) reported a positive relationship between past output prices and current productivity, while market interventions such as price supports can speed up the adoption of new technologies.

The characteristic of the technology itself has an important influence on farmers' technology adoption and usage decisions (Adesina and Zinnah, 1993). In particular, the relative complexity, risk and investment characteristics of technologies significantly affect their adoption and diffusion. Looking at the differences between capital-intensive and management-intensive technologies, it was observed that age, size and specialization in dairy production increased the likelihood of adopting a capital-intensive technology, whereas education and size of operation positively impacted on the decision to adopt a

management-intensive technology. In this context, the risk preferences of farmers are important in influencing the technology adoption decision, especially if capital-intensive technology costs are irreversible (Sunding and Zilberman, 2001).

Other parts of the social science literature emphasize the role of distance and geography in the adoption of agricultural technologies (Rogers, 2003). In this case, any significant travel costs involved in the initial learning about a technology and subsequently establishing it might reduce the likelihood of that technology's adoption. More recently, some economists and other social scientists have focused more explicitly on farmers' motivations, values, objectives and behavioural influences in the context of technology adoption. This literature focuses on explaining how social norms, beliefs about a technology's performance and importance and farmers' intentions to change practices impact on the adoption of technologies. Finally, many studies concur that interaction with extension services and peer-group behavior also positively impact in farmers' technology adoption decisions. (Garforth *et al.*, 2003)

It is clear from this brief review of the general technology adoption literature that many explanatory variables are considered important. Specifically in relation to breeding technologies, Khanal and Gillespie (2013) report that in the US dairy sector specialized, younger, more educated farmers are more likely to adopt advanced breeding technologies such as Artificial Insemination (AI), sexed semen and embryo transplants. An analysis of the use of Artificial Insemination (AI) for Ugandan dairy farmers revealed that age of the farmer, years of awareness of the AI technology, total farm milk production and sales, extension visits per year, and quality of AI services provided to the farmers were positively associated with adoption and use of AI technology. The factors negatively associated with adoption and use of AI technology included farm level cost of Artificial Insemination (AI) services, farming experience, herd size and breed of animals (Kaya et al., 2006). The analysis that follows adheres to the strand of the literature identified above that focus on heterogeneity in structural farm and farmer characteristics as explanatory

variables for technology adoption patterns. Variables such as risk, education and farmers' attitudes towards technology are excluded from the analysis due to limitations in the data set used.

Social network also plays important role in adoption of innovation. To understand how social network influence adoption, it is pertinent to examine social network analysis. Social Network Analysis (SNA) is a simple methodological approach to the study of relationships among agents, groups or entities. Farmer networks are essentially informal channels that farmers employ to receive and share information. SNA provide tools to visualize, measure, and analyze relationships among actors (Wasserman and Faust, 2004: Borgatti; 2006). Social networks are essentially composed of actors who are identified as an integral part of a sector and their contacts within or outside of the network. Social ties are the core elements of a social network that drive social exchange serving as the medium for interacting and sharing information in the social network, while network characteristics such as degree, density, betweenness, and network centrality determines these exchange patterns within the network.

Ties are viewed as either strong or weak based on the number of interactions, time, and frequency of interactions between actors, as well as the reciprocatory services that characterize the tie (Wasserman, 1994; Sykes et al., 2009). With constant interaction and contact comes trust which is paramount in the exchange of ideas and information among actors in a social network. Strong ties influence each other more compared to weak ties because they share similar view. Communicating effectively is seen as very important in the sharing of complex innovations and tasks especially in agricultural discourse. According to Crona and Bodin (2006), this is attributed to the frequency of interactions: and trust that actors have developed for each other over time. Weak ties although represent less influential interactions. They tend to be important, especially among network actors who are disjointed drawing resources from many other actors and sources making weak ties relevant and preferable for the innovation purposes (Hansen, 1999).

Ties and interactions in social network analysis can be measured at different levels to represent the level of interaction: binary, interval or ordinal. Binary level presents measures of relation between two actors in which a measure exists if there is a relation between these two actors. A symmetric characteristic that shows the direction of the flow of the interaction is especially important in the study of information as it indicates from which actor the interaction originates. (Scott, 2000; Hanneman and Riddle, 2005).

The major problem with the adoption of improved agricultural technology by cassava farmers in Kogi State of Nigeria, as observed by KSADP (1997) is that of inadequate finance. Finance is viewed as an issue crucial to entering processing and buying of farm inputs like herbicides, insecticides, and fertilizer in farming of which cassava is inclusive. Effective management of cassava farmers toward higher productivity is a function of the availability and level of finance or credit facility at the cassava farmers' disposal. Also, cassava farmers in Kogi State are faced with the problem of land tenure system. This is because land for agricultural production is predominantly acquired through inheritance or within the extended family.

This problem of land tenure, as observed by Adofu, Orebiyi and Otitilaiye (2013) robs a lot of people who are interested in the cultivation of cassava the opportunity to do that which now shifts their interest to non- agricultural trade. In another thought, some land owners feel that it is unjust and immoral to sell their land to farm users since this may deprive their future generation of the inheritance opportunity. Low level of literacy among cassava farmers is another major problem. Majority of farm populace are those who live in the rural areas and are mostly illiterates. This has adverse effect on the role they play in their different economic activities. Pandey, (1989) observed that the level of education of farmers plays a vital role and accelerates the adoption rate of farmers. Obinne and Anyanwu (1991) suggested that education is believed to help develop managerial skills which lead to enhanced adoption index, and adoption is positively

related to education. Research has shown that the age of farmer plays a significant role in his adoption decision.

2.1. 14 Improving Agricultural Methods and Production

Tropical forests cannot be maintained unless agricultural production is greatly improved. However, to feed the projected population of the mid 21st century even at present levels, not to mention a level approaching that of developed countries, agricultural efficiencies would have to be far greater than is currently the case in most countries. There is need to increase agricultural productivity between 1.8% and 3% annually. The average annual growth rate of agricultural productivity in Sub-Saharan Africa between 1991 and 1995 was 2.4%, which must be maintained to prevent a decline in nutritional levels as populations grow (Musters, de Graaf, & ter Keurs, 2000). To provide levels of nutrition equivalent to more developed countries, higher production growth rates will be necessary. This can occur only if technologies are greatly improved and substantial financial support is provided by wealthier countries.

It is argued that, with proper techniques, including irrigation, sustainable agriculture can be established on former rainforest soils (soybeans in the Brazilian Amazon, for example). Of course, sugar has been raised in the Caribbean, and rice has been successfully cropped for thousands of years in South-east Asia on tropical forest soils. This type of agriculture is possible where soils are fertile, as in the regions of Indonesia which have rich volcanic soils. But elsewhere, as in East Java, only the most marginal agriculture (raising tapioca and other low-nutrient tubers) is possible, and these areas are extremely poor. Some non-volcanic rainforest areas lie on reasonably fertile soils (especially in Deltas) and can sometimes sustain appropriate crops. Recently, archeologists have discovered the remains of ancient agricultural systems in the Beni region of Bolivia. These artifacts lie in seasonally-flooded savannas which have long been thought to be useful only for cattle ranching. However, the many raised agricultural fields, fish ponds and other agricultural constructions indicate that these areas have been productive in the past. Recently, the construction of similar raised fields in savanna areas

in Bolivia has permitted the cultivation of tubers, maize, and manioc (Mann, 2000). If more of these areas could be converted to productive agriculture, they could provide a source of land as an alternative to rainforest removal. Often, however, governments encourage and indeed, almost coerce the development of unsuitable agricultural products, although they should not attempt to introduce non-native species and unsuitable crops or domestic animals into forest areas. For example, the Peruvian government has aggressively promoted the introduction of rice cultivation and water buffalo husbandry into many areas of the Amazon rainforest. In most places, rice is a most unsuitable cultivar, and water buffalo have caused serious erosion of riverbanks and destruction of vegetation.

Osbound (2010) observed that to improve agricultural productivity, a number of things must be accomplished: Firstly, reduction of the present rate of degradation and loss of productive farm land due to erosion, salinization, waterlogging, and nutrient depletion: Technologies for these purposes are available, but are little used because of the expense. However, many non-technological methods have been used for years by farmers (contour plowing, abandonment of marginal agricultural lands, planting of wind barriers, fallowing). Erosion can be prevented by the careful selection of appropriate crops, keeping ground cover on the soil, and contour plowing. Irrigation increases crop yields by about 200%, so more land must be irrigated to increase production efficiency, but this uses great quantities of water. More efficient methods must be utilized to prevent water shortages, as only 45% of irrigation water is actually absorbed by plants. Drip irrigation and other efficient delivery systems, better water distribution systems, improved control systems, and raising crops suited to the climate and soil will aid in this endeavor. Excessive or continual irrigation leads to salinization and waterlogging of the soil, which will diminish or destroy its agricultural capacity.

Secondly, raising the crop yield on current agricultural land, as most land is not producing yields even close to the maximum possible (in part because modern

technologies are not used). If the gap between current and potential yield could be bridged, the production of soybeans could be increased by 64%, that of peanuts by 208%, pulses by 472%, and cereals by 170% over a period of several years. The theoretical maximum yield for cereals is 13.4 tonnes per hectare, but the average cereal yield (1992-1994) was 2.77 tonnes per hectare – not even close to this figure (Goklany, 1998). There are regional inequities as well. Yields tend to be much lower in the tropical developing countries with large, growing human populations. For instance, in Sub-saharan Africa, yields of cereal grains are only one-third of the cereal yield in the northern hemisphere. Increasing yields can raise income for marginal agriculturalists and reduce dependence upon destructive slash-and-burn agricultural methods. This may be done by improving tillage methods to preserve soils and nutrients, which will be more beneficial than removing rain forest to open more agricultural land. Other techniques might include soil testing to determine soil chemistry profiles, crop rotation, nutrient and water management, terracing, instituting appropriate tillage methods for the soil/terrain, crop diversification, and interspersing crops with trees.

These methods could reverse the nutrient depletion characteristic of so many cultivated soils in tropical areas. To increase productivity, one must also reduce losses from disease and pests, both during growth periods and after harvest (currently, an average of 42% of crop yields is lost to these agents [Goklany, 1998]). Pest and disease-resistant varieties, better storage facilities and improved transportation could help in this, as well as the development of new high-yield crop varieties, suitable to local weather and soil conditions. Except for the "green revolution" with rice, less effort has been put into the development and study of tropical crops than temperate ones. Osbond (2010) enumerated the following reforms as necessary for improving productivity in Sub-Saharan Africa:

1. Reforming agricultural practices to be less harmful to forests and forest regeneration: Among these reforms could be reductions in the use of burning, minimizing the use of toxic chemicals, and using swidden land less intensively by

increasing fallow times. Zero tillage agriculture should also be utilized. When the soil is left untilled, organic matter is retained, preserving soil fertility and preventing erosion and runoff. Where the soils contain organic matter, forests can often regenerate.

2. Improving the distribution of agricultural products: Distribution systems are extremely unequal in most tropical countries, and often unreliable. Access to food and other agricultural goods must be increased in terms of availability (delivery) and affordability.

3. Reduction of the environmental impacts of new technologies. To diminish environmental impacts, agricultural management systems must be devised which are suitable for specific areas and crops. This would allow reduction in artificial inputs, so that fertilizer and pesticide use could be considerably reduced.

4. Reformation of policies relating to water management, allocation, and distribution. For instance, governments will frequently subsidize water use for agriculture, reducing incentives for water conservation. That users pay fairly for water is essential (now, frequently, the poor pay more for water than the rich). Many countries have achieved considerable water conservation by this method (Chile, Jordan, India and others), and it could certainly be applied by most tropical countries.

5. Retention of trees as crops to protect water and soil resources. In southern Malaysia, 60% of the forested area has been kept in forest, while the other lands are used for agricultural purposes (Spears, 1988). How much of this land will remain protected with increasing demand for palm oil and other products is questionable.

6. Development of agroforestry projects: Cash crops might be raised in small- scale agroforestry plots. Such crops as avocados, papayas, peppers, palm fruits, mangos and many other local crops are being raised in this way in the Amazon. According to Spears (1988), the need for industrial wood could be provided by tree plantations of approximately 25 million hectares. About 10% of the remaining forest area, but as of the date of the article, only 2.6 million hectares of such plantations had been established. They could preclude the need to remove virgin forest, particularly if they consist of rapidly-growing species. Such projects can act as alternatives to the of agricultural areas.

7. Provision of a system of tropical agricultural research stations and, especially, agricultural extension workers and soil experts to assist local farmers. This is absolutely essential for the success of agricultural reform. If farmers don't know or understand the methods, nothing can be improved.

8. Provision of governmental guidance and regulation: The "green revolution" was successful and widespread only partly because of the dispersal of information to virtually all rice-growers. In addition, some coercive regulation was undertaken by governing bodies – usually local – in some places. In Bali, for instance, water for irrigation is provided only to those farmers who use the new varieties of rice.
9. Some of these scenarios require that new technologies be developed, while Others do not. All of these changes require that economic benefits accrue to farmers to provide them with incentives for using different technologies and methods, and for using them effectively. Economic and scientific aid will be required from international agencies as well as national governmental agencies in order to assure that any changes made are sound, adapted to local conditions, and environmentally safe.

2.2 Review of Empirical Studies

Weyori, Mulubrhan, and Herman (2012) carried out a study on Agricultural Innovations Systems and Adoption Decision in Ghana. Their main objectives were analyzing social network and agricultural innovations development; and innovations systems and farm technology adoption linkages. The study used a combination of Rapid Agricultural Appraisal Knowledge Systems and Social Network Analysis (SNA) to identify, map and analyze agricultural innovations system of plantain in Ghana. It also addressed the impact of the innovations systems on adoption of improved technologies through social network. The study showed that the innovations are generally weak in Ghana and observed that although farmers are central through interactions, they have little to no influence in the innovations system perspective. They also found out that the overall adoption of improved farm technologies is low. Weak innovation system, short shelf life, taste and cooking texture are some of the characteristic that hinder farm technology adoption. The social network capital of farmers, extension agents, Crop Research Institute (CRI) and a combined index for all innovations actors all significantly influenced adoption suggesting that public, private-public partnership should be strengthened to increase their interaction in the innovations system and thereby farm technology adoption.

Iheke and Nwaru (2014) carried out a similar research on Innovation Adoption, Farm Productivity and Poverty Status of Rural Smallholder Farm Households in South-East, Nigeria. It was established that Innovation adoption is key to increasing farm productivity and that increasing agricultural productivity can increase food availability and access as well as rural incomes for majority of Africa's population, most of whom count agriculture as their major source of income. Data collected using structured questionnaire and interview schedules were analyzed using descriptive statistical tools such as frequency tables, percentages, regression analysis and Chow's test statistic. Result of data analysis revealed that the most adopted innovations/technologies were use of inorganic fertilizer, improved seed, terracing, crop residue recycling, crop rotation and use of animal waste. The significant factors influencing adoption of the

innovations/technologies were gender, age, years of formal education attainment, household income, extension contact and membership of cooperative.

The Chow's test revealed that innovation/technology adoption has significant and positive impact on farm productivity. Also, the study revealed improved livelihood or better welfare for innovation adopters than for non-adopters. Therefore, efforts at increasing farm productivity and reducing poverty among farm households should involve policies that would encourage households to embrace or step up adoption of agricultural innovations should be put in place. This should involve educating and enlightening the farm households on the benefits of these innovations. In this respect, they noted that agricultural extension services should be strengthened to provide the informal training that helps to unlock the natural talents and inherent enterprising qualities of the farm householders, enhancing his ability to understand and evaluate new production techniques/innovations, leading to increased farm productivity and incomes with concomitant reduction in poverty.

Awotide (2012) in a similar study examined the impact of improved rice varieties adoption on rice productivity and farming households' welfare in Nigeria, using a cross sectional data of 481 rice farmers drawn from three States to represent the major rice producing ecologies (Irrigated, upland and lowland) in Nigeria. Access to seed was found to be one of the significant determinants of adoption. Poverty incidence was also higher among the non-adopters than the adopters. This study also adopted the counterfactual outcomes framework of modern evaluation theory to provide a consistent estimate of the impact. Specifically, LATE technique which uses the system of instrumental variable method was adopted to assess the impact of improved rice varieties adoption on rice productivity and total household expenditure (Proxy for welfare). The results showed a significant positive impact of 358.89kg/ha on rice productivity and total households' expenditure (N32,890.82) This suggests that adoption of improved rice varieties significantly generate an improvement in farming household living standard, hence, efforts should be intensified to ensure that farmers have access to adequate quality

improved rice seed at the right time. The work also suggested that all programs, strategies and policies that could lead to increase in improved rice adoption should be intensified in order to achieve the much desired poverty reduction and generate an improvement in rural farming households' welfare in Nigeria.

Bawa, and Ani (2014) carried out a study on analysis of the Adoption of Improved Maize Production Technology among Farmers in Southern Borno. The specific objectives were to analyze the relationship between socio-economic characteristics of the respondents and their adoption of improved maize technology, and to determine innovation utilization and its effect on farmer's production. Data for the study were obtained from 360 respondents selected through multi-stage sampling procedure. Both descriptive and inferential statistical techniques were used to analyze the data. Gross margin was used to measure the profit of farm enterprises (effect of farmer's production) before and after utilizing the agricultural innovation, while Ordinary Least Square (OLS) regression analysis, was used to establish relationship between socio-economic characteristics of the respondents and adoption of agricultural innovation. The result of the profitability analysis revealed that the gross margin per hectare of respondents before adoption of agricultural innovation was ₦59, 009.44, while the gross margin per hectare of respondents after adoption of agricultural innovation stood at ₦76, 003.43, translating to 29% increase in gross margin of the respondents. Level of education ($P< 0.01$), and gender ($P< 0.01$) were the most important factors that influenced adoption of agricultural innovations among farmers in the study area. Farm size ($P< 0.01$), age of respondents ($P < 0.01$), extension contact ($P < 0.01$), radio ownership ($P< 0.01$) and cosmo politeness ($P < 0.05$) were also important in influencing adoption of agricultural innovations by farmers in the study area. Based on the findings, the researchers recommended that farmers should be given more easy access to credit. In line with this, there is need to link farmers to sources of credit, given its importance in the utilization of improved agricultural technologies.

Washington, Wirimayi, & Shepherd (2012) carried out a similar work on the Impact of Technology Adoption on Smallholder Agricultural Productivity in Sub-Saharan Africa: This review article on the impacts of technology adoption on agricultural productivity in smallholder agriculture in the sub-Saharan African region observed that the use of agricultural technologies determines how the increase in agricultural output impacts on poverty levels and environmental degradation. Experience and evidence from countries within and around the sub-Saharan African region indicate that returns to agricultural technology development could be very high and far reaching. The factors affecting technology adoption are assets, income, institutions, vulnerability, awareness, labour, and innovativeness by smallholder farmers. It was also found out that technologies that require few assets, have lower risk premium, and are less expensive with higher chance of being adopted by smallholder farmers. He noted that some traditional smallholder agricultural technologies in sub-Saharan Africa have their own merits, and some of these technologies are more efficient in their use of scarce production resources than modern technologies. The work recommended that modern researchers should seek to understand the rationale behind traditional smallholder farmer behaviour in technology use. This will make their future technological interventions in smallholder agriculture more effective.

Olujenyo (2008) considered the determinants of agricultural production and profitability with special reference to maize production in Akoko North-East and South West Local Government Areas of Ondo-State using the Ordinary Least Square (OLS) criterion to estimate the parameters of the production function. He showed that age, education, labour and cost of non-labour inputs were positively related to output, while farm size and years of experience carried negative signs. However, only labour input had significant influence on output.

Olubanjo and Oyebanjo (2005) analyzed the effect of farm inputs use on the profitability of rain-fed paddy rice production in Ikenne Agricultural Zone, Ogun State, Nigeria. The Zellner's Seemingly Unrelated Regression (SUR) method was adopted in the analysis of

the data. Results revealed that the elasticity of the profit function increased with quantity of fertilizer applied and farm size cultivated, and decreased with respect to increased use of hired labour and seeds.

Izekor and Olumese (2010) examined the determinants of yam production and profitability in Edo State, Nigeria using Gross Margin analysis and Production function analysis using the Ordinary Least Square (OLS) criterion to estimate the parameters of the production function. Result showed that yam production was profitable in the study area with an average gross margin of N58,400. Farm size, staking, yam sets and the operating cost were found to be positively related to output, with labour as the major determinant. The result further showed a return to scale of 4.582 indicating an increasing return to scale, implying inefficiency in the use of resources in the enterprise as production was in the irrational stage (stage 1) of production.

Igwe and Esonwune (2011) used secondary data generated from the Abia State Agricultural Development Programme, National Root Crops' Research Institute Umudike in Abia State and the Central Bank of Nigeria, to examine the determinants of Agricultural production in Abia State. Result showed that total land area cropped, total annual rainfall and total production were strong factors that significantly determined total crop output in the state at 1% level. Whereas, the total land area and total annual rainfall were positive in signs, the total population was negative.

Mpawenimana (2005) investigated the socio-economic factors affecting the production of banana in Rwanda, and a case studied was the district of Kanama. The results described that land, physical capital, fertilizer and price, had positive relationship with the output.

There have also been many works on agricultural productivity. For example, Olujenyo (2005) investigated the determinants of agricultural production and profitability with special reference to maize production in Akoko North-East and South-West Local

Government Areas of Ondo State. This study was unique in that it focused on agricultural production among cooperative farmers which arguably have been a platform for the government involvement, support and participation in food production in Nigeria.
Findings revealed that farmers were burdened with high prices of farm inputs, inefficiency of farming techniques, inadequate production infrastructure, poor market and heavy constraints in obtaining credits facilities. The ugly situation was further compounded by the general economic downturn and government drives to remove subsidies on farm inputs such as chemical fertilizers, and agro-chemicals. Of recent, the co-operative option has come into focus as a viable way to effectively mobilize farmers to form groups and pool resources so as to become more effective in agricultural production. In addition to the values and principles of cooperatives, studies have been conducted on wide varieties of issues relating to the importance of co-operative societies.

Veerakumaran (2005) explained that cooperatives serve as fundamental tool for achieving food security at household level. He used secondary data of over eighty studies on contributions of cooperative to agriculture. Descriptive and regression analysis were employed to analyze the data generated and concluded that co-operatives were the best institutional intervention for attaining food security in any country. The developed nations like United States of America, Canada, Australia, almost all European countries and Socialist country like China have attained food self sufficiency through cooperatives (Chambo, 2009).

Gertler (2001) adopted probit model to investigate the role of cooperatives in economic development. His findings showed co-operatives as a practical tool for collaboration, collective action and that they build and reinforce community, stabilize regional economies and provide a favourable climate for further investment. Co-operatives are capable of reducing spatial inequality and promote equitable sharing of the cost and benefits of development. They promote economic democracy and the empowerment of

marginalized groups- a hallmark of sustainable development and a precondition for shared responsibility.

Ojiako and Ogbukwa (2012) examined loan repayment capacity of smallholder cooperative farmers in Yewa North area of Ogun State, Nigeria using correlation and regression techniques. The study showed that farm credit played vital roles in the socio-economic transformation of the rural economies. However, loan acquisition and repayment were characterized by numerous challenges, including high levels of default among beneficiaries. The study concluded that promoting smallholder cooperative farmers' loan repayment capacity would require conscious use of policies directed at increasing loan size and farmers' farm holdings or reducing household size.

Similarly, Ofuoku and Urang (2009) assessed the effect of cohesion of farmer co-operatives societies on loan repayment among members in Delta State, Nigeria using Spearman's rank order correlation analysis. The study observed that there was almost perfect positive relationship between rates of loan repayment perception and cohesion. Consequently, they recommended that extension agents should take advantage of the effect of cohesion on loan repayment to promote cohesion in upcoming co-operative societies.

In evaluating agricultural credit utilization by cooperative farmers in Benue State, Nigeria, Okwoche *et. al* (2001) observed a significant difference between the agricultural output and income of farmers' before and after the utilization of loan acquired. The t-test analysis shows that farmers joined the farmer co-operatives societies mainly to access credit.The study recommended that the farmers should be adequately motivated with needed credit facilities as this will further enhance agricultural production.

Maerere, *et al.* (2010) conducted a study on the Agricultural Science, Technology and Innovation (ASTI) system in the banana sub-sector in Tanzania. Major policies were

reviewed with respect to their impact on the sub-sector. Linkages among key actors were identified and analyzed. Surveys were conducted in four agro-ecological zones that are major banana producers. The information was collected using two structured questionnaires: one for farmers and another for organizations. Generally, Tanzania was found to have well established agricultural and science and technology policies. However, implementation was hampered by low investment that did not match with government commitments.

Main key actors, identified in the subsector, included smallholder farmers, private enterprises and various organizations that played major roles in creation, diffusion and utilization of knowledge. Research and training were found to be mainly under the control of the Ministry of Agriculture, Food and Cooperatives and the Sokoine University of Agriculture. Results indicate that 60% of smallholder banana farmers had received primary education. Land was under family ownership, with an average 1.5 ha of which 25–53% was devoted to banana production. Most banana producers were found to operate on an individual basis, with collaboration mainly amongst themselves rather than with other actors. They lacked specialized training and operated at traditional level with very low use of innovations. It was recommended that all major areas of action require strengthening of existing information diffusion system, incentives for innovations, infrastructure, credit schemes, and recognition of banana as an important food and cash crop.

Adegbite (2011) investigated the relationship between membership of Co-operative Societies by women farmers and their adoption behavior. It covered Oke-ogun area of Oyo State; which comprises eleven Local Government Areas. Three Local Government Areas were purposefully selected. A total of one hundred and fifty five respondents were randomly interviewed through structured interview schedule in proportion to the number of women farmers in each sampled farming communities in the selected Local Government Areas. Analysis was done using OLS technique and mean rating. Result obtained shows significant relationship between membership of Co-operative societies

and adoption of improved cassava varieties by women farmers in the area of study. Also, positive and significant relationship were found between membership of cooperative and demographic-socio-economic characteristics such as number of children assisting in farm work (r = 0.373); sources of credit (r = 0.675). Membership of cooperative societies is very significant to favourable adoption behaviour of women farmers towards agricultural innovations; hence membership of cooperative should be encouraged as a strategy for improving the agricultural productivity and livelihoods of the women farmers, which is crucial to the achievement of sustainable rural development in Nigeria.

Weyori *et al* (2012) carried out their research on how agricultural innovations system affects adoption using data from plantain farmers. This work was limited to only plantain farmers alone and this implies that the innovation process was limited to them alone. They administered questionnaire to 360 plantain farmers. Descriptive and inferential statistics were used to analyze the data. Findings show that awareness of innovation and availability of extension agents play critical role.

Iheke and Nwani *et al* (2014), in their work: Innovation Adoption, Farm Productivity and Poverty Status of Rural Smallholder Farm Households in South-East. They used questionnaire method and regression analysis to study the effect of innovation adoption on farm productivity and poverty status of farmers. Findings revealed that uptake of agricultural innovation were very significant determinant of farm productivity. They noted, innovation is the key to productivity and increased food availability and access to rural income.

This work on adoption of innovations among selected co-operative farmers towards improving agricultural productivity aimed at addressing some salient issues. The work was aimed at closing the gap in finding out the sources of information of these improved practices to farmers to know the ones that need to be intensified as a source of informing them on the improved practices. This work tried to find out improved farm practices that

the farmers have been exposed to and the ones that they have started practicing already. The work touched on different areas and came out with a conclusion. The work also brought out the underlying work of the extension agents in passing across the innovations to cooperative farmers and achieving greater results. Also the work established the fact that cooperative is an agent of transformation even to the grassroot level.

Eze *et al* (2008) conducted a study of how peer farmers influence innovation adoption using correlation and regression analysis. Findings revealed that peer farmers exhibit significant influence on farmer's adoption process. This implies that when farmers are close to people who adopted innovations, the possibility of adopting the innovation will increase.

In a study on the effect of cooperative membership and participation on adoption decisions, Nwankwo, Peters & Bolkemann (2009) showed that there is a strong positive correlation between adopted innovations and awareness of source of recently adopted innovations, indicating that those who became aware of new technologies from cooperatives trusted the information as reliable. They used probit model to assess data from 300 farmers in the area of study in order to arrive at the findings.

In an assessment of factors influencing the utilization of improved cereal crop production innovations by small-scale farmers in Benue State, Odoemenem & Obinne (2010) found a positive correlation between membership of cooperatives and adoption of innovations implying that farmers who are members of cooperative associations adopted more technologies than non-members. They used regression analysis to analyze data from 402 farmers who were cooperative members in the area of study.

In another study on capital resource mobilization and allocation efficiency by small-scale cereal crop farmers of Benue State, Odoemenem and Otanwa (2011) concluded that cooperative membership enhanced access to information on improved technologies, material inputs of the technologies such as fertilizer and chemicals, and credit for the

purchase of inputs and payment of hired labour. Data was generated from 214 farmers which was subsequently analyzed using t-test and regression analysis.

On the other hand, membership of farmers association was found to have no significant influence on the adoption of chemical pest control among cowpea farmers in Makarfi Local Government Area of Kaduna State, Nigeria (Omolehin, 2007). He generated data from 287 farmers who were both cooperative and non-cooperative farmers. Data were analyzed using ANOVA and probit model.

According to Onyenweaku, *et al.* (1994) there was no significant relationship between membership of social organization and adoption of fertilizer among rice farmers in Bende Local Government Area of Abia State, Nigeria. The study used correlation and regression analysis on 610 farmers who were members of social organization

Nwankwo *et al* (2009) studied the effects of cooperative membership and participation on adoption decision of agricultural innovations in the States of Kaduna and Borno using a structured questionnaire on 1,120 respondents. Data generated were analysed using regression analysis. Result indicates that farmers adopt new innovations more if they are disseminated through cooperatives than through other channels. It also revealed that many farmers belonged to cooperatives majorly for the purpose of obtaining information, as well as having access to social capital.

Uaine, Arnt and Master (2009) evaluated the determinants of agricultural technology adoption in Mozambique using questionnaire distributed to 600 farmers. The data were analyzed using ANOVA and regression analysis. They discovered that membership of agricultural associations such as cooperatives play important role in adoption. Other factors identified included access to credit, level of education and availability of extension services.

Using household survey data from Ethiopia (2014); Abate, Francesconi and Genet (2014) examines the impact of agricultural cooperatives on smallholder farmers' efficiency using questionnaire and content analysis. Their results indicate that agricultural cooperatives

are effective in providing support services such as innovation services that contribute to significant increase in farmer's technical efficiency.

Adediji, Nosiru, Akinsulu, Ewebiyi, Abiona and Jimoh (2013) studied the determinants of adoption of New Rice for Africa (NERICA) in Ogun State Nigeria. Questionnaire and interview methods were used to generate the data and descriptive statistics, as well as regression analysis were used to analyze the data. Findings revealed that adoption rate was 33.36%, while the socio-economic determinants of adoption include farming experience, farm size and frequency of contact with agricultural development programme officials.

Table 4. Summary of Review of Related Empirical studies

Author	**Methodology**	**Findings**
Weyori *et al* (2012)	Combination of agricultural innovation development and innovation linkage framework	Overall adoption rate is weak. Shelf life and taste texture hinder adoption
Iheke and Nwaru (2003)	Descriptive tools, regression analysis and Chow's test	Adoption had significant effect on productivity and innovation adopted include improved seed, crop residue recycling, terracing etc
Awotide (2012)	LATE Technique and use of instrumental variable method	Adoption had significant positive impact on household expenditure, standard of living and productivity.
Bawa and Ani (2006)	Gross margin analysis, OLS and descriptive statistics	There is improvement in productivity and determinants of adoption including age, extension contact, radio ownership and cosmopoliteness
Washington et.al (2012)	Descriptive and inferential statistics	Improved agricultural technology increases output, impact poverty reduction and determinants include income, labour , awareness and favourable institutions
Olujenjo (2003)	OLS, production function, Descriptive statistics	Significant determinants of adoption include age, farm size, and years of farming experience
Olujenjo and Oyebanjo (2005)	The Zeller's seemingly unrelated regression method	Elasticity of the profit function increased with quality of fertilizer applied and farm size cultivated
Izekor and Olumese (2010)	Gross margin analysis, OLS and production	Yam production was profitable and operating cost was positively related to

	function	output. Labour is major determinant of output
Esonwunne (2011)	Secondary data, OLS, Correlation analysis	Output is dependent on annual rainfall and area cropped
Mpaweniman (2005)	Descriptive tools and t-test	Area of land farmed, physical capital, price of output and fertilizer have positive relationship with output
Olujenjo (2005)	ANOVA and regression analysis	Inadequate production infrastructure, poor marketing and credit facility affect maize production
Veerakumaran (2005)	Regression analysis and descriptive tools	Cooperative contributes significantly to food security in most countries
Getler (2001)	Probit model	Cooperatives contributes to economic development, a tool to stabilize economies, collective action and equitable income distribution
Ojiako and Ogbukwa (2012)	Correlation and regression technique	Farm credit play vital role in socio-economic transformation of rural economies
Ofuoko and Urang (2009)	Spearman rank order	Positive relationship exists between rate of loan repayment perception and cohesion of cooperatives.
Okwoche $et\ al$ (2010)	T-test and descriptive tools	Farmers joined cooperative to obtain credits, inputs and learn about new innovations
Maerere $et\ al$ (2010)	Policy review mechanism and descriptive tools	Low implementation of policies and absence of commitment weakens government policies in agriculture through cooperatives.
Adegbite (2011)	OLS technique, descriptive statistics	Significant relationship exist between adoption of innovation and cooperative membership
Weyori $et\ al$ (2012)	Descriptive tools and inferential tools	Awareness of innovation and availability of extension agents play critical role in adoption process
Onwuchekwa *et.al* (2013)	Regression analysis	Agricultural innovation is a significant determinant of farm productivity
Eze $et\ al$ (2008)	Correlation analysis and regression	Peer farmers exhibit significance influence on farmers adoption process
Nwankwo, Peters and Bolkemann (2009)	Probit model and correlation analysis	Strong positive correlation between innovations and awareness of source of recently adopted innovation
Odoemena and Obinne (2010)	Regression analysis on 402 farmers	Positive relationship between membership of cooperative and adoption of innovation
Onyenweaku*, et al*	Correlation and	Significant relationship exist between

(1994)	regression analysis	membership of social organization and adoption of fertilizer
Odoemenam *et al* (2011)	t-test and regression analysis	Membership of farmers association has no significant influence on adoption chemical pest control
Nwankwo and Bokelmann(2009)	Regression analysisi and descriptive tools	Farmers adopt new innovations more if they are disseminated through cooperatives.
Uaine, Arnt and Master (2009)	ANOVA and regression analysis	Membership of agricultural cooperatives play significant role in adoption
Abate, Francesconi and Ganet (2014)	Content analysis, descriptive tools	Agricultural cooperatives impact on smallholder farmers efficiency
Adediji $et\ al$ (2013)	Descriptive tools, and regression analysis	Determinants of adoption include farming experience, farm size and frequency of contact with extension agents.

Some of the empirical studies focused on the production of a particular food crop or cash crop, without due concentration to agricultural productivity in general, ignoring the fact that most of these farmers are mixed crop farmers. Looking at agricultural productivity in general offers a better insight to the understanding of the factors that affect the productivity. This study aims to fill the lapse in the existing literature by empirically examining the effect of innovation adoption on productivity of cooperatives in Imo State.

2.3 Theoretical Framework:

THE THEORY OF COOPERATION

Cooperation has been described by a variety of theorists. According to Glaser-Segura & Anghel (2002), it represents the union of two or more entities, leading to a more complex combination, which has a greater chance of surviving environmental forces than as separate entities. Kropotkin (1902) extended Darwin's theory of natural selection to include cooperation among living and social systems. Darwin's explanation of how preferential survival of the slightest benefits can lead to advanced forms is the most important explanatory principle in biology, and extremely powerful in many other fields. Such success has reinforced notions that life is in all respects a war of each against all,

where every *individual* has to look out for himself, that your gain is my loss but Kroptokin had observed that the species survive where the individuals cooperated, that "mutual aid" (cooperation) was found at all levels of existence .Mead (1937), in studies of living primitive societies, equally found that cooperative social organization leads to higher affluence not found in a solely competitive social organization.

In a political-historical analysis of civilizations, Eisler (1988) found variations between the social dominator model, in which societal exchange is carried out in hierarchical and competitive relationships, and the social partnership model, in which exchanges are made through cooperative relationships. Eisler's framework is included in the collection of women's studies and provides an explanation of male-dominated versus male-female shared-power societies through history. Proponents of socio-biology, in a different approach, view cooperation as a genetic survival trait (Bateson, 1972; 2000). In the socio-biological paradigm, cooperation is found among relatives because extended family groups survived over individuals who did not cooperate with family and tribal members. In socio-biology, co-operation is also considered an evolved trait among humans and other life forms (Nowak, May, & Sigmund, 1995).

These approaches to cooperation are varied; they place cooperation in historical and a historical contexts, at macro- and microsocial settings, and as genetic and learned behaviors. This research approach specifically relies on what Campbell (1975) termed as a socio-cultural explanation for cooperation. His framework rests on variation, selection, and retention of behaviors over time. In essence, variation provides the mutations or trials of behavior that provide for the adaptation of groups to new situations. Selection involves the process of evaluating one variation over another and selecting the better version. Retention involves the process of accumulating behaviors and values in a social system. Campbell's theory functions at the social system level because individuals eventually die, but institutions and conduct are retained within social systems. Campbell further argued

that urban social complexity has come about through social evolution rather than through socio-biological evolution.

Cooperation is also described in Wikipedia (nd) as the process by which the components of a system work together to achieve the global properties. In other words, individual components which appear to be "selfish" and independent work together to create a highly complex, greater-than-the-sum-of-its-parts system. Examples can be found all around us. The components in a cell work together to keep it living. Cells work together and communicate to produce multicellular organisms. Organisms form food chains and ecosystems. People from families, tribes, cities and nations. Neurons create thought and consciousness. Atoms cooperate in a simple way, by combining to make up molecules. Understanding the mechanisms that create cooperating agents in a system is one of the most important and least well understood phenomena in nature, though there has not been a lack of effort.

Individual action on behalf of a larger system may be *coerced* (forced), voluntary (freely chosen), or even unintentional, and consequently individuals and groups might act in concert even though they have almost nothing in common as regards interests or goals. Examples of that can be found in market trade, military wars, families, work places, schools and prisons, and more generally any institution or organization of which individuals are part (out of own choice, by law, or forced).

Our study focuses on adoption of agricultural innovation and agricultural production that cooperative arrangements offer the best approach to adoption of agricultural innovations. Cooperation theory offers enough reasons why people come together to tackle social-economic tasks that would seem insurmountable if not impossible for an individual to accomplish. We can thus deduce from the theory that cooperative institutions are not mere ad hoc arrangements that wound up once tasks are accomplished. Indeed, the antecedents of cooperative societies from the start of modern cooperative movement via the Equitable Society of Rochdale Pioneers, to founding of International Cooperative

Alliance (ICA) have shown the cooperative as veritable institution of change and development.

The implication of the above is that cooperatives are expected to always strive to bring about socio-economic change for which they are established and are expected to maximally bring the cooperative advantage to bear on improving agriculture through cooperation and adopting new innovations.

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Social Action Theory

Max Weber (1864-1920) was one of the founding fathers of Sociology. Weber saw both structural and action approaches as necessary to developing a full understanding of society and social change. In one of his most important works 'Economy and Society', first published in the 1920s, he said 'Sociology is a science concerning itself with interpretive understanding of social action and thereby with a causal explanation of its course and consequences.' *(Weber- Max 1991),*

Social action, also known as **Weberian social action**, refers to an act which takes into account the actions and reactions of individuals (or 'agents'). According to Max Weber, "an action is 'social' if the acting individual takes account of the behavior of others and is thereby oriented in its course". Max Weber began with the idea of social action to make of sociology a scientific enquiry. Thus the idea of action is central to Max Weber's sociology. For Weber, the combined qualities of "action" and "meaning" were the central facts for sociology's scientific analysis.

Weber defined **sociology as,** "the interpretative understanding of social action in order to arrive at causal explanation of its courses and effects." Action in Weber's analysis is all human behaviour to which an actor attaches subjective meaning. According to Weber "action is social, in so far as by virtue of the subjective meaning attached to it by the acting individual, it takes account of the behaviour of others, and thereby is oriented in its course."

For the purposes of A level Sociology we can reduce Weber's extensive contribution to Sociology to three things – firstly he argued that 'Verstehen' or empathetic understanding is crucial to understanding human action and social change, a point which he emphasized in his classic study 'The Protestant Ethic and the Spirit of Capitalism'. Secondly, he believed we could make generalizations about the basic types of motivation for human action (there are four basic types) and thirdly, he still argued that structure shaped human action, because certain societies or groups encourage certain general types of motivation (but within these general types, there is a lot of variation possible). *(Sciulli 1992)*

Social Action and Verstehen

Weber argued that before the cause of an action could be ascertained you had to understand the meaning attached to it by the individual. He distinguished between two types of understanding.

First, he referred to **Aktuelles Verstehen** – or direct observational understanding, where you just observe what people are doing. For example, it is possible to observe what people are doing – for example, you can observe someone chopping wood, or you can even ascertain (with reasonable certainty) someone's emotional state from their body language or facial expression. However, observational understanding alone is not sufficient to explain social action.

The second type of understanding is **Eklarendes Verstehen** – or Empathetic Understanding – in which sociologists must try to understand the meaning of an act in terms of the motives that have given rise to it. This type of understanding would require you to find out why someone is chopping wood – Are they doing it because they need the firewood, are they just clearing a forest as part of their job, are they working off anger, just doing it because they enjoy it? To achieve this, Weber argued that you had to get into the shoes of people doing the activity.

The basic concept was primarily developed in the non-positivist theory of Max Weber to observe how human behaviors relate to cause and effect in the social realm. For Weber, sociology is the study of society and behavior and must therefore look at the heart of interaction. The theory of social action, more than structural-functionalist positions, accepts and assumes that humans vary their actions according to social contexts and how it will affect other people. When a potential reaction is not desirable, the action is modified accordingly. Action can mean either a basic action (one that has a meaning) or an advanced social action, which not only has a meaning but is directed at other actors and causes action (or, perhaps, *inaction*).

1. Rational actions (also known as value-rational actions, *wertrational*): actions which are taken because it leads to a valued goal, but with no thought of its consequences and often without consideration of the appropriateness of the means chosen to achieve it ('the end justifies the means'). Value rational or instrumentally rational social action is divided into two groups: rational consideration and rational orientation. Rational consideration is when secondary results are taken into account rationally. This is also considered alternative means when secondary consequences have ended. Determining this mean of action is quite hard and even incompatible. Rational orientation is being able to recognize and understand certain mediums under common conditions. According to Weber, heterogeneous actors and groups that are competing, find it hard to settle on a certain medium and understand the common social action;
2. Instrumental action (also known as value relation, goal-instrumental ones, *zweckrational*): actions which are planned and taken after evaluating the goal in relation to other goals, and after thorough consideration of various means (and consequences) to achieve it. An example would be a high school student preparing for life as a lawyer. The student knows that in order to get into college, he/she must take the appropriate tests and fill out the proper forms to get into college and then do well in college in order to get into law school and ultimately

realize his/her goal of becoming a lawyer. If the student chooses not to do well in college, he/she knows that it will be difficult to get into law school and ultimately achieve the goal of being a lawyer. Thus the student must take the appropriate steps to reach the ultimate goal.

3. Affective action (also known as emotional actions): actions which are taken due to 'one's emotions, to express personal feelings. For example, cheering after a victory, crying at a funeral would be affective actions. Affective is divided into two subgroups: uncontrolled reaction, and emotional tension. In uncontrolled reaction there is no restraint and there is lack of discretion. A person with an uncontrolled reaction becomes less inclined to consider other peoples' feelings as much as their own. Emotional tension comes from a basic belief that a person is unworthy or powerless to obtain his/her deepest aspirations. When aspirations are not fulfilled there is internal unrest. It is often difficult to be productive in society because of the unfulfilled life. Emotion is often neglected because of concepts at the core of exchange theory. A common example is behavioral and rational choice assumptions.
4. Emotion: Emotions are one's feelings in response to a certain situation. There are six types of emotion: social emotions, counterfactual emotions, emotions generated by what may happen (often manifested as anxiety), emotions generated by joy and grief (examples found in responses typically seen when a student gets a good grade, and when a person is at a funeral, respectively), thought-triggered emotions (sometimes manifested as flashbacks), and finally emotions of love and disgust. All of these emotions are considered to be unresolved. There are six features that are used to define emotions: intentional objects, valence, cognitive antecedents, physiological arousal, action tendencies, and lastly physiological expressions. These six concepts were identified by Aristotle and are still the topic of several talks. *(Sciulli 1992)*

Weber's Four Types of Action (and types of society)

Max Weber didn't just believe that individuals shape society – societies encourage certain types of motive for action. For example, the religion of Calvinism encouraged people to save money, which eventually led to capitalism

Weber believes that there are four ideal types of social actions. Ideal types are used as a tool to look at real cases and compare them to the ideal types to see where they fall. No social action is purely just one of the four types.

1. Traditional Social Action: actions controlled by traditions, "the way it has always been done"
2. Affective Social Action: actions determined by one's specific affections and emotional state. You do not think about the consequences
3. Value Rational Social Action: actions that are determined by a conscious belief in the inherent value of a type of behavior (eg: religion)
4. Instrumental-Rational Social Action: actions that are carried out to achieve a certain goal, you do something because it leads to a result

To illustrate these different types of action, consider someone "going to school" in terms of these four ideal types: Traditionally, one may attend college because her grandparents, parents, aunts, and uncles have as well. They wish to continue the family tradition and continue with college as well. When relating to affective, one may go to school just because they enjoy learning. They love going to college whether or not it will make them broke. With value rational, one may attend college because it's a part of his/her religion that everyone must receive the proper education. Therefore, this person attends college for that reason only. Finally, one may go to college because he/she may want an amazing job in the future and in order to get that job, he/she needs a college degree.

Max Weber was particularly interested in the later of these – he believed that modern societies encouraged **'Instrumental-Action'** – that is we are encouraged to do things in the most efficient way (e.g. driving to work) rather than thinking about whether driving to work is the right thing to do (which would be value-rational action.

Weber believed that modern societies were obsessed with efficiency – modernizing and getting things done, such that questions of ethics, affection and tradition were brushed to one side. This has the consequence of making people miserable and leading to enormous social problems. Weber was actually very depressed about this and had a mental breakdown towards the end of his life. *(Sciulli,1992)*

Evaluations of Max Weber's Social Action Theory

- ***Positive*** *– He recognized that we need to understand individual meanings to understand how societies change (unlike Marxism)*
- ***Negative*** *– Still too much focus on society shaping the individual – symbolic interactionism argues that individuals have more freedom to shape their identities.*

Max Weber conceived of sociology as a comprehensive science of social action. His primary focus was on the subjective meanings that human actors attach to their actions in their mutual orientations within specific socio-historical contexts. *(Sciulli, 1992)*

Collective Action Theory

Collective action refers to action taken together by a group of people whose goal is to enhance their status and achieve a common objective. It is a term that has formulations and theories in many areas of the social sciences, including psychology, sociology, anthropology, political science and economics.

The logic of collective action (Olson 1965), which has proved to be applicable to a broad range of social and economic situations, assumes that cooperation must be explained by

the individual's cost-benefit calculus rather than that of the group because the group as a whole is not rational but can only consist of rational individuals. Groups often seek public goods that are available, once they have been generated, to everyone, including those who did not contribute to producing them. Because individuals potentially can receive the benefits of public goods without having contributed to their production, they have an incentive to let others pay for them.

In classic examples of collective action problems, such as preserving the environment, sharing a natural resource, participating in national defense, voting in mass elections, and engaging in social protests, group members gain when all individuals do their share, but for any individual, the marginal benefit of contributing exceeds the cost. If each individual follows his or her self-interest, the outcome (total defection) is worse for everyone than if all had cooperated in supplying the public good. Studies of collective action using game theory, laboratory experiments, and historical cases have been used to identify the conditions under which rational actors are likely to cooperate when they have a strong incentive to be free riders.

Many groups alter cost-benefit calculations by offering selective incentives in the form of material rewards to cooperators and punishments to free riders. Shame, praise, honor, and ostracism can be viewed in this regard as non-material social selective incentives. The administration of a system of selective incentives by a central authority or by group members, however, usually entails a separate collective action problem that requires further explanation because individuals have an incentive not to contribute to the maintenance of such a system.

Another potential selective incentive is the psychological or expressive benefit inherent in the activity. In this case, the motivation for cooperation is not the outcome sought through collective action, but the process or experience of participation. For some people, political and organizational activity builds self-esteem and feelings of political efficacy,

symbolizes political citizenship, reinforces moral convictions, and constitutes an enthralling experience.

Aside from changing individual incentives, cooperation in groups can be fostered by repeated social interactions that introduce long-term calculations. In iterated social interaction, a person can try to influence the behavior of others by making his or her choices contingent on their earlier choices. Cooperation is, therefore, possible among self-interested individuals if they care sufficiently about future payoffs to modify their current behavior.

Conditional cooperation is less likely to solve the collective action problem as group size increases because defection is harder to identify and deter when many people are involved. Intuitively, the members of small groups are likely to have closer personal bonds. Individual contributions will have a greater impact on the likelihood of collective success, and individual defections can be observed more readily. For this reason, contingent cooperation in large-scale ventures is facilitated when collective action entails a federated network of community groups and organizations.

There is no reason to suppose that successful collective action can be driven by a single motivation, either coercive or voluntary. Self-interested calculations that are based on selective material incentives and ongoing social exchange often have to be supplemented by moral and psychological considerations and coordinated by political leadership to motivate people to contribute to collective goods. Also it is not necessary to assume that all contributors to collective action will employ the same cost-benefit calculus. Collective action frequently relies on the initiative and sacrifice of committed leaders who supply information, resources, and monitoring and lay the foundation for subsequent conditional cooperation among more narrowly self-interested actors.

Rogers's Theory of Innovation Diffusion

The theory that underpinned the study is the Roger's diffusion of innovation theory. The process of adopting new innovations has been studied for over 30 years, and one of the most popular adoption models is described by Rogers in his book, *Diffusion of Innovations* (Sherry & Gibson, 2002). Much research from a broad variety of disciplines has used the model as a framework. Dooley (1999) and Stuart (2000) mentioned several of these disciplines as political science, public health, communications, history, economics, technology, and education, and defined Rogers' theory as a widely used theoretical framework in the area of technology diffusion and adoption.

Rogers' diffusion of innovations theory is the most appropriate for investigating the adoption of technology in agricultural cooperative context. In fact, much diffusion research involves technological innovations. Rogers (2003) used the word "technology" and "innovation" as synonyms. For Rogers, "a *technology* is a design for instrumental action that reduces the uncertainty in the cause-effect relationships involved in achieving a desired outcome" (p. 13). It is composed of two parts: hardware and software. While hardware is "the tool that embodies the technology in the form of a material or physical object," software is "the information base for the tool" (Rogers, 2003). Since software (as a technological innovation) has a low level of observability, its rate of adoption is quite slow.

For Rogers (2003), adoption is a decision of "full use of an innovation as the best course of action available" and rejection is a decision "not to adopt an innovation". Rogers defines diffusion as "the process in which an innovation is communicated through certain channels over time among the members of a social system".

As expressed in this definition, innovation, communication channels, time, and social system are the four key components of the diffusion of innovations.

Four Main Elements in the Diffusion of Innovations

Innovation

Rogers offered the following description of an innovation: "An *innovation* is an idea, practice, or project that is perceived as new by an individual or other unit of adoption" (Rogers, 2003). An innovation may have been invented a long time ago, but if individuals perceive it as new, then it may still be an innovation for them. The newness characteristic of an adoption is more related to the three steps (knowledge, persuasion, and decision) of the innovation-decision process that will be discussed later. In addition, Rogers claimed there is a lack of diffusion research on technology clusters. For Rogers (2003), "a technology cluster consists of one or more distinguishable elements of technology that are perceived as being closely interrelated". Uncertainty is an important obstacle to the adoption of innovations. An innovation's consequences may create uncertainty: "*Consequences* are the changes that occur in an individual or a social system as a result of the adoption or rejection of an innovation" (Rogers, 2003). To reduce the uncertainty of adopting the innovation, individuals should be informed about its advantages and disadvantages to make them aware of all its consequences. Moreover, Rogers claimed that consequences can be classified as desirable versus undesirable (functional or dysfunctional), direct versus indirect (immediate result or result of the immediate result), and anticipated versus unanticipated (recognized and intended or not)

Communication Channels

The second element of the diffusion of innovations process is communication channels. For Rogers (2003), communication is "a process in which participants create and share information with one another in order to reach a mutual understanding". This communication occurs through channels between sources. Rogers states that "a *source* is an individual or an institution that originates a message. A channel is the means by which a message gets from the source to the receiver". Rogers states that diffusion is a specific kind of communication and includes these communication elements: an innovation, two individuals or other units of adoption, and a communication channel. *Mass media* and

interpersonal communication are two communication channels. While mass media channels include a mass medium such as TV, radio, or newspaper, interpersonal channels consist of a two-way communication between two or more individuals. On the other hand, "diffusion is a very social process that involves interpersonal communication relationships" (Rogers, 2003). Thus, interpersonal channels are more powerful to create or change strong attitudes held by an individual. In interpersonal channels, the communication may have a characteristic of *homophily*, that is, "the degree to which two or more individuals who interact are similar in certain attributes, such as beliefs, education, socio-economic status, and the like," but the diffusion of innovations requires at least some degree of heterophily, which is "the degree to which two or more individuals who interact are different in certain attributes." In fact, "one of the most distinctive problems in the diffusion of innovations is that the participants are usually quite heterophilous" (Rogers, 2003).

Communication channels also can be categorized as *localite channels* and *cosmopolite channels* that communicate between individuals within the social system and outside sources. While interpersonal channels can be local or cosmopolite, almost all mass media channels are cosmopolite. Because of these communication channels' characteristics, mass media channels and cosmopolite channels are more significant at the knowledge stage and localite channels and interpersonal channels are more important at the persuasion stage of the innovation-decision process (Rogers, 2003).

Time

According to Rogers (2003), the time aspect is ignored in most behavioral research. He argued that including the time dimension in diffusion research illustrates one of its strengths. The innovation-diffusion process, adopter categorization, and rate of adoption, all include a time dimension.

Social System

The social system is the last element in the diffusion process. Rogers (2003) defined the social system as "a set of interrelated units engaged in joint problem solving to accomplish a common goal" Since diffusion of innovations takes place in the social system, it is influenced by the social structure of the social system. For Rogers (2003), structure is "the patterned arrangements of the units in a system". He further claimed that the nature of the social system affects individuals' innovativeness, which is the main criterion for categorizing adopters.

Innovation-Decision Process

Rogers (2003) described the innovation-decision process as "an information-seeking and information-processing activity, where an individual is motivated to reduce uncertainty about the advantages and disadvantages of an innovation". For Rogers (2003), the innovation-decision process involves five steps: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation. These stages typically follow each other in a time-ordered manner.

Knowledge Stage

The innovation-decision process starts with the knowledge stage. In this step, an individual learns about the existence of innovation and seeks information about the innovation. "What?," "how?," and "why?" are the critical questions in the knowledge phase. During this phase, the individual attempts to determine "what the innovation is and how and why it works" (Rogers, 2003). According to Rogers, the questions form three types of knowledge: (1) awareness-knowledge, (2) how-to-knowledge, and (3) principles-knowledge.

• Awareness-knowledge: Awareness-knowledge represents the knowledge of the innovation's existence. This type of knowledge can motivate the individual to learn more

about the innovation and, eventually, to adopt it. Also, it may encourage an individual to learn about other two types of knowledge.

• How-to-knowledge: The other type of knowledge, how-to-knowledge, contains information about how to use an innovation correctly. As Wetzel (1993) stated, even the faculty who have technical backgrounds may not use technology in teaching, if they do not have knowledge of how to use it correctly. Thus, technology is not used at an expected level, since they need help on how to use the technology effectively in teaching (Spotts, 1999). Rogers saw this knowledge as an essential variable in the innovation-decision process. To increase the adoption chance of an innovation, an individual should have a sufficient level of how-to-knowledge prior to the trial of this innovation. Thus, this knowledge becomes more critical for relatively complex innovations.

• Principles-knowledge: The last knowledge type is principles-knowledge. This knowledge includes the functioning principles describing how and why an innovation works. An innovation can be adopted without this knowledge, but the misuse of the innovation may cause its discontinuance. In fact, an individual may have all the necessary knowledge, but this does not mean that the individual will adopt the innovation because the individual's attitudes also shape the adoption or rejection of the innovation.

Persuasion Stage

The persuasion step occurs when the individual has a negative or positive attitude toward the innovation, but "the formation of a favorable or unfavorable attitude toward an innovation does not always lead directly or indirectly to an adoption or rejection" (Rogers, 2003). The individual shapes his or her attitude after he or she knows about the innovation, so the persuasion stage follows the knowledge stage in the innovation-decision process. Furthermore, Rogers states that while the knowledge stage is more cognitive- (or knowing-) centered, the persuasion stage is more affective- (or feeling-) centered. Thus, the individual is involved more sensitively with the innovation at the

persuasion stage. The degree of uncertainty about the innovation's functioning and the social reinforcement from others (colleagues, peers, etc.) affect the individual's opinions and beliefs about the innovation. Close peers' subjective evaluations of the innovation that reduce uncertainty about the innovation outcomes are usually more credible to the individual: Individuals continue to search for innovation evaluation information and messages through the decision stage.

Decision Stage

At the decision stage in the innovation-decision process, the individual chooses to adopt or reject the innovation. While adoption refers to "full use of an innovation as the best course of action available," rejection means "not to adopt an innovation" (Rogers, 2003). If an innovation has a partial trial basis, it is usually adopted more quickly, since most individuals first want to try the innovation in their own situation and then come to an adoption decision. The vicarious trial can speed up the innovation-decision process. However, rejection is possible in every stage of the innovation-decision process. Rogers expressed two types of rejection: *active rejection* and *passive rejection*. In an active rejection situation, an individual tries an innovation and thinks about adopting it, but later he or she decides not to adopt it. A *discontinuance* decision, which is to reject an innovation after adopting it earlier, may be considered as an active type of rejection. In a passive rejection (or non-adoption) position, the individual does not think about adopting the innovation at all. Rogers stated that these two types of rejection have not been distinguished and studied enough in past diffusion research. In some cases, the order of the knowledge persuasion-decision stages can be knowledge-decision-persuasion. Especially in collectivistic cultures such as those in Eastern countries, this order takes place and group influence on adoption of an innovation can transform the personal innovation decision into a collective innovation decision (Rogers, 2003). In any case, however, the implementation stage follows the decision stage.

Implementation Stage

At the implementation stage, an innovation is put into practice. However, an innovation brings the newness in which "some degree of uncertainty is involved in diffusion". Uncertainty about the outcomes of the innovation still can be a problem at this stage. Thus, the implementer may need technical assistance from change agents and others to reduce the degree of uncertainty about the consequences. Moreover, the innovation-decision process will end, since "the innovation loses its distinctive quality as the separate identity of the new idea

disappears" (Rogers, 2003). Reinvention usually happens at the implementation stage, so it is an important part of this stage. Reinvention is "the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation" (Rogers, 2003). Also, Rogers (2003) explained the difference between invention and innovation. While "invention is the process by which a new idea is discovered or created," the adoption of an innovation is the process of using an existing idea" (Rogers, 2003). Rogers further discussed that the more reinvention takes place, the more rapidly an innovation is adopted and becomes institutionalized. As innovations, computers are the tools that consist of many possible opportunities and applications, so computer technologies are more open to reinvention.

Confirmation Stage

The innovation-decision already has been made, but at the confirmation stage the individual looks for support for his or her decision. According to Rogers (2003), this decision can be reversed if the individual is "exposed to conflicting messages about the innovation". However, the individual tends to stay away from these messages and seeks supportive messages that confirm his or her decision. Thus, attitudes become more crucial at the confirmation stage. Depending on the support for adoption of the innovation and the attitude of the individual, later adoption or discontinuance happens during this stage. Discontinuance may occur during this stage in two ways. First, the individual rejects the innovation to adopt a better innovation replacing it. This type of

discontinuance decision is called *replacement discontinuance*. The other type of discontinuance decision is *disenchantment discontinuance.* In the latter, the individual rejects the innovation because he or she is not satisfied with its performance. Another reason for this type of discontinuance decision may be that the innovation does not meet the needs of the individual. So, it does not provide a perceived relative advantage, which is the first attribute of innovations and affects the rate of adoption.

Attributes of Innovations and Rate of Adoption

Rogers (2003) described the innovation-diffusion process as "an uncertainty reduction process" and he proposes attributes of innovations that help to decrease uncertainty about the innovation. Attributes of innovations includes five characteristics of innovations: (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability, and (5) observability. Rogers (2003) stated that "individuals' perceptions of these characteristics predict the rate of adoption of innovations". Also, Rogers noted that although there is a lot of diffusion research on the characteristics of the adopter categories, there is a lack of research on the effects of the perceived characteristics of innovations on the rate of adoption.

Rogers (2003) defined the *rate of adoption* as "the relative speed with which an innovation is adopted by members of a social system". For instance, the number of individuals who adopted the innovation for a period of time can be measured as the rate of adoption of the innovation. The perceived attributes of an innovation are significant predictors of the rate of adoption. Rogers reported that 49-87% of the variance in the rate of adoption of innovations is explained by these five attributes. In addition to these attributes, the innovation-decision type (optional, collective, or authority), communication channels (mass media or interpersonal channels), social system (norms or network interconnectedness), and change agents may increase the predictability of the rate of adoption of innovations. For instance, personal and optional innovations usually are adopted faster than the innovations involving an organizational or collective

innovation-decision. However, for Rogers, relative advantage is the strongest predictor of the rate of adoption of an innovation.

Relative Advantage

Rogers (2003) defined relative advantage as "the degree to which an innovation is perceived as being better than the idea it supersedes". The cost and social status motivation aspects of innovations are elements of relative advantage. For instance, while innovators, early adopters, and early majority are more status-motivated for adopting innovations, the late majority and laggards perceive status as less significant. Moreover, Rogers categorized innovations into two types: preventive and incremental (non-preventive) innovations. "A preventive innovation is a new idea that an individual adopts now in order to lower the probability of some unwanted future event" (Rogers, 2003). Preventive innovations usually have a slow rate of adoption so their relative advantage is highly uncertain. However, incremental innovations provide beneficial outcomes in a short period. To increase the rate of adopting innovations and to make relative advantage more effective, direct or indirect financial payment incentives may be used to support the individuals of a social system in adopting an innovation. Incentives are part of support and motivation factors. Another motivation factor in the diffusion process is the compatibility attribute.

Compatibility

In some diffusion research, relative advantage and compatibility were viewed as similar, although they are conceptually different. Rogers (2003) stated that "compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters". A lack of compatibility in Information Technology (IT) with individual needs may negatively affect the individual's IT use (McKenzie, 2001; Sherry, 1997). If an innovation is compatible with an individual's needs, then uncertainty will decrease and the rate of adoption of the innovation will increase. Thus, even naming the innovation is an important part of compatibility. What

the innovation is called should be meaningful to the potential adopter. What the innovation means should also be clear. This is part of the complexity attribute.

Complexity

Rogers (2003) defined complexity as "the degree to which an innovation is perceived as relatively difficult to understand and use". As Rogers stated, opposite to the other attributes, complexity is negatively correlated with the rate of adoption. Thus, excessive complexity of an innovation is an important obstacle in its adoption.

Trialability

According to Rogers (2003), "*trialability* is the degree to which an innovation may be experimented with on a limited basis". Also, trialability is positively correlated with the rate of adoption. The more an innovation is tried, the faster its adoption is. As discussed in the implementation stage of the innovation-decision process, reinvention may occur during the trial of the innovation. Then, the innovation may be changed or modified by the potential adopter. Increased reinvention may create faster adoption of the innovation. For the adoption of an innovation, another important factor is the vicarious trial, which is especially helpful for later adopters. However, Rogers stated that earlier adopters see the trialability attribute of innovations as more important than later adopters.

Observability

The last characteristic of innovations is observability. Rogers (2003) defined *observability as* "the degree to which the results of an innovation are visible to others". Role modeling (or peer observation) is the key motivational factor in the adoption and diffusion of technology (Parisot, 1997). Similar to relative advantage, compatibility, and trialability, observability also is positively correlated with the rate of adoption of an innovation. In summary, Rogers (2003) argued that innovations offering more relative advantage, compatibility, simplicity, trialability, and observability will be adopted faster than other innovations.

Adopter Categories

Rogers (2003) defined the adopter categories as "the classification of members of a social system on the basis of innovativeness". This classification includes innovators, early adopters, early majority, late majority, and laggards. In each adopter category, individuals are similar in terms of their innovativeness: "Innovativeness is the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a system" (Rogers, 2003). Braak (2001) described innovativeness as "a relatively-stable, socially-constructed, innovation-dependent characteristic that indicates an individual's willingness to change his or her familiar practices". For Rogers, innovativeness helped in understanding the desired and main behavior in the innovation-decision process. Thus, he categorizes the adopters based on innovativeness. Also, Rogers (2003) noted that incomplete adoption and non-adoption do not form this adopter classification. Only adopters of successful innovations generate this curve over time. In this normal distribution, each category is defined using a standardized percentage of respondents. For instance, the area lying under the left side of the curve and two standard deviations below the mean includes innovators who adopt an innovation as the first 2.5% of the individuals in a system.

Innovators

For Rogers (2003), innovators were willing to experience new ideas. Thus, they should be prepared to cope with unprofitable and unsuccessful innovations, and a certain level of uncertainty about the innovation. Also, Rogers added that innovators are the gatekeepers bringing the innovation in from outside of the system. They may not be respected by other members of the social system because of their venturesomeness and close relationships outside the social system. Their venturesomeness requires innovators to have complex technical knowledge.

Early Adopters

Compared to innovators, early adopters are more limited with the boundaries of the social system. Rogers (2003) argued that since early adopters are more likely to hold leadership roles in the social system, other members come to them to get advice or information about the innovation. In fact, "leaders play a central role at virtually every stage of the innovation process, from initiation to implementation, particularly in deploying the resources that carry innovation forward" (Light, 1998). Thus, as role models, early adopters' attitudes toward innovations are more important. Their subjective evaluations about the innovation reach other members of the social system through the interpersonal networks. Early adopters' leadership in adopting the innovation decreases uncertainty about the innovation in the diffusion process. Finally, "early adopters put their stamp of approval on a new idea by adopting it" (Rogers, 2003).

Early Majority

Rogers (2003) claimed that although the early majority have a good interaction with other members of the social system, they do not have the leadership role that early adopters have. However, their interpersonal networks are still important in the innovation-diffusion process.

As Rogers stated, they are deliberate in adopting an innovation and they are neither the first nor the last to adopt it. Thus, their innovation decision usually takes more time than it takes innovators and early adopters.

Late Majority

Similar to the early majority, the late majority includes one-third of all members of the social system who wait until most of their peers adopt the innovation. Although they are skeptical about the innovation and its outcomes, economic necessity and peer pressure may lead them to the adoption of the innovation. To reduce the uncertainty of the innovation, interpersonal networks of close peers should persuade the late majority to adopt it. Then, "the late majority feels that it is safe to adopt" (Rogers, 2003).

Laggards

As Rogers (2003) stated, laggards have the traditional view and they are more skeptical about innovations and change agents than the late majority. As the most localized group of the social system, their interpersonal networks mainly consist of other members of the social system from the same category. Moreover, they do not have a leadership role. Because of the limited resources and the lack of awareness-knowledge of innovations, they first want to make sure that an innovation works before they adopt. Thus, laggards tend to decide after looking at whether the innovation is successfully adopted by other members of the social system in the past. Due to all these characteristics, laggards' innovation-decision period is relatively long. In addition to these five categories of adopters, Rogers (2003) further described his five categories of adopters in two main groups: earlier adopters and later adopters. Earlier adopters consist of innovators, early adopters, and early majority, while late majority and laggards comprise later adopters. Rogers identifies the differences between these two groups in terms of socio-economic status, personality variables, and communication behaviors, which usually are positively related to innovativeness. For instance, "the individuals or other units in a system who most need the benefits of a new idea (the less educated, less wealthy, and the like) are generally the last to adopt an innovation" (Rogers, 2003).

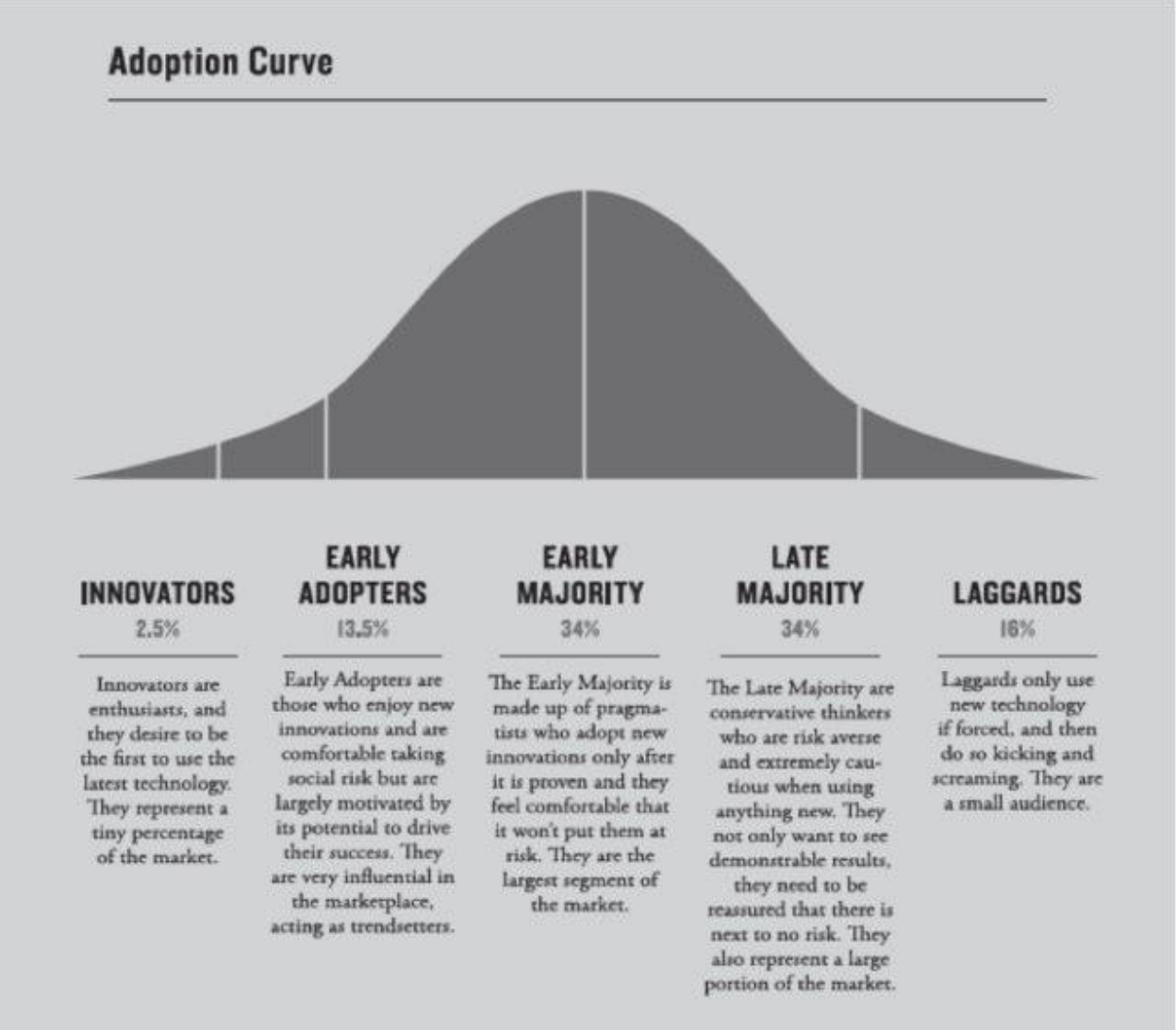

Fig 4: Adopter Categories graph.

2.4 Relevance of the Theory to the Study

This theory is relevant to this work because it explains the processes, stages and interrelated activities and actors that influence or define the adoption of innovation. Most importantly, it explains the role of the social system which cooperative societies typify in adoption of innovation. The theory is also relevant to the study because it provides framework for understanding why, how and when people adopt innovations, as well as the role social system in determining the rate and success of the adoption.

2.5 Summary of Literature Review: The missing gap

Agricultural technologies consist of improved inputs and methods used in agricultural production process. Spread of innovation leads to technology transfer and there is strong linkage between innovation uptake and agricultural productivity. Literature is rich with various attempts for improving agricultural productivity, including the role of agricultural productivity. There seem to be a consensus among researchers that strengthening agricultural cooperatives can have significant effect on agricultural productivity. However, the extent to which agricultural cooperatives contribute to adoption of agricultural innovation is still controversial. Furthermore, in as much as many factors were adjudged as determinants of agricultural innovation adoption in various literature, there is the need to identify the factors that are peculiar to the farmers in Imo State. A number of empirical studies have attempted to determine the effect of adoption on agricultural productivity but there is limited evidence that a comparative study of cooperative and non-cooperative farmers have been conducted. This is the gap this study is meant to fill.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

This chapter provides the reader the steps followed to conduct the research. A clear and concise description of the methods and procedures was done under the following sub-sections: Research design, Area of study, Population of the study, Sampling procedure and size, Sources of data, Description of data collection instruments, Validity of instrument, Reliability of research instrument, and Method of data analysis.

3.1 Research Design

The research design used in this study is descriptive survey. Data was gathered from a large number of respondents who constitute the sample to be the representative of the population of interest. These data collected were important in understanding the fact and events better and gives better interpretation and explanation, as well as make predictions about variables easy. In gathering the data, a cross-sectional research design was deployed whereby a one-time observation was made on the elements of the sample and on those variables which were relevant to this research.

3.2 Area of Study

The area of study is Imo State. It is one of the 36 States in Nigeria, set in the heart of Ibo land, and arguably the most strategic of the five States in South-East Nigeria. The important cities in the State are Owerri, Okigwe and Orlu. It had an estimated population of about 4,769,239 (National Census Commission 2006).. The State shares boundary with Anambra in the North, Abia in the East and Rivers State in the South.

The State Slogan is Heartland and It is currently referred to as the entertainment capital of Nigeria because of its high density of spacious hotels, high street casinos, production studios and high quality centres of relaxation. It is the home to an annual beauty pageant called "Miss Heartland".

Owerri is the State capital. It was also the last of four capitals of the Republic of Biafra in 1969. The capital of the Secessionist State was continuously being moved as Nigerian troops captured the older capitals. The State sits in the rain forest and produces many agricultural products, such as yams, cassava, taro, corn, rubber and palm products. The State sits on huge crude oil and natural gas reserves like most of the Igbo land areas.

Imo State has 27 Local Government Areas which are divided into three zones that is Orlu zone, Owerri zone and Okigwe zone. Orlu zone covers local government areas like Oguta, Orsu, Ideato North, Ideato south, Oru East, Oru West, Njaba, Nwangele, Nkwere, Isu, Umuna, Ohaji Egbema. In Okigwe zone we have these Local Government Areas: Okigwe, Onuimo, Isiala Mbano, Iheme, Ihiteuboma, Obowo, Umuna. Owerri zone has the following Local Government Areas: Mbaitoli, Ikeduru, Owerri Municipal, Owerri West, Owerri North, Ngor Okpala, Abor Mbaise, and Ezinihite.

The State is agrarian in nature with over 60% of the population into one form of agriculture or the other. Farming took place more in rural areas and most of the farmers in the State belong to cooperatives popular crop, farming techniques, literacy level etc.

3.3 Population of the Study

The population of the study consists of all registered agricultural cooperatives in Imo State and non-cooperative farmers registered in the Ministry of Agriculture Imo State. From the data gotten from the State Ministry of Cooperative that is Ministry of Commerce and Industry in 2017, there was a total of 1184 registered agricultural cooperatives that are active and functional. The researcher has a total population of 2678 non-cooperative farmers, gotten from the register of All Farmers Association of Nigeria Imo State branch. These 1184 agricultural cooperatives have membership strength of 38,520. They all formed the population of the study.

3.4 Sample Size Determination and Sampling Technique

Multistage sampling technique was used in this study. All agricultural cooperatives in the area were categorized into the three agricultural zones in the State. . In stage one, the Local Government Areas that were predominantly agrarian, where these agricultural cooperatives were based were purposively selected from each of the three agricultural Zones: Owerri Zone, Orlu Zone and Okigwe Zone. In stage two, ten percent of the cooperatives in these Local Government Areas were selected using simple random sampling technique. Thirdly, ten percent of the members of these selected cooperatives were also selected using simple random sampling technique. The choice of 10% is supported by Alreck and Settle (1995) who states that it is seldom necessary to sample more than 10% of the population.

Due to the comparative nature of the study, 10% of active registered farmers in the local governments were also selected. These farmers live in the same areas where the selected cooperatives members live and share similar socio-economic characteristics.

Table 1. Showing Agricultural Zones, Number of Cooperatives and members selected

Zones	No. of Agricultural Cooperatives	No of members	No. of registered individual farmers	No of cooperative selected	No of members selected	No of registered individual selected
Owerri						
Ikeduru	24	720	610	2	72	61
Ezinihite	21	714	628	2	71	62
Ngor Okpala	25	820	510	3	82	51
Okigwe						
Obowo	29	928	483	3	92	48
Onuimo	21	630	539	2	63	54
Iheme	21	642	436	2	64	44
Orlu						

Njaba	26	782	546	3	78	55
Nkwere	24	689	490	2	68	49
Oru West	22	609	473	2	60	47
Total	213	6534	4715	21	653	471

To determine the sample size, Taro Yamani formular was used.

The formular was $n= N/1+N(e)^2$

Where n = desired sample size

N = population generated for the study

E = Acceptable error limit (0.05%)

Substituting the formular for Cooperative Farmers,

653/1+ (653 X 0.0025)

= 248

Substituting the formular for Non-cooperative Farmers

471/ 1+(471 x 0.0025)

= 216

3.5 Sources of Data

Two main sources of data were employed to gather data for this study. These are secondary and primary sources: (1) Secondary Sources: Secondary data were sourced from already existing materials such as textbooks, government publications and bulletins, journals, unpublished theses and dissertations, discussion papers, etc. (2) Primary Sources: First-hand data were collected from primary sources. The main instrument for this task was structured questionnaire which contained uniform questions made up of appropriate combination of Likert-formatted and some open ended questions which were administered on all the respondents.

3.6 Instrument for Data Collection

The instrument used for data collection is a structured questionnaire designed by the researcher, in line with the objectives of the study. Information obtained was with respect to socio-economic characteristics of the farmers such as age, gender, education, farm size, household size, and income. Other information obtained included responses about their adoption behaviour and their production behaviour.

Data for evaluation of effect of adoption was obtained through the employment of Likert-scale with five levels: Strongly Agree (5); Agree (4); Undecided (3); Disagree (2); and Strongly Disagree (1) to obtain responses from the respondents. The cooperative members were requested to indicate their level of agreement with each of the items in the questionnaire.

A total of 248 copies of questionnaires were distributed to cooperative farmers, while 216 were distributed to non-cooperative farmers. However, only 206 were dully filled from cooperative farmers and 196 for non-cooperative farmers.

3.7 Validity of Research Instrument

The instrument for data collection was given to four senior academic Staff in the Faculty of Management Sciences who are experts in the subject area after the inputs from ADP staff have been factored in. The experts assessed the items contained in the questionnaire and their suitability to elicit the required information. To achieve face validity for the research instrument, efforts was made to include all appropriate items that could be used to measure what was studied. Also, all confusing and controversial words and questions were removed. The validators which include my Supervisor, Senior lecturers in the Faculty of Management Sciences, with expertise in the research area agricultural cooperatives, handled the content validity for the research instrument. They used the research questions, the hypotheses and productivity assessment tools, to ensure that the research instrument provided adequate coverage of the study. Their corrections and

suggestions in line with the guidance of the Supervisor enabled the researcher to produce the final draft copy of the questionnaire which was used for the study.

3.8 Reliability of the Research Instrument

Reliability test in order to check the consistency of the measuring instrument over time was conducted, in a test-retest manner, using Pearson Correlation coefficient. Under this procedure the instrument was administered to a sample of 30 farmers in the area of study. Their responses was noted and appropriately coded. Thereafter the same instrument was administered to the same group of farmers after 3 weeks and their first and second responses were examined using Pearson Correlation Analysis. The result of the test showed a test result affirming the instrument to be reliable.

Table 3.1: Reliability test (correlation).

		Test One	Test Two
Test One	**Pearson Correlation**	**1**	**0.893****
	Sig. (2- tailed)		**0.000**
	N	**30**	**30**
Test Two	**Pearson Correlation**	**0.883****	**1**
	Sig. (2-tailed)	**0.000**	
	N	**30**	**30**

****Correlation is significant at the 0.01 level (2-tailed)**

3.9 Method and Tools for Data Analysis

Descriptive statistics such as frequency distribution, means and percentages was used to analyze the data obtained to address the objectives of the study. Also inferential statistics, such as One-Way Analysis of Variance (ANOVA), t-test and regression was employed to address the research questions and to test the promulgated hypotheses. Specifically, mean rating and descriptive statistics were used to address the research questions, while ANOVA, t-test was used to test the hypotheses at 5% level of significance.

Objective number one was achieved using one-way ANOVA.
Decision Rule: Accept the null hypothesis if the f-value is not significant (f > 0.05)

Objective number two was achieved using t-test
Decision Rule: Accept the null hypothesis of the t-value is not significant (t > 0.05)

Objective number three was achieved using multiple regression.
Decision Rule: Accept the null hypothesis if the t-value is not significant (t > 0.05)
Objective four was achieved using ANOVA.
Decision Rule: Accept the null hypothesis when the f-value is not significant (f > 0.05)

The Statistical Package for Social Sciences (*SPSS*) version 22 was the software employed in the analysis of the data generated.

3.10 Model Specification

The multiple regression analysis was employed to determine the effect of innovation on agricultural productivity. Cob-Douglas production function which establishes the relationship between inputs and outputs formed the basis of the regression equation (Gujarati,1995). The equations regressed the effect of innovation on agricultural production.

Hypothesis 3 which looks at establishing the relationship between agricultural innovation and production was achieved using the relationship below

$$Y = \alpha + \beta_1 x1 + \beta_2 x2 + \beta_2 x3 + \beta_4 x4 + \beta_5 x5 + \beta_6 x6 + \beta_7 x7 + \varepsilon \ldots\ldots\ldots\ldots 1$$

Where Y = adoption Level of agricultural innovations measured in (levels)

X1 = Amount of capital invested. (#)

X2= Year of farming experience. (No)

X3= value of assets (#)

X4= Duration of cooperative membership. Dummy : member 1, otherwise 0)

X5= Size of farm measured in hectare. (Hectres)

X6= Household size. (No)

X7 = educational qualification. (Years)

β_1 to β_7 were the coefficients to be determined, the variables have the same description as seen in the equation.

The three functional forms of regression which express the algebraic relationship between dependent and independent variables were stated and tested in the study before the linear model was selected. They include

- The Linear functional form which expresses the relationship between the dependent and independent variables in a straight line
- The semi-log functional form in which the dependent or independent variables are transformed using natural logarithm transformation
- Double-log functional form in which both the dependent and the independent variables are transformed using the natural logarithm transformation.

The mathematical equations for the three functional forms are

Linear:

$Y = \alpha + \beta_1 x1 + \beta_2 x2 + \beta_2 x3 + \beta_4 x4 + \beta_5 x5 + \beta_6 x6 + \beta_7 x7 + e$…….Equation 2

Semi-log:

$LnY = \alpha + \beta_1 x1 + \beta_2 x2 + \beta_2 x3 + \beta_4 x4 + \beta_5 x5 + \beta_6 x6 + \beta_7 x7 + e$…….Equation 3

Double-log

$LnY = \alpha + \beta_1 lnx1 + \beta_2 lnx2 + \beta_3 lnx3 + \beta_4 lnx4 + \beta_5 lnx5 + \beta_6 lnx6 + \beta_7 lnx + e$…….Equation 4

After testing the three functional forms, the most suitable functional form was selected. This is dependent on the nature of data generated and the type of analysis required.

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

4.1 Socio-Economic Characteristics of the Respondents

In this chapter, data collected were presented and analyzed. Research questions and hypothesis were respectively answered and tested based on the data collected.

Table 4.1 Socio-economic characteristics of cooperative and non cooperative farmers studied.

No.	Variables	Frequency	Percentage (%)
1.	**Sex**		
	Male	164	41
	Female	238	59
	Total	402	100.00
2.	**Age**		
	Less than 25	41	10
	26- 40	111	28
	41-65	184	46
	Above 65	66	16
	Total	402	100.00
3.	**Marital status**		
	Single	91	23
	Married	194	48
	Widowed/divorced	116	29
	Total	402	100.00
4.	**Farm size**		
	Less than I hectare	152	38
	3 hectare	187	47
	Above 3 hectare	63	15
	Total	402	100.00
5.	**Educational qualification**		
	No formal education	45	11
	Primary	172	43

	Secondary Tertiary	108 77	27 19
	Total	402	100.00
6	**Household size**		
	1-3	53	13
	4-6	94	23
	7-9	158	39
	10-12	73	18
	Above 12	24	5
	Total	402	100
7	**Years of cooperative membership**		
	Non members	196	49
	0-5 years	54	13
	6-10 years	96	24
	11-15 years	33	09
	16-20 years	20	05
	Above 21 years	3	1
	Total	402	100
8	**Output**		
	Less than 1ton	44	11
	1-3 tons	168	42
	4-10 tons	141	35
	Above 10tons	49	12
	Total	402	100
9	**Annual income**		
	Less than 500,000	53	13
	500,001 – 1 million	166	41
	1 m- 3 million	123	31
	Above 3 million	60	15
	Total	402	100

Socio-economic profile of the respondents as shown in Table 4.1 reveals that 59% of the respondents were female while 41% were male. The blend of both male and female was proportionate as there were more females than males in most cooperatives that operate in the area studied. About 84% of the respondents belong to active population bracket (25-65 years). Ten percent of the sample selected were less than 25 years old while 5%, were above 65 years. In terms of marital status, 23% of the respondents were single, while 48% were married. Surprisingly, 29% were widowed /divorced. Majority of respondents

had more than three hectares of land. Thirty percent cultivate less than three hectares whereas 15% worked on more than three hectares. Result showed that over 80% of the respondents had formal education. Nineteen percent attempted tertiary education, while 11% did not attempt any formal education. Furthermore, the profile showed that majority of the respondents had large household size. Sixty-two percent had 4-9 persons in their household, whereas only 13% had 1-3 persons. Table 4.1 revealed that 41% of the respondents do not belong to cooperative societies, while 51% were cooperative members. Majority of the farmers who belonged to cooperative have spent between 6-10 years in the cooperative. In terms of volume of agricultural production of the respondents, 77% produce between 2-10 tonnes. Annual income profile of the respondents showed that 72% earn between 500,000 – 3 million naira. Thirteen percent earn less than 500,000, while 15% earn above 3 million naira.

Table 4.2 Determinants of agricultural innovation adoption among cooperative and non-cooperative farmers.

Table 4.2 Determinants of agricultural innovation adoption among cooperative and non cooperative farmers

Determinants	Mean(Cooperative) ($\bar{X}$)	Remark(Cooperative) ($\bar{X}$)	Mean (Non - Cooperatives) ($\bar{X}$)	Remark (Non-cooperative) ($\bar{X}$)
Education Level	4.2	Accepted	4.51	Accepted
Annual Income	4.9	Accepted	4.3	Accepted
Farm experience	4.39	Accepted	3.4	Accepted
Frequency of contact with extension staff	3.87	Accepted	3.93	Accepted
Cooperative Membership	3.92	Accepted	3.63	Accepted
Farm size	3.2	Accepted	2.47	Rejected
Price of the produce	3.3	Accepted	3.2	Accepted
Type of Media	4.1	Accepted	3.8	Accepted
Government policy	3.9	Accepted	3.6	Accepted
Source of funding	2.8	Rejected	3.2	Accepted
Availability of success stories	4.8	Accepted	4.5	Accepted
Market value of farm assets	2.7	Rejected	2.9	Rejected
Frequency of training	4.31	Accepted	3.92	Accepted
Attitude to novel ideas	3.82	Accepted	4.0	Accepted
Household size	3.52	Accepted	3.71	Accepted
Extent of livelihood diversification	3.78	Accepted	3.3	Accepted
Location of the farmers	2.48	Rejected	3.4	Accepted
Availability of markets	3.2	Accepted	3.6	Accepted
Motive for farming	2.73	Rejected	2.51	Rejected
Parents' occupation	3.2	Accepted	3.3	Accepted

Table 4.2 reveals that important determinants of adoption include educational level, annual income, farm experience, frequency of contact, cooperative membership, price of

the produce, others are, type of media used, government policy, availability of success stories, frequency of training, attitude to novel ideas, household size, extent of livelihood diversification, availability of markets and parents occupation. Interestingly, farm size, market value of farm assets, location of farmers and motives for farming were not found to be important determinants of adoption of agricultural innovation in the area studied.

Hypothesis 1

Ho: There is no significant difference in determinants of adoption of agricultural innovation among cooperative and non-cooperative farmers.

Table 4.3 ANOVA table (One way) comparing determinants of agricultural innovation adoption among cooperative and non-cooperative farmers

Adoption Parameter S		Sum of Squares	Df	Mean Square	F	Sig.
Attitude to novel ideas	Between Groups	1.752	5	.350	1.436	.209
	Within Groups	144.873	397	.244		
	Total	146.625	402			
Education	Between Groups	35.108	5	7.022	1.088	.366
	Within Groups	3832.611	397	6.452		
	Total	3867.718	402			
Farm size	Between Groups	44.960	5	8.992	5.699	.210
	Within Groups	693.734	397	1.168		
	Total	738.693	402			
Frequency of contact	Between Groups	7.382	5	1.476	3.082	.109
	Within Groups	284.511	397	.479		
	Total	291.893	402			
Availability of markets	Between Groups	15.624	5	3.125	4.257	.061
	Within Groups	436.001	397	.734		
	Total	451.625	402			
Membership of cooperative	Between Groups	28.195	5	5.639	5.985	0.910
	Within Groups	372.803	397	.628		
	Total	400.998	402			
Location of the farm	Between Groups	13.888	5	2.778	1.254	.282
	Within Groups	1315.710	397	2.215		
	Total	1329.598	402			
Farm experience	Between Groups	16.030	5	3.206	1.569	.027
	Within Groups	1213.803	397	2.043		
	Total	1229.833	402			
Price of the produce	Between Groups	195.541	5	39.108	3.490	.100
	Within Groups	911.332	397	1.534		
	Total	1106.873	402			
Motive for farming	Between Groups	1.398	5	.280	1.229	.094
	Within Groups	135.076	397	.227		
	Total	136.473	402			
Parents occupation	Between Groups	4.035	5	.807	2.385	.087
	Within Groups	200.950	397	.338		

	Total	204.985	402			
Type of media in use	Between Groups	11.944	5	2.389	2.111	1.03
	Within Groups	672.254	397	1.132		
	Total	684.198	402			
Household size	Between Groups	5.548	5	1.110	1.368	.234
	Within Groups	481.645	397	.811		
	Total	487.193	402			
Annual income	Between Groups	28.710	5	5.742	3.133	.008
	Within Groups	1088.783	397	1.833		
	Total	1117.493	402			
Training attendance	Between Groups	18.366	5	3.673	2.171	.066
	Within Groups	1004.967	397	1.692		
	Total	1023.333	402			
Source of fund for farming	Between Groups	5.920	5	1.184	1.143	.336
	Within Groups	615.273	397	1.036		
	Total	621.193	402			
Value of productive assets	Between Groups	13.003	5	2.601	4.653	.720
	Within Groups	331.956	397	.559		
	Total	344.958	402			
Success stories	Between Groups	7.330	5	1.466	3.689	1.03
	Within Groups	236.055	397	.397		
	Total	243.385	402			
Attitude of extension agents	Between Groups	21.271	5	4.254	2.317	.092
	Within Groups	1090.794	397	1.836		
	Total	1112.065	402			
Literacy level of farmers	Between Groups	13.646	5	2.729	3.758	.082
	Within Groups	431.419	397	.726		
	Total	445.065	402			

ANOVA table Table 4.3 reveals that determinants of adoption were same for both cooperative and non-cooperative farmers. The hypothesis tested was not significant at 5% level. Therefore, we accept the null hypotheses and conclude that there is no significant difference in determinants of adoption of agricultural innovation among cooperative and non-cooperative farmers.

Table 4. 4 Mean rating indicating the extent to which agricultural technologies were used.

Agricultural Technologies	Mean ($\bar{X}$)	Standard deviation	Remark
Processing technique	3.4	1.41	Accepted
Fertilizer application technique	4.6	0.58	Accepted
Use of agro chemicals	3.9	1.47	Accepted
Use of improved planting methods	3.8	1.92	Accepted
Use of improved seeds and breeds	4.2	0.81	Accepted
Irrigation farming technique	2.0	2.38	Rejected
Farm management practices	3.1	1.97	Accepted
Use of mechanized implement	2.7	0.86	Rejected

Table 4.4 reveals that farmers have adopted the following agricultural innovations extensively: Processing technique, fertilizer application, use of agro-chemical, use of improved planting method, use of improved seeds and breeds, farm management practices. Unfortunately, they have not adopted irrigation farming techniques and use of mechanized implement.

Hypothesis 2

Ho: Agricultural innovations are not extensively used by farmers

Table 4.5 One-Sample Test on extent of use of different agricultural innovations among farmers

	Test Value = 0					
					95% Confidence Interval of the Difference	
	T	Df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Processing technique	21.951	401	.031	1.40000	1.2724	1.5276
Fertilizer application	19.565	401	.026	1.85000	1.6608	2.0392
Use of agro chemicals	25.389	401	.0418	3.43333	3.1627	3.7039
Improved planting methods	28.626	401	.015	2.50000	2.3252	2.6748
Improved seeds and breeds	24.9816	401	0.014	2.1897	2.4081	2.7862
Farm management practices	18.769	401	0.0643	2.981	1.897	1.0945
Irrigation technique	3.0926	401	0.094	1.978	2.985	1.754
Use of mechanized implement	4.9824	401	0.124	1.341	2.897	3.981

Table 4.5 shows the result of hypotheses tested. Since the t-ratios are higher and significant, the null hypothesis is rejected. Therefore, we conclude that agricultural innovations are extensively used by cooperative farmers in the area studied.

Table. 4.6 Mean rating on the perception of farmers on agricultural production.

	Mean	S.D	Remark
Increased productivity	3.8	2.83	Accepted
Increased output	4.2	1.96	Accepted
Increased income	4.4	1.48	Accepted
Better land management	3.1	0.79	Accepted
Efficiency in use of resources	3.0	2.10	Accepted
Better climatic management	2.40	1.63	Rejected
Increase in mechanization	2.9	3.93	Rejected
Increased access to foreign market	2.64	1.46	Rejected
Increased industrialization	2.19	0.43	Rejected
Increased interest in agriculture	4.2	1.78	Accepted
Commercialization of agricultural activities	3.2	1.24	Rejected
Increased funding opportunities	2.3	1.61	Rejected

Table 4.6 affirms that adoption of agricultural innovation increases man hour saved, output, better land management, efficient use of resources, increased interest in agriculture, and commercialization of agriculture. However, adoption of innovation does not affect increased industrialization, commercialization, access to foreign market and increased access to funding opportunities.

Hypothesis 3

Ho: Socio-economic characteristics have no influence on adoption behaviour of farmers.

Table 4.7 Regression summary of influence of socio-economic characteristics on adoption behaviour of farmers' production. (output)

Model	**Coefficient Estimates**	**t-Value**	**Significance**
(CONSTANT)	1.187	4.113	0.030
Sex	0.184	1.904	0.273
Marital status	0.206	1.860	0.428
Education	2.016	4.121	0.039
Household size	3.099	3.763	0.178
Farm experience	1.713	4.653	0.016
Value of assets owned	2.205	6.194	0.046
Farm size	0.421	6.437	0.076
Annual income	0.370	7.87	0.023
Cooperative membership	2.425	5.246	0.039
Age	1.890	3.761	0.029
R^2	0.770		
Adj R^2	0.751		
F	20.114 (Sig. @ 0.05)		

Dependent Variable: Annual agricultural output

Table 4.7 contains the regression summary of the effect of adoption on productivity. The effect of adoption on agricultural production (measured by output) is positive and significant suggesting that increase in use of agricultural innovation has actually increased production. R^2 of 0.77 revealed that over 77% of changes in output were

accounted for by the variables in the model. An F-ratio of 20.114 was significant at 5% level showing that the model was strong.

Table 4.8 Showing adoption levels of agricultural innovations among cooperative and non-cooperative farmers.

	Awareness	Interest	Evaluating)	Trial	Adoption
Processing technique	4.2 (3.2)	5.3 (5.0)	4.8 (4.2)	4.4 (3.9)	3.4 (2.9)
Fertilizer application technique	5.0(4.7)	5.6 (5.3)	5.2 (4.6)	4.2 (3.6)	4.6 (3.4)
Use of agro chemicals	4.8(4.4)	5.4 (4.9)	5.0 (4.6)	4.9 (4.2)	3.9 (4.1)
Use of improved planting methods	4.5 (4.7)	5.7 (4.8)	5.4 (4.9)	5.1 (4.3)	3.8 (3.0)
Use of improved seeds and breeds	5.4 (4.9)	4.9 (5.1)	4.6 (4.9)	4.4 (4.6)	4.2 (4.4)
Irrigation farming technique	4.0 (3.8)	3.9 (3.2)	2.0 (1.63)	1.4 (1.2)	1.2 (0.67)
Farm management practices	3.9 (3.2)	4.8 (5.3)	4.4 (4.8)	3.8 (3.1)	3.0 (3.6)
Use of mechanized implement	3.8 (3.2)	3.1 (3.6)	3.9(4.1)	3.8 (3.1)	2.7 (2.3)
Use of fertilizer	4.9 (3.7)	5.1 (4.6)	4.9 (4.6)	4.2 (3.9)	4.7 (4.6)

NB: Figures for non-cooperative farmers are in parenthesis

Table 4.8 compares the awareness, interest, evaluating, trial and adoption levels of cooperative and non-cooperative farmers. Findings suggest that cooperative members exhibit higher awareness, higher interest, evaluation, trial and eventual adoption. This trend was observed in all agricultural innovations, except in the use of improved seeds and breed where non-cooperative farmers had higher values. The table also reveals that

Adoption level for irrigation farming techniques and use of mechanized implement was very low for cooperative and non- cooperative farmers.

Hypothesis 4:

Ho: There is no significant difference in the adoption level of agricultural innovations among cooperative and non-cooperative farmers

Table 4.9 One Way ANOVA testing of difference between adoption level of cooperative and non-cooperative farmers

Annual Income	**Sum of squares**	**Df**	**Mean square**	**F**	**Sig.**
Between Groups	6.415	1	5.216	8.619	0.033
Within Groups	98.626	401	0.730		
Total	**94.281**	**402**			

Source: Authors computation using SPSS version

Decision: The results of the one-way ANOVA in Table 4.9 shows that there is a difference between the adoption level of agricultural innovation of cooperative and non-cooperative farmers. It showed an F-ratio value of 8.619 which was very significant at the conventional 5% level. As a result of this, the null hypothesis as stated above is rejected, and we conclude that there is a significant difference between the adoption level of cooperative and non- cooperative farmers. The implication of this is that cooperatives play critical roles in adoption of agricultural innovation.

4.2 Discussion of Findings

The study evaluated the determinants, extent of adoption of agricultural innovation, as well as roles of cooperative and effects of adoption on productivity. Findings revealed that determinant of adoption were same for both cooperative and non-cooperative farmers in line with Awotide (2012). Determinants of adoption included educational level, farm experience, household size and level of innovativeness. It confirmed the assertion made in Bawa and Ani (2014) who identified education and farming experience as important

determinants of adoption. The study identified other factors that drive adoption of innovation to include frequency of contact with extension agents, availability of success stories, extent of livelihood diversification, parents' occupation, source of funding for farming, and type of media used. This finding, unlike that of Olulenjo (2003), singled out determinants such as availability of success stories, livelihood diversification, type of media in use. In other words, the study expanded not only farmers' specific factors but also the institutional and structural factors that drive or hinder adoption. Findings have brought to the limelight the factors that need to be focused on, how to make these determinants favourable for both cooperative and non-cooperative farmers.

Findings on objective two affirmed that farmers in Imo State had adopted processing techniques, fertilizer application, use of agro-chemicals, use of improved seeds, improved planting methods and improved farm management extensively. This is in line with the findings in Adegbite (2011) and Awotide (2012). However, the study made significant contribution by expanding the types of innovation unlike other studies that focused only on the use of improved seed and mechanization. This study expanded the frontiers of knowledge in this discipline by differentiating between mere adoption and extensive use. This distinction is important because some innovations could be used for some time and discontinued. In contrast, this study focused on those innovations that were not merely used but have become part of farming practices. The revelation made in this study about low adoption rate of irrigation and mechanization should be addressed by policy makers. This can be explained partly because of huge capital outlay required and absence of government support for agriculture. In the views of Weyori *et.al* (2012), farmers would have liked to adopt these innovations if there were infrastructures. Government needs to understand that necessary conditions need to be created for innovations to thrive. Moreover, these types of innovations cannot be adopted without external support. Provision of irrigation facilities and mechanized implement should be part of public goods meant to attract people especially youths and investors into agriculture.

Findings established the critical role of cooperatives in adoption of innovation. Cooperative farmers exhibit higher adoption rate when compared with non-cooperative farmers. This findings is in line with observation made in Veerakumaran (2005) who affirmed that cooperatives were not only effective agents for diffusing agricultural innovations but also effective at stabilizing rural economy and promoting economic democracy. This study re-established the finding of Adegbite (2011) that cooperative members adopt new farming technologies than non-cooperative members. The study expanded the frontiers of knowledge in the area of cooperative and adoption behavior by revealing that cooperatives farmers also had higher awareness, interest, evaluating and trial rate compared to non-cooperatives. The policy implication of this finding is that cooperatives should be given a pride of place in agricultural innovation diffusion. Effective collaboration between cooperative societies and research institutes should be pursued in both short and long run.

The question of whether adoption of agricultural innovations increases production was positive. The study affirmed that increase in the rate of adoption correlates with increase in production. These findings were in line with observation of Iheke and Nwaru (2013) affirming that adoption of innovation increases production. Indeed, adoption increases agricultural output, efficient use of resources, commercialization of agriculture, number of man hour saved, farm income and better land management. The findings of this study expanded the findings made in Washington *et.al* (2012) who observed that adoption increases farm yield and saves labour costs. The relationship between adoption of agricultural innovation and increase in productivity has been established. The implication of this finding is that uptake of agricultural innovation should be seen as critical policy for rural development, food security and farmers welfare package. It shall also form part of national climate policy. Strengthening the stakeholders involved in agricultural technology transfer and diffusion is a right step in attaining food sufficiency all year round.

CHAPTER FIVE

SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

This concluding Chapter deals with the summary of the research findings, implications of the study, recommendations and concluding remarks.

5.1 Summary of Findings

- Important determinants of adoption include educational level, annual income, farm experience, frequency of contact, cooperative membership, price of the produce, type of media used, government policy, others are availability of success stories, frequency of training, attitude to novel ideas, household size, extent of livelihood diversification, availability of markets and parents occupation. Determinants of agricultural innovation adoption were also the same for cooperative and non-cooperative farmers.
- Farmers have adopted the following agricultural innovations extensively: Processing technique, fertilizer application, use of agro-chemical, use of improved planting method, use of improved seeds and breeds, farm management practices. These innovations were extensively used in the area studied.
- Adoption of agricultural innovation increases man hour saved, output, better land management, efficient use of resources, increased interest in agriculture, and commercialization of agriculture. Adoption of agricultural innovation had significant and positive effect on agricultural productivity
- Cooperative members exhibit higher awareness, higher interest, higher evaluation, higher trial and higher adoption levels than non-cooperative farmers. This trend was observed in all agricultural innovations, except in the use of improved seeds and breeds where non-cooperative farmers had higher values. Adoption level for irrigation farming techniques and use of mechanized implement was very low for both cooperative and non-cooperative farmers. Also, there was a significant difference between the adoption level of cooperative and non-cooperative farmers.

5.2 Conclusion

Achieving food security and making farming attractive have remained the main thrust of the Nigerian agricultural policy. This can be done through adequate technology transfer and effective adoption of improved agricultural innovations. Having realized that some farming practices hinder efficiency and increased output, government through different programmes and cooperative societies have tried to create awareness and increase the rate of adoption of various agricultural innovations. Understanding the role of cooperatives in adoption and the extent to which farmers in Imo State adopted agricultural innovations will help in mitigating hindrances to uptake, as well as in designing effective intervention programmes. This study has revealed the types of agricultural innovations that have been extensively adopted by farmers. It has elaborated on significant determinants that drive, encourage or hinder adoption. Apart from x-raying the effect of increase in rate of adoption on agricultural innovations on agricultural productivity, it has brought to the limelight the critical role of agricultural cooperatives in diffusion of agricultural innovations. This understanding has policy implication for the government, as well as cooperative movement and farming community.

5.3Recommendations

Based on the findings made in the study, the following recommendations are made.

1. Cooperative extension services need to be revolutionalized and given adequate attention. This can be achieved by developing new framework for cooperative extension and forging a common ground for both cooperative and agricultural extension work. Apart from recruitment and deployment of competent and well motivated staff, there is the need for provision of work gadget and work tools that are in tune with technological changes. Supervision and retraining of extension staff should also become a priority.
2. Management of agricultural cooperatives should be strengthened and made responsive to changes. Many agricultural cooperatives owing to their structure and management are not flexible and as a result, do not adopt innovations quickly.

This can be achieved through effective linkages and strong apexes. Cooperative societies should desist from operating in isolation as it weakens them. Also, unnecessary rivalry and competitions should be avoided. Apex cooperatives should assume important roles of information management and training. This would help cooperatives to benefit from economies of scale and increased operation.

3. Mode of delivery of agricultural extension services need to be revisited. There is the need to increase the frequency of visits, as well as the media channel employed in the technology transfer. Their curriculum should include influencing farming motives, breaking cultural barriers, first time apathy to adoption and motivating farmers to attend trainings. Success stories that are reliable and accessible should also be used during extension activities.
4. Cooperatives should maximize every opportunity they have to get trained and acquire skills. There is growing need for enhancing members' technical skills and regular training in cooperative knowledge to help them gain a better understanding of the cooperative's function. Farming is an occupation that needs improved skills, and training is important to reduce individualism and increase large scale-farming. This will improve the quality of member's participation and steer the cooperatives toward success.

5.4 Contributions of the Study

This study made reasonable contribution by validating the determinants of adoption for both cooperative and non-cooperative farmers. Initial studies did not compare the determinants simultaneously as done in this study. The study made significant contribution in determining the extent of adoption in quantitative terms. Farmers in Imo State have extensively adopted fertilizer application, improved planting method, improved management practices and use of improved breed. The study has filled the knowledge gap in analyzing the impact of agricultural cooperative in adoption process. It has also established a strong linkage between adoption of agricultural innovation and its

increase in agricultural productivity. These contributions have great policy implications and should form the basis for future policies and intervention programmes.

5.5 Suggestion for further Research

It is recommended that the following areas can be explored in future research

9. Effect of adoption of agricultural innovation on different farm crop such as cereals, root and tubers, cash crops and animal husbandry
10. Influence of educational system on adoption of improved agricultural innovation
11. Health implication of adopting new technologies among farmers and their households.

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QUESTIONNAIRE

Dept. of Cooperative Economics and Management
Nnamdi Azikiwe University, Awka,
Anambra State.
27th September, 2017.

Dear Respondent,

QUESTIONNAIRE

This questionnaire is designed to obtain information for a research study titled:

Adoption of Agricultural Innovations and agricultural Production in Imo State, Nigeria. This questionnaire is designed to obtain information for a research study. I solicit your support to provide adequate and accurate information as all information provided will be used for academic purpose and treated with confidentiality.

Thanks.

Michael Maureen .C.

PhD Student/Researcher

SECTION A: SOCIO-ECONOMIC CHARACTERISTICS OF THE RESPONDENTS

Please provide information or tick [√] where appropriate

1. Name of your community.....

2. Membership status:

(a) I am a member of cooperative.....

(b) I am not a member of cooperative.....

3. Gender of respondent:

( ) Female.....

( ) Male.....

4. Age of respondent: 0-30 ( ), 31-45 ( ), 46-60( ), 61+ ( ) Years

5. Marital status: single ( ) Married ( ) Divorced ( ) Widowed ( )

6. Educational level: No formal education ( ) Adult education ( ) Primary education ( ) Secondary education ( ) Tertiary education ( )

7. Primary occupation: Trading ( ) Farming ( ) Artisan Others ( )

8. Household size: 1-3 ( ), 4-6 ( ), 7-9 ( ), 10-12 ( ) 13 and above ( )

9. Total area of farmland owned in hectares: < 2.5( ), 2.5-4.9 ( ), 5.0 ( )

10. Agricultural experience level of farmer: 0-10 ( ), 11-20 ( ), 21-30 ( ), 31-40 ( ) 41 and above

11. Farmer' membership duration in farmers' cooperatives: 0-5 ( ), 6-10 ( ), 11-15 (), 16-20 ( ), 21 and above ( ) Years.

Section B

12. What is your annual farm income before adoption of the innovation?

a. Less than 200,000

b. Between 201, 000 – 500,000

c. Between 501,000 – 1,000,000

d. Above 1,000,001

13. What is your annual farm income after adoption of the innovation?

a. Less than 200,000

b. Between 201, 000 – 500,000

c. Between 501,000 – 1,000,000

d. Above 1,000,001

14. What is your annual farm output before adoption of the innovation?

a. Less than 2tons

b. Between 2-5 tons

c. Between 5tons-10tons

d. Above 10tons

15. What is your annual farm output after adoption of the innovation?

a. Less than 2tons

b. Between 2-5 tons

c. Between 5tons-10tons

d. Above 10tons

16. Indicate the extent to determinants of agricultural adoption among cooperative and non cooperative farmers

	Very High	High	Moderate	Low	Very Low
Educational level					
Annual income					
Farm experience					
Contact with extension staff					
Cooperative Membership					
Farm Size					
Price of the Produce					
Type of Media					
Government Policy					
Source of Funding					
Availability of Success Story					

17. Indicate the extent to which you have used the following technologies

	Very High	High	Moderate	Low	Very Low
Processing technique					
Fertilizer application technique					
Use of agro chemicals					
Use of improved rice planting methods					
Use of improved seeds and breeds					
Irrigation farming technique					

Farm management practices					
Use of mechanized implement					

18. Indicate your stage of adoption of the following agricultural technologies

	Awareness	Interest	Evaluating	Trial	Adoption
Processing technique					
Fertilizer application technique					
Use of agro chemicals					
Use of improved rice planting methods					
Use of improved seeds and breeds					
Irrigation farming technique					
Farm management practices					
Use of mechanized implement					
Use of fertilizer					

19. To what extent has adoption of innovation affected production positively?

	Very High	High	Moderate	Low	Very Low
Increased productivity					
Increased output					
Increased income					
Better land management					
Efficiency in use of resources					
Better climatic management					
Increase in mechanization					
Increased access to foreign market					
Increased industrialization					

Increased interest in agriculture					
Commercialization of agricultural activities					
Increased funding opportunities					

20. To what extent has adoption of innovation affected production negatively?

	Very High	High	Moderate	Low	Very Low
Health implication of the produce					
Erosion of cultural values					
Exploitation and excessive profit maximization					
Displacement of labourers					
Exploitation of land and other resources					
Creation of beaurecracy/inefficiency					
Increasing need for capital/funding					
Crowding out of subsistence producer					
Affect religious and personal beliefs					
Increases climatic imbalance					
Unnecessary Increase in maintenance cost					
Increase in poverty of vulnerable farmers					