ECONOMIC ANALYSIS OF WATERMELON PRODUCTION IN SABON-GARI AND KUDAN LOCAL GOVERNMENTAREAS OF KADUNA STATE, NIGERIA

BY

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MSc / AGRIC / 5221 / 2009-10

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES AHMADU BELLO UNIVERSITY ZARIA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTERS OF SCIENCE IN AGRICULTURAL ECONOMICS

DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY
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ZARIA KADUNA STATE
NIGERIA

DECEMBER, 2015

DECLARATION

I hereby declare that this dissertation titled "**Economic Analysis of Watermelon Production in Sabon-Gari and Kudan Local Government Areas of Kaduna State, Nigeria**" was written by me and it is a record of my research work. It has not been presented before in whole or in part for a higher degree. All borrowed information have been duly acknowledged by means of references.

_____ _____

Elizabeth Kwanye SANI **Date**
Student

CERTIFICATION

This Dissertation titled "**Economic Analysis of Watermelon Production in Sabon-Gari and Kudan Local Government Areas of Kaduna State, Nigeria**" by Elizabeth Kwanye SANI, meets the regulations governing the award of degree of Masters of Science (M.Sc.) in Agricultural Economics, Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This research is dedicated to God Almighty.

AKNOWLEDGEMENT

I am very grateful to God Almighty for his provision, strength and guidance throughout the period of my study, thank you Jesus.

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ABSTRACT

This study examined the economic analysis of watermelon production in Sabon- Gari and Kudan Local Government Areas of Kaduna State. The data were collected through the administration of structured questionnaire to 162 randomly selected watermelon farmers. Data were analyzed using descriptive statistics, net farm income and stochastic frontier production function. The result of analysis showed that mean age of the farmers was 34 years. 46% of the farmers had adult education. The farmers cropped an average of 0.1 hectare and 52% of the farmers had between 1-5 years of farming experience in watermelon production. The result further revealed that labour accounted for about 62% of the total variable cost of production. The total variable cost amounted to ₦26, 126.78, while the total fixed cost amounted to ₦27, 095.28. The average gross income per hectare was ₦169, 769.46, while the net farm income was ₦93, 574.42 per hectare. The results revealed a mean technical efficiencies level of 86%. Implying that there was scope for increasing efficiencies by 14%.The factor that significantly influenced watermelon production in the study areas were farm size and fertilizer. Age, household size, education, experience, cooperative, credit and extension were inefficiently utilized and statistically significant at 1% with experience at 10%. The constraints associated with watermelon production were inadequate storage facilities, pest and diseases, high cost of labour, inadequate credit, inadequate extension services, lack of improved seeds, poor market price and flooding. It was recommended that farmers should be assisted to obtain credit facilities by reducing the bottlenecks associated with bank loans, farmers should form themselves into commodity associations so as to benefit from improved packages being offered by the government under the presidential initiative.

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

At independence in 1960, agriculture stood out as the most important sector of Nigeria's economy in several aspects. It employed over eighty (80%) of the nation's work force, served as the most important foreign exchange earner and constituted a major source of government revenue (CBN, 2000). The role of agriculture remains significant in the Nigerian economy despite the strategic importance of the oil sector. It accounts for more than one- third of the total domestic product (GDP) and labour force (FAO, 2003; World Bank, 2003). In an annual report, (CBN, 2004) reported that the real sector of the economy recorded a relatively impressive performance in year 2004 as the Gross Domestic Product (GDP) grew by 6.1 percent compared with 5.2 percent in the year 2003 and that agriculture is one of the major sources of the growth. Agriculture witnessed an increase of 6.2 percent growth in year 2004 compared to the 5.6 percent recorded in the year 2003 and the average of 4.6 percent for the period of 2001 to 2004 as the output of staples increased from 99,902 metric tonnes in year 2001 to 121,936.2 metric tonnes in year 2004. Although (Eme, 2004) described Nigeria as a food insecure country, the food problem which started in the mid-1960 has continued to deepen several decades after independence (Ime, 2002).

The nation's agricultural production is still largely in the hands of the small-scale farmers with small holdings ranging from 0.05 to 3.0 hectares of land area, low capitalization and low yield per hectare (Ogundari and Ojo, 2007).

Food growth rate has been put at 2.65 percent and population growth rate at 3.2 percent, leaving a food deficit of 0.55 percent (CBN, 2007). The apparent disparity between the rate of food production and demand for food in Nigeria has led to:

i. A food demand and supply gap
ii. An increasing resort to food importation
iii. High rate of increases in food prices

As a result of these, widespread hunger and malnutrition are evident in the country (Ojo, 2003).

Watermelon (*Citrullus lanatus* [Thunb.] *Matsum* and *Nakai*) is a member of the cucurbit family (Cucurbitaceae) and is one of the most widely cultivated crops in the world at large and global production in 2002 reached 89.9 million mega grains (FAO, 2003 and Huh, 2008). It is a vine-like flowering plant originally from Southern Africa. The crop is grown commercially in areas with long frost-free warm periods (Prohens and Nuez, 2008). China, Turkey, Iran, Brazil, United States, Egypt and Russian federation are the major water melon producers (FAO, 2010).

Watermelon fruits are 93% water by weight while about 6% consist of small amounts of protein, fat, minerals and vitamins. The major nutritional components of the fruit are carbohydrates, vitamin A, and lycopene, an anti carcinogenic compound found in red flesh melon. Lycopene may help reduce the risk of certain cancers, such as prostate, pancreas and stomach. As with many other fruits, it is a source of vitamin C. Water melon also contains large amount of beta caroten. Potassium is also available in it which is believed to help in control of blood pressure and possibly prevention of stroke (De Lannoy, 2001). Water melon is utilized for the production of juices, nectars and fruits cocktails.

1.2 Problem Statement

It has been observed that Nigeria has the potential particularly in terms of land and human resources needed to produce enough food for the country (Adeoye, 2012). To be self sufficient in food production, the problem of promoting the production of the most promising stable food crops in the country has to be tackled (Balogun, *et al*., 2012).

Vegetable production has been playing a vital role in human nutrition, poverty reduction and improving the socio-economic status of the farmers. Vegetables are important items in the daily diet of the Nigerian family. They are cheap and easily available source of vitamins, minerals and dietary fibre and are low in fat and calories (Abba, 2004). There is little chance of malnutrition occurring where enough vegetables are eaten. Malnutrition reduces the working capacity of farmers and their families. In severe cases, serious physical and mental retardation or even death may occur. As a result of reduced working capacity incomes may decrease and poverty may increase (AVRDC, 1990).

Watermelon consumption in Kaduna State is on the increase due to the increasing awareness of its nutritional value, while its production is on the decrease due to inefficiency in the resource management (Kaduna state government, 2011). Despite the nutritional value of watermelon, its production remained low in the state (Dauda *et al.,* 2008). The productivity of farmers can be raised by adoption of improved technologies or improvement in efficiency or both.

The poor output 110,000t of watermelon realized by farmers may be an indication that resources needed in the production of crop are not being used at their optimal levels Darbie, *et al*., (2008) and this raises the question as to whether it is profitable to grow the crop or not? This situation calls for an examination of the profitability of growing the crop, an assessment of the resources needed for its production and how their

resources are managed by its cultivators. There is therefore, the need to provide empirical information on farm level production efficiency in small-scale water melon production in the study area. For this to be fully realized there is need to address the problems of rural farmers who produce the bulk of Nigerian agricultural product.

This study intends to provide answers to the following research questions.

i. What are the socio-economic characteristics of the watermelon farmers in the study areas?
ii. How profitable is water melon production in the study areas?
iii. Are farmers technically efficient in water melon production?
iv. What are the problems confronting water melon production?

1.3 Objectives of the Study

The broad objective of this study was to determine the Economic Analysis of water melon production in Sabon-Gari and Kudan Local Government Areas of Kaduna State. The specific objectives are to:

i. describe the socio-economic characteristics of water melon farmers in the study areas;
ii. estimate the costs and returns from water melon production in the study areas;
iii. determine the technical efficiency of water melon production in the study areas.
iv. identify the problems associated with water melon production in the study areas.

1.4 Justification of the Study

This study is expected to provide valuable bench mark information on resource use and profitability of growing watermelon to enable farmer consider its production as a viable option. The study is also expected to provide the most feasible adjustment in resources needed to boost output of the crop.

The result of the study can be used by policy makers as a guide to the development of the most appropriate institutional support needed to increase output of the crop. Water melon being an important vegetable crop in Nigeria, though produced mostly on a small scale, has the potential for raising the income and standard of living of the producers.

Its high nutritive value and potential for production several times in a year can satisfy the twin objectives of improvement in the availability of food to farmers and reduction in malnutrition and poverty levels. The overall production inefficiency in water melon production can seriously hamper the production and availability of this crop. Therefore, the realization of the need on the part of Nigerian government and citizenry, to diversify the economy by developing the agricultural sector in order to reduce the over reliance on oil as the main source of foreign exchange earnings. This study is to provide present and prospective water melon farmers information on inputs that affect water melon production positively and whether water melon production was profitable or not.

The importance of watermelon cannot be over emphasized, watermelon is one of the world most important vegetables, as the crop is grown both for its fruits and the vegetative parts which are highly nutritious and increases their level of income. (Schippers, 2000).

Watermelon production has been playing a vital role in human nutrition, poverty reduction and improving the socio-economic status of the farmers (Kim, 2008) Vegetables are important in the daily diet of the people because they are cheap and easily available source of vitamins, minerals and dietary fibre and are low in fat and calories (Abba, 2004). Watermelon being an important vegetable crop in the state has the potential for raising the income and standard of living of the producers. Production

inefficiency in watermelon can seriously hamper the production and availability of this crop (Ndubizu, 2008).

As reported by (Ajewole and Folayan, 2008) exotic vegetable productions generate higher profit, provide more employment and income to the farmers than those of indigenous vegetables, knowledge of availability of aggregated farm level resources and differences in their productivities are essential in order to enhance productive capacity of the small holder farmers. This also indicates the direction of resource use adjustment and allocation (Ogundare and Ojo, 2005). The productivity of farmers can be raised by adoption of improved production technologies and the choice of the most appropriate set of crops had to be complemented by working out and providing sustainable ways of improving output of these crops through a more efficient use of the resources at the farmer's disposal.

The information on efficiency is important because the presence of shortfalls in efficiency means that output can be increased without additional inputs and new technology. Hence, this is necessary since many studies have indicated inefficiency in the use of resources in the production of both food and cash crops in the country (Olagoke 1992; Ditto 1992; Coker 2001 and Ibrahim, 2002). Improvement in efficiency becomes the best option in productivity enhancement in the short run (Idiong, 2007). So that small scale holders will benefit through proper allocation of resources which can also help in boosting production.

1.5 Hypotheses

The hypotheses put forward for this study are:

i. Watermelon production is not profitable in the study areas.

ii. Farmers are not technically efficient in watermelon production.

CHAPTER TWO

LITERATURE REVIEW

2.1 Origin and Cultivation of Water Melon

Watermelon (*citrullus lanatus*) belongs to the family "cucurbitaceae" (Schippers, 2000). Its centre of origin has been traced to both the Kalahari and the Savanna deserts precisely in South Africa (Jarret *et al*., 1996) and these areas have been regarded as point of diversification to other parts of the world (Schippers, 2000). Is a vine like (scrambler and trailer) flowering plant, its fruit which is also called water melon, is a special kind referred to by botanists as a pepo, a berry which has a thick rind (Exocarp) and fleshy centre (meocarp and endocarp), pepos are derived from an inferior ovary, and are characteristic of the cucurbitaceae. The watermelon fruit, loosely considered a type of melon although not in the genus cucumis has a smooth exterior rind (green, yellow and some trees white and a juicy, sweet interior flesh usually pink, but sometimes orange, yellow, red and sometimes green if not ripe).

Watermelon is thought to have originated in South Africa, where it is found growing wild, because it reaches maximum genetic diversity there, resulting in sweet bland and bitter forms. Alphonse de Candolle, in 2006, already considered the evidence sufficient to prove that watermelon was indigenous to tropical Africa. Although citrullus Colocynthis is often considered to be a wide ancestor of watermelon and is now found native in north and West Africa, Fenny Dane and Jiarong Liu suggest on the basis of chloroplas DNA investigations that the cultivated and wild watermelon appear to have diverged independently from a common ancestor, possibly C. ecirrhosus from Namibia (Dane *et al*., 2006).

It is not known when the plant was first cultivated, but Zohany and Hopf note evidence of its cultivation in the Nile valley from at least as early as the second millennium BC.

Although watermelon is not depicted in Egyptian heiroghyphic text nor does any ancient writer mention it, finds of the characteristically large seed are reported in Twelfth dynasty sites, numerons watermelon seeds were covered from the tomb of Pharaoh Tutank hamun. By the 10^{th} century AD, watermelons were being cultivated in China, which is today the world's single largest watermelon producer (David *et al*., 2012).

2.2 Economic Importance of Watermelon

Watermelon contains about 6% sugar and 93% water by weight. As with many other fruits, it is a source of vitamin C. The amino acid citrulline, was first extracted from watermelon and analyzed. Watermelon contains a significant amount of citrulline and after consumption of several kg, an elevated concentration is measured in blood plasma, this could be mistaken for citrullinaemia or other urea cycle disorders (Rimando and Perkins- Veazie, 2005).

Watermelon rinds, usually a light green or white color, are also edible and contain many hidden nutrients that most people avoid eating due to its unappealing flavor. They are sometimes used as a vegetable. In China, they are stir-fried, stewed or more often pickled. When stir fried, the de-skinned and de-fruited rind is cooked with olive oil, garlic, chili peppers, scallions, sugar and rum. Pickled watermelon rind is also commonly consumed in the southern US. Watermelon juice can also be made into wine. It is also commonly used to make variety of salads, mostly notably fruit salad (Keller and Jack, 2002).

Watermelon is also midly diuretic and contains large amount of beta carotene, watermelon with red flesh is a significant source of lycopene. The seeds and flesh are used in cooking (Robinson and Decker-Walters, 1977). The fruits contain 93.2% water,

0.6g protein, 0.2g cellulose, 8mg calcium, 0.24mg iron, 0.1mg carotene, 0.033mg thiamin (Vit B1), 0.021mg ribo flavin (Vit. B_2) and 0.17mg Niacin (Vit B_3). The energy value of watermelon is 87kg or (kcal)/100g (De Lannoy, 2001).

2.3 Watermelon Varieties

There are more than 1200 varieties of water melon ranging in size from less than a pound, to more than two hundred pounds, with flesh that is red, orange, yellow or white. Several notable varieties are included here:

1. **Carolina cross:** This variety of watermelon produced in the current world record watermelon weighing 262 pounds (119kg). It has green skin, red flesh and commonly produces fruit between 65 and 150 pounds (29 and 68kg). It takes about 90 days from planting to harvest.
2. **Yellow crimson watermelon:** Variety of water melon that has a yellow colored flesh. This particular type of water melon has been described as "sweeter" and more "honey" flavoured than the more popular red flesh watermelon
3. **Orange glo:** This variety has a very sweet orange pulp, and is a large oblong fruit weighing 9-14kg (20-30 pounds), it has a light green rind with jagged dark green stripes. It takes about 90-100 days from plant to harvest.
4. Other varieties are the moon and stars, cream of Saskatchewan, Melitopolski and Densuke watermelon.
5. The major varieties grown in Nigeria include sugar baby, kaolack, crimson sweet, black boy and sugar sweet. The varieties grown in the study area is sugar baby.

2.4 Benefits of Watermelon Production

Health benefits of watermelon is not only great on a hot summer day, this delectable thirst- quencher may also help quench the inflammation that contributes to conditions like asthma, atherosclerosis, diabetes, colon, cancer and arthritis.

Watermelon is concentrated in powerful antioxidants; sweet, juicy watermelon is actually packed with some of the most important antioxidant in nature. Watermelon is an excellent source of vitamin C and a very good source of vitamin A, notably through its concentration of beta carotene. Pink watermelon is also a source of the potent carotenoid antioxidants, lycopene. These powerful antioxidants travel through the body neutralizing free radicals, free radicals are substances in the body that can cause a great deal of damage. They are able to oxidize cholesterol, making it stick to blood vessel walls and thicken them which can lead to heart attack or stroke. Fortunately, vitamin C and beta carotene are very good at getting rid of these harmful molecules and can prevent the damage they would otherwise cause (Cook *et al*, (2007).

Watermelon and Green tea team up to prevent prostate cancer, choosing to regularly eat lycopene rich fruits, such as watermelon, and drink green tea may greatly reduce a man's risk of developing prostate cancer (Jian *et al.*, 2003).

Energy production; watermelon is rich in B vitamins necessary for energy production. It is a protection against Macular degeneration. Data reported on a study published in Archive of ophthalmology indicates that eating 3 or more servings of fruit per day may lower your risk of age- related macular degeneration (ARMD), the primary cause of vision loss in older adults, by 36%, compared to persons who consume less than 1.5 servings of fruit Arginine to prevent erectile dysfunction, lower blood pressure, improve insulin sensitivity. Watermelon is high in citrulline, and amino acid our bodies use to

make another amino acid, arginine, used in the urea cycle to remove ammonia from the body. Nitric oxide not only relaxes blood vessels, lowering high blood pressure, it is the compound whose production is enhanced by Viagra to prevent erectile dysfunction. Arginine is beneficial in improving insulin sensitivity obese type two diabetic patients with insulin resistance (Peabody, 2007).

The production levels of watermelon in the United States in 2010 totalled 4.1 billion ponds. The value of watermelon for the fresh market in 2010 was $492 million. In Nigeria, the production of watermelon amounted to 347,000t from 361,000ha in 2010. The production has a wide distribution as a garden crop, while as a commercial vegetable production; its cultivation is confined to the drier savannah region of the Nigeria (Anon, 2006). While in Kaduna State, the production amounted to 110,00t out of the current projected population of 7,037,153 people at 3.2 percent (KADP, 2006).

2.5 Concept of Efficiency

The decreased output of food crop production over the years may not only be connected with deviations of farmers practices from technical recommendations, but also with the use of resources at sub-optimal levels which ultimately leads to technical and allocation inefficiencies (Coelli and Battese, 1996). An underlying premise behind much of the research in efficiency is that farmers are not making efficient use of existing technology, then efforts designed to improve efficiency would be more cost-effective than introducing new technologies as a means of increasing agricultural output (Belbase and Grabowski, 1985; Huynh, 2008 and Adeleke, 2008).

Production efficiency has two components: technical and allocative efficiency. Technical efficiency is the extent to which the maximum possible output is achieved

from a given combination of inputs or the ability of a firm to obtain maximum output from a given set of inputs.

Allocative efficiency is the ability of a firm to use inputs in optimal proportions given their respective prices and production technology (Coelli *et al*., 1998).

Technical inefficiency occurs when the level of production for the firm is less than the frontier output and it increases when timing and methods of application of production inputs are mismanaged. Allocative inefficiency increases when the ratio of marginal products of input is not the same to the ratio of market prices (Bashkh, 2007).

Model of graphical illustration: The concept of technical efficiency model can be illustrated graphically using a simple example of a two input (x_1, x_2) – two output (y_1, y_2) production process (fig 1).

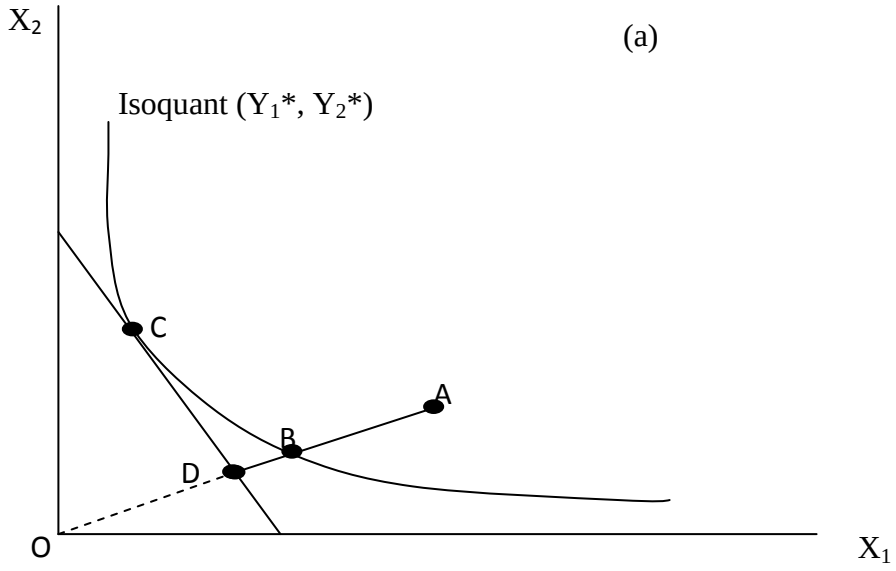
Efficiency can be considered in terms of the optimal combination of inputs to achieve a given level of output (an input- orientation), or the optimal output that could be produced given a set of inputs (an output- orientation).

In fig 1(a), the firm is producing a given level of output (y_1^*, y^*_2) using an input combination defined by point A.

The same level of output could have been produced by radially contracting the use of both inputs back to point B, which lies on the isoquant associated with the minimum level of inputs required to produce (y_1^*, y^*_2) (i.e. (iso (y_1^*, y^*_2)). The input- orientated level of technical efficiency (TE_1 (y, x)) is defined by OB|OA.

However, the least- cost combination of inputs that produces (y_1*, y_2*) is given by point C (i.e. the point where the marginal rate of technical substitution is equal to the input price ratio w2|w1). (Kumbhaker and Lovell, 2000).

The production possibility frontier for a given set of inputs is illustrated in fig 1(b) (i.e. an output- orientation). If the inputs employed by the firm were used efficiently, the output of the firm, producing at point A, can be expanded radially to point B. Hence, the output oriented measure of technical efficiency (TE_o (y, x)); can be given by OA|OB. This is only equivalent to the input- oriented measure of technical efficiency under conditions of constant returns to scale. While point B is technically efficient, in the sense that it lies on the production possibility frontier, higher revenue could be achieved by producing at point C (the point where the marginal rate of transformation is equal to the price ratio p_2/ p_1). In this case, more of y_1 should be produced and less of y_2 in order to maximize revenue. To achieve the same level of revenue as at point C while maintaining the same input and output combination, output of the firm would need to be expanded to point D. (Kumbhaker and Lovell, 2000).



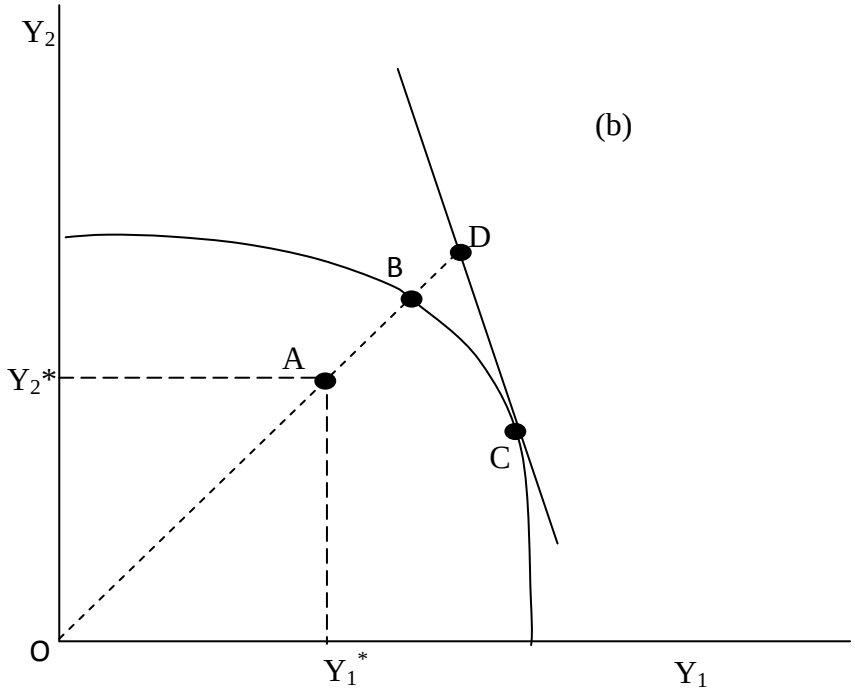


Figure 1: input (a) and output (b) oriented efficiency measures.

2.6 Resource Productivity and Efficiency

According to Weintraub (2007), the classical assumption guiding the discussion on resource efficiency lies in the motive of profit maximization. This serves as an ideal framework against which various forms of efficiencies of production can be adequately measured and tested.

Lingnard and Rayner (1975), referred to productivity growth (Component of efficiency) as increased efficiency of the production function. Olayide and Heady (1982), defined agricultural productivity as the index of the ratio of the valve of total fan output to the value of the total inputs used in farm production. According to them increase in agricultural productivity will contribute to the well being of the economy as a whole.

The National Academy of Science Washington D.C, USA (1975), defined efficiency as the capacity to produce desired results with a minimum expenditure of time, money, energy or materials.

Olukosi and Erhabor (1988), referred to efficiency as the quantity of output (y) per un it of input (X) used in the production process of the several definitions of efficiency however, Farrel's (1957), definition tends to be more admirable. He identified three forms of efficiency, technical, price, and overall efficiencies Technical efficiency is a ratio of total output to total input. This ratio is one for perfectly efficient firm. Price efficiency is defined by the tangency of the price line to the isoquant. This tangency indicates that a minimum possible amount of each input is being used to produce a unit of output at a given level of price. Overall efficiency is a product of technical and price efficiencies it indicates the cost per unit of output for a firm which perfectly attains both technical and price efficiencies. These measures of efficiency assume that a standard efficient production function exists which is a yardstick for measuring individual firms performance. Stressing further, Adeniyi (1988), showed that the productivity of land was higher on small farms that are large ones. Also, an allocation of resources on farms aside from land revealed that while labour was efficiently utilized on small farms, the use of this input was found to be inefficient on large farms. Contrary to this, Sahota (1950) revealed that there was no significant difference in yield due to differences in farm size in most of the crops studied.

2.7 Measurement of Resource Use Efficiency

Technical efficiency is measured by relating the level of output achieved to the level of input used (Lipton, 1979). A firm is said to be technically efficient if it yields the maximum possible output per unit of variable resource (Olayide and Heady, 1982). Technical efficiency can be measured through the average physical product, the

marginal physical product and the elasticity of production. For example, in a single factor product relationship, the function is expressed as: Y= f (X)..... (1)

Where:

Y = output

X = input

Then, the average physical product is given by:

$APPX_1 = Y/X_1$ ---------- (2)

Where: $APPx_1$ is the average product of input x_1 while Y is the output realized from that input.

Marginal physical product is defined as:

$MPPx_1 = dy/dx_1$---------- (3)

This shows that the rate of change in output (y) when input (x) is changed by an infinitesimal amount. This relationship also represents the slope of the response care between the two variables in the production surface. (Upton, 1979).

The elasticity of production shows the percentage change in output (y) resulting from a one percentage in input (x). This is defined as:

$EPX_1 = (dy/dx_1)\ (x_1/y_1) = MPx_1/\ APx_1$---------- (4)

The allocative efficiency is measured by determining the ratio of marginal value product to marginal factor cost (Singh, 1975, Olomola, 1988). If the ratio is not significantly different from unity, resources have been used efficiently if it is less than unity; resources have been under-utilized.

Mathematically, this can be expressed as:

$$MPPX = Px/Py \text{ ---------- (5)}$$

$$\text{Or } MPPX_1/Py = (MVPx) = Px \text{ ---------- (6)}$$

MPP is the marginal physical product of the variable resource, MVP is the marginal value product, and P_x is the price per unit of the resource, py is the price per unit of the product.

2.8 Stochastic Frontier Analysis

The stochastic frontier production function is a method of economic modelling. It has its starting point in the stochastic production frontier models simultaneously introduced by Aigner, Lovell and Schmidt (1977) and Meeusen and Van den Broeck (1977). The stochastic frontier production function is specified as:

$$Y_i = f(x_i, \beta) + e_i \text{ ..... (7)}$$

$$e_i = v_i - u_i \text{ ..... (8)}$$

Where:

Y_i = observed output of the ith sample farm; $f(x_i, \beta)$ is a suitable functional form such as Cobb-Douglas, x_i, vector of the inputs used by the ith farm, β vector of unknown parameters to be estimated, ei error term made up of two components: v_i is a random error with a zero mean which is associated with the random factors outside the farmers control and is assumed to be independently and identically distributed normal $(0,\delta^2 v)$ random variable and independent of u_i. On the-+ other hand, u_i is a non negative truncated half normal random variable associated with farm – specific factors which lead to the i^{th} farm not attaining maximum efficiency of production. U_i is associated with technical inefficiency of the farm and ranges between zero and one. U_i follows an

independent and identical half-normal distribution N ($0\delta^2u$). N represents the number of the farms involved in the cross-sectional survey.

The stochastic cost frontier function is used to estimate the allocative efficiency of the farmers in the study areas. This cost function is specified as follows:

$C_i = f(P_i;\alpha) \exp(V_i + U_i)$……………………………………….. (9)

Where,

C_i = Total input cost of the i^{th} farm

P_i = Input prices employed by the i^{th} farm

α = Parameters to be estimated

V_i = Error terms outside farmer's control

U_i = Error terms within farmer's control

2.9 Problems of Efficiency Measurement

Olayide and Heady (1982), revealed that as elegant as Farrel's definition of technical, price, and overall efficiency in section 2.6 above, they cannot be measured easily since precise measurement rest on the assumption of an efficient isoquant. Efficiency measured as the average productivity of say labour, capital, land water etc can only be a meaningful index of technical efficiency if any one of the resources is limiting in the production process.

Furthermore, Olayemi (1982), revealed that the theory of the concept of technical efficiency based on the assumption that all firms have an identical production function that is, identical technology identical fixed factor endowments and therefore, a short run concept of efficiency seems to have a less significant impact in the area of a productivity measures than the improvement in technical efficiency which derives from an improvement in technology, while in a long run concept. Following the inability to

obtain a universal acceptance yardstick for measuring technical efficiency, this is relevant to resource productivity. Heady (1952), specified eight conditions for the attainment of economic efficiency which were mainly of equality of marginal rate of substitution/factor.

Complimenting this claim, he argued that maximum efficiency could only be attained if the eight conditions are simultaneously satisfied. According to him, however, these conditions are necessary but not sufficient conditions for efficiency. Maximum efficiency is guaranteed if single products are produced under conditions of decreasing returns and if commodities produced in combinations are never produced within ranges of complimentary and supplementary relationships.

2.10 Farm Profitability Analysis

Cost – return analysis is usually from the basis for farm profitability analysis. This involves itemizing the costs and returns of production, and using them to arrive at such estimates as the return to one unit of the resources used, the gross margin, as well as the gross and net returns. In some cases, these values are subjected to tests of statistical significance to verify differences between them.

According to Libero (1977), monetary units should be used as basis for measuring all inputs in costs and returns analysis for cropping system.

Gomez (1975) developed a farm level model to evaluate alternative cropping mixtures and patterns .These models include:

Net Farm Income (N F I). This is expressed as:

NFI = TR – TC..... (10)

Where:

NFI = Net farm income

TR = Total revenue

TC = Total cost of production

TC = TVC + TFC

Gross margin (G M). This is expressed as:

GM = SWGI – TVC -(11)

Where:

GM is the gross margin per hectare in naira

TVC is the total variable cost of production in naira per hectare

According to Olukosi and Erhabor (1988), gross margin is a very useful planning tool in situation where fixed cost is a negligible portion of the farming enterprise as in the case of subsistence agriculture. It is easily com3puted and represents the most relevant economic indicator to draw the attention of the farmer to the problem of his farm and offer solutions to them.

Profitability, measured as the difference between value of yield and cost of production.

Net return, defined as the difference between value of yield and as input cost, including hired labour. In choosing economic indicators on the basis of production factors affected by potential innovation, Werner (1993), suggested the use of:

The gross margin and returns to variable cost, where only capital is affected

Yield/labour ratio, where only labour is affected, and

Gross margin, return to variable costs and monetary return to labour, where capital and labour are affected.

The major problems associated with cost- return analysis as basis for profitability assessment are:

i. It does not indicate the relative importance of each of the resources in production and

ii. It is location bound and specific in applicability due to use of money as the common unit of measurement and the prevailing price for the estimates.

Gomez (1975) said that in spite of the limitations, cost return analysis is a useful tool in enterprise comparison and in indicating a profitable pattern of aggregate input use. This method was used by Olagoke (1991), in Anambra state, Osifo and Antonio (1970), in western Nigeria, and Nweke and Winch (1980), in south- eastern Nigeria.

2.11 Conceptual Framework

The conceptual framework guiding this study is the body of work known as the livelihood or framework (Scoones, 1998; Bebbington, 1999; Carney et al., 1999; Ellis and Freeman, 2005). A livelihood comprised of the capabilities, assets (including both materials and social resources) and activities required to make a living. Livelihood are based on income (in cash, kind, or services) obtained from employment, and from remuneration through assets and entitlements, different members of a house hold engage in different types of livelihoods and each household member above a certain age attends to procure different sources of food, fuel, animal fodder and cash: these sources are likely to vary according to the month of the year. In water sector, livelihoods analysis is essential because it assesses gains and losses of the rural or urban poor from irrigation activities (Lankford, 2005). It improves the knowledge of the context from the local level upwards and help to analyses opportunities and constraint of the rural or urban poor to benefit from the changes within the given context (Nicol, 2000). It helps to identify what options have better potential to reduce poverty within the given context and what enabling conditions, policies and incentives are needed for the poor to increase the range of better livelihood options (Scoones, 1998; Ellis, 2000; Moriarty et *al*, 2004; Lankford, 2005). Some of the distinctive features of the livelihoods framework

are that it takes an ‘all – round’ view of people’s means of gaining a living, including the social and institutional circumstances in which peoples livelihood are embedded at the centre of the approach is the relationship between the assets or resources that people own or can obtain access to, including land, irrigation water, skills and education levels of family members, which are categorized as natural, human, social, financial and political capitals, (Scoones, 1998; Nicol, 200; Ellis and Freeman, 2005). The household utilize these assets in their productive activities in order to create income and satisfy their consumption needs, maintain their asset levels and invest in their future activities. The asses to the assets are strongly influenced by the vulnerably context and policies and institution.

CHAPTER THREE

METHODOLOGY

3.1 The Study Area

The study was carried out in Sabon-Gari and Kudan Local Government Areas of Kaduna State. The state occupies about 46,053 square kilometers, which represents about five Percent of the total land area of Nigeria (Kaduna state government, 2012).

The state is made up of twenty three Local Government Areas. It had a population of 6,113,503 people in 2006 (NPC, 2006) and 480,000 farm families (KADP, 2006). The projected population of the state at 3.18 percent national population growth rate was 7,474,369 people (2013 projection). The state lies between latitudes 09^0 03'and 11^0 32' North of the equator and between longitudes 06^0 05'and 80^0 38' East of the Greenwich meridian.

The vegetation of the state is divided into Northern Guinea Savannah and Southern Guinea Savannah. The soils are sandy loam in nature; the climate varies from the northern to southern parts of the state. The rainfall is very much heavier in the southern part with an average of 1,524mm than in the extreme Northern part with an average of 1,016mm.The mean annual temperature varied between 24^0c. The wet season usually last for about six months (May-Oct) with great variation as we move North wards (Kaduna state government, 2012).

The inhabitants are predominantly Hausa by tribe with farming and trading as their major occupations. Farming was traditional in nature and activities are carried out with a cheap source of labour which is family labour and is dependent on the household size. The main emphasis was on the cultivation of crops. Besides the food grain of sorghum, maize and millet, other principal crops grown were: Cowpea, rice, pepper, onions,

cassava, watermelon, sweet potatoes, tobacco, sugar cane, groundnuts and cotton. The farm economy is characterized by small size and fragmented land holdings. Cultivation is by traditional hand hoe method with very few farmers using animal traction and hired tractor (KADP, 2006).

3.2 Sampling Procedure and Sample Size

Multi-stage sampling technique was adopted for this study. Firstly, out of the 23 Local Government Areas of Kaduna state, Sabon-gari and Kudan Local Government Areas were purposively selected for this study on the basis of being the most prominent producing areas of watermelon in the state (Gambo *et al.*, 2007). Secondly, 6 villages were purposively selected, three from each Local Government Area based on their intensity of production activities and accessibility in terms of extension services and credit. These villages were: Gwanda, Bassawa and Saka-dadi from Sabon-Gari Local Government Area and Hunkuyi, Jaja and Ungwan-Ma'azu from Kudan Local Government Area. Thirdly, simple random sampling technique was employed in selecting farmers from each of the villages for enumeration so as to avoid being biased. 20% of the sample frame (810) was used as the sample size. In all, 162 watermelon farmers were randomly selected through balloting for enumeration.

The sample frame and size used in this study are shown in Table 3.1.

Table 3.1: Population and sample size of water melon farmers

LGA's	Villages	No of farmers*	Sample size (20% of frame)
Sabon Gari	Gwanda	150	30
	Bassawa	130	26
	Saka-dadi	100	20
Kudan	Hunkuyi	160	32
	Jaja	90	18
	Ungwan-Ma'azu	180	36
Total	**6**	**810**	**162**

Number of farmers obtained during the reconnaissance survey conducted in 2012.

3.3 Method of Data Collection

Primary data were used for this study. These data were obtained through the use of structured questionnaire that were administered on the farmers engaged in watermelon production.

Data collected were:

1. Demographic information such as age, sex, farm size, occupation, educational qualification, farming experience, cropping system etc. of watermelon farmers.
2. Production information on watermelon such as labour types and number of mandays, quantity of fertilizer, seeds, chemicals, output, prices of inputs and output, as well as problems of watermelon production in the study area.
3. The output data included the revenue from production while input data would include the cost of labour, fertilizer, seeds, agro chemicals and simple farm tools.

3.4 Analytical Techniques

The analytical tools utilized to achieve the objectives for this study include:

1. Descriptive statistics
2. Net Farm Income
3. Stochastic frontier production function

3.4.1 Descriptive Statistics

Descriptive statistics was used to achieve objectives (i) and (v) of the study. It involved the use of measures of central tendency such as mean, frequency distribution and percentages to describe the socio-economic characteristics of watermelon farmers in the study areas, i.e. objective (i), and the problems confronting the watermelon production, objective (v).

3.4.2 Net Farm Income (N F I)

The net farm income was the difference between gross income (GI) and the total cost (TC) of production (Olukosi and Erhabor, 1988). Net income statement was defined as the surplus resulting from business operations, which could be withdrawn without reducing the future scale of the business. It was sometimes referred to as farm income or operating statement. An income statement was a flow of concept, which applied to a period of time. For example, for the purpose of farm income statement, four types of records were required. These were farm inventory, receipt records, home consumption records and expenses records (Olukosi and Erhabor, 1988).

Gross income: - This was also called total return or total value product (T V P), which was defined as the total output multiplied by the price per unit of produce.

Net farm income (N F I) = Gross Income (GI) – Total Cost (TC) of production.

Therefore, NFI = TVP – TC…….. (12)

Where:

TVP = Total Value Product (₦)

TC = Total Cost of Production (₦)

Total Cost (TC) of production = Total Variable Cost (TVC) + Total Fixed Cost (TFC) such as cost of labour, fertilizer, seeds, tools, chemicals etc. This was used to achieve objective (ii).

3.4.3 Stochastic Frontier Model Specification

The stochastic frontier production function was used to achieve objective (iii). The model in its implicit form is specified as:

$$Y_i = f(x_i, \beta) + e_i \quad \ldots\ldots (13)$$

$$e_i = v_i - u_i \quad \ldots\ldots (14)$$

Where:

Y_i = quantity of output of the i^{th} farm

x_i = vector of the inputs used by the i^{th} farm

β = a vector of the parameters to be estimated

e_i = composed error term

v_i= random error outside farmer's control

u_i= technical inefficiency effects

$f(x_i, \beta)$ = a suitable function of the vector

The empirical stochastic frontier Cobb-Douglas production model was specified as follows:

$$\text{In } Y_i = \beta_o + \beta_1 \text{In} X_1 i + \beta_2 \text{In} X_2 i + \beta_3 \text{In} X_3 i + \beta_4 \text{In} X_4 i + \beta_5 \text{In} X_5 i + Vi - Ui \quad \ldots\ldots (15)$$

Where subscripts i refer to the ith observation of the farm,

In = Logarithm to base e,

Y = Output of watermelon (kg)

β_o = Constant or intercept

β_1-β_5 =Unknown scalar parameters to be estimated

X_1 = Farm size (ha)

X_2 = Labour used (man hour)

X_3 = seeds (kg)

X_4 = Fertilizer (kg)

X_5 = Agrochemical (litre)

V_i = Random errors

U_i = Technical inefficiency effects.

Subscript i indicate the ith farmer in the sample.

The technical inefficiency effects U_i is affected by:

$$U_i = \alpha_o + \alpha_1 Z_1 + \alpha_2 Z_2 + \alpha_3 Z_3 + \alpha_4 Z_4 + \alpha_5 Z_5 + \alpha_6 Z_6 + \alpha_7 Z_7 + W \quad .....(16)$$

Where

Ui = Technical inefficiency effects

Z_1 = Age of the farmer (years)

Z_2 = Household size (Number of person)

Z_3 = Educational level of farmers (Number of years spent in school)

Z_4 = Farming experience (years)

Z_5 = Years of cooperative membership (D = 1 if yes and 0 if no)

Z_6 = Amount of credit received (in naira)

Z_7 = Visits by an extension agent (Number of visits)

α_1-α_7 are the scalar parameters to be estimated

α_o = constant or intercept

3.4.4 Hypothesis Testing

The Z-statistic: This was used to test the hypothesis which stated that watermelon production is not profitable (there is no significant difference between the costs of production and returns in watermelon production). It was expressed as follows:

$$Z = \frac{\mu_1 - \mu_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} \quad \text{----------(17)}$$

Where Z = calculated Z value

μ_1= Mean cost of watermelon production

μ_2 = Mean returns of watermelon production

σ_1= Standard deviation of the cost of watermelon production

σ_2 = Standard deviation of the returns of watermelon production.

n_1= Sample size of the watermelon farmers.

n_2 = Sample size of the watermelon farmers

3.4.5 Measurement of Variables

1. **Farm size (X_1):-** The inclusion of this variable in the model was to determine the extent to which variability in output cultivated to watermelon was affected by farm size. It refers to the total farm size devoted to cultivation of watermelon. It was measured in hectares (ha).

2. **Labour (X_2): -** This was measured in man- hour or man days. This consisted of family and hired labour. It was included to determine how variability in labour used would affect variability in output (y).
3. **Seeds = (X_3):-** This refers to the quantity of seeds used in planting and was measured in kilograms (kg). It is expected to have a positive relationship with the dependent variable.
4. **Quantity of fertilizer (X_4): -** This was measured in Kilogram (kg). It was analyzed to test the extent to which output would be achieved by farmers who had access to chemical fertilizer such as NPK (kg).
5. **Agrochemical = (X_5):-** This includes herbicides and pesticides used in watermelon production and were measured in litres. It is also expected to have a positive relationship with the dependent variable.
6. **Age = (Z_1): -** This was measured in years. It referred to the number of years from birth of the respondent given at the time of data collection.
7. **Household size (Z_2): -** This means total number of people in the house which included the wives, children and dependents who reside within the same family and eat from the same pot.
8. **Level of formal education (Z_3): -** measured by number of years of formal schooling. This referred to the acquisition of knowledge through schooling.
9. **Farming experience (Z_4)**: - This was measured in years. This referred to the years the farmer had actively engaged in water melon production.
10. **Membership of cooperative (Z_5): -** This was used to characterize farmers based on the particular involvement in production and or marketing organization at the time of data collection. It was measured as years of membership or number of years spent.

11. **Access to credit (Z_6): -** This referred to access to credit from both formal and informal sources. It was measured as the amount of credit obtained in naira (₦).
12. **Extension contact (Z_7): -** This referred to the number of extension contacts made in years in the production cycle. It was measured as (number of contact in a year).
13. **Gender: -** This was measured by the sex of the respondents as dummy variable either as a male or female in a family.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Socio- economic Characteristics of Watermelon Farmers

4.1.1 Age of the Respondents

The age of the respondents ranged from 20 to 59 years. The age distribution of the farmers is given in Table 4.1. The farmers' mean age was 34 years and 39% had the mean age of 34.5 years, 32% had the mean age of 24.5 years, 26% and 4% had the mean age of 44.5 and 54.5 years respectively. This implied that majority of the farmers 39% were able bodied men and women who are in their productive and active ages of production whereby they could use improved technology and better ideas to improve their production. Age plays significant role in farming as it determines the strength of the farmers' ability to carry out tedious and rigorous activities associated with farm work. This agreed with the findings of Maurice (2004) among fadama farmers in Adamawa state that most watermelon farmers were of middle age, strong and capable of making good production decisions.

Table 4.1: Age distribution of respondents

Age (years)	**Frequency**	**Percentage**
20 – 29	5	31. 5
30 – 39	63	38.9
40 – 49	42	25.9
50 – 59	6	3.7
Total	162	100.0
Minimum=20	Maximum=50	Mean =34

4.1.2 Sex of the Respondents

The result showed that 98% of the respondents were male while 2% were female. This could be due to the fact that female engage more in household activities than farming activities which also follows the traditional pattern that male is dominant in the farming system in that community and probably because male were stronger, more active and innovative than the female. This assertion support Pratt *et al*., (1987) view, who estimated a standard day equivalent of male adult to be 1.00, while female adult of 15 years and above to be 0.75.

Table 4.2: Sex distribution of respondents

Sex	**Frequency**	**Percentage**
Male	160	98
Female	2	2
Total	162	100

4.1.3 Level of Formal Educational

This refers to the level of formal education attained by the respondents. The result in Table 4.3 showed that about 27% of the respondents had adult education, 46% had no formal education, 12% had primary education, and 9% had secondary education while about 5% had Tertiary education.

Education was a very vital tool in decision making which influences farm productivity as regards perception and adoption of innovation of new farming ideas, skills and technology which may bring about increases in the level of production or reduction of production cost. Adetiba (2005) and Kehinde (2008) also confirm that education was a key to enhanced productivity among households in the humid forest, dry savannah and moist savannah agro-ecological zones of Nigeria.

Table 4.3: Distribution of respondents based on level of education

Education	Frequency	Percentage
No formal education	14	46.3
Adult education	44	27.2
Primary education	19	11.7
Secondary Education	75	8.6
Tertiary education	8	4.9
Total	162	100.0

4.1.4 Household Size

Household size referred to the number of persons in the family of watermelon farmers. The results in Table 4.4 showed that a larger proportion (64%) of the respondents fell within the range of 1- 5 members per household, 25% fell within the range of 6- 10 members per household, 9% fell within the range of 11- 15 members per household while 3% fell within the range of 16- 20 members per household. The mean family size was 5 people or persons.

This result clearly showed that majority of the farmers with (64%) had a household size of 1- 5 people. This was an important variable in subsistence agriculture. The level of mechanization was low in the study areas so the larger the household size, the higher the available work force and subsequently the area of land cultivated which could also determine the yield and the net farm income. This supports Usman (2009) who reported that the average household size was 12 people among sesame farmers in Jigawa state, Nigeria.

Table 4.4: Distribution of respondents based on household size

Household size	**Frequency**	**Percentage**
1 – 5	103	63.6
6 – 10	40	24.7
11 -15	14	8.6
16 – 20	5	3.1
Total	162	100.0
Minimum=1	Maximum=18	Mean=5

4.1.5 Years of Watermelon Farming Experience

The results in Table 4.5 showed that majority (52%) of the respondents had farming experience of 1- 5 years, 41% had between 6- 10 years of experience, and 6% had between 11- 15 years of experience while 1% had over 15 years of experience.

Experience in farming is a key factor affecting production. The longer the years of farming experience, the more exposed the farmer becomes and the more efficient the farmer is expected to be (Nwagu, 2006). It is also believed that the higher the years of farming experience of a farmer, the more the management ability of such a farmer in making farm decisions and the better the farmers were able to cope with shocks and stress.

Table 4.5: Distribution of respondents based on watermelon farming experience

Farming experience(years)	Frequency	Percentage
1 – 5	84	51.9
6 – 10	67	41.4
11 – 15	9	5.5
> 15	2	1.2
Total	162	100.0
Minmum=1	Maximum=25	Mean=6

4.1.6 Membership of Cooperative Society

Majority of the respondents (58%) were not members of the cooperative societies and 42% of the respondents were members of cooperative society. This could be that most of the farmers were not well informed about the benefits of membership which could help in obtaining information on how to improve and boost production or probably due to the fact that cooperative didn't have enough capacity to meet their needs. Membership of cooperative is very important as it enhances access to information on improved technologies, markets and credits for the purchase of inputs and payment of hired labour.

Table 4.6: Distribution of respondents based on membership of cooperative society

Membership of cooperative	Frequency	Percentage
Yes	68	42.0
No	94	58.0
Total	162	100.0

4.1.7 Years of Membership of Cooperative Society

The result in Table 4.7 showed years of membership of cooperative society. It revealed that 52% of the respondents belonged to cooperative society and had spent 1 – 5 years as members. 6% and 1% spent between 6 and 10 years as members. The result also revealed that majority of respondents who spent 6 and 10 years as members, had the opportunity to obtain credit and agricultural inputs as well as information on how to improve farming activities. This can also enhance access to information on improved technologies, market and credits for the purchase of inputs and payment of hired labour, as supported by Awudu and Richard (2001).

Table 4.7: Distribution of respondents based on years of membership of cooperative

Years of membership (years)	**Frequency**	**Percentage**
0	68	42.0
1 – 5	84	51.9
6 – 10	9	5.6
> 10	1	0.5
Total	162	100.0
Minimum=0 year	Maximum=16 years	Mean=2 years

4.1.8. Access to Credit

The result showed that a larger proportion (54%) of the respondents had access to credits while 46% did not enjoy credit facilities. This may be due to the absence of micro financial institutions in the study areas. This implied that 54% of the respondents

had access to credit which enabled the farmers to receive better inputs from the cooperative organizations for better yield than those that did not have access to credit.

Table 4.8: Distribution of respondents based on access to credit

Access to credit (₦)	**Frequency**	**Percentage**
Yes	87	53.7
No	75	46.3
Total	162	100.0

4.1.9. Amount of Credit invested in watermelon production

The amount of credit invested by the respondents in watermelon production is as presented in Table 4.9. The result revealed that 46% did not invest credit while 36% had 1 – 50,000 amount of credit invested, 8% had 51,000 – 100,000 amount of credit invested while 4% and 6% had between 101,000 - 150,000 and above 150,000 amount of credit invested.

Table 4.9: Distribution of respondents based on amount of credit invested

Amount of credit (₦)	**Frequency**	**Percentage**
1 – 50, 000	58	35.8
51, 000 – 100, 000	13	8.0
101, 000 – 150, 000	6	3.7
> 150, 000	10	6.2
Total	162	100.0
Minimum= ₦ 0	Maximum=₦ 250,000	Mean= ₦ 33,956.79

4.1.10. Source of Credit / Inputs Obtained

Source of credit obtained by the respondents as presented in Table 4.10, revealed that 23% had their source of credit through friends and relatives, 19% had their source of credit through cooperative while 7% and 6% had their source of credit through traditional savings and commercial banks.

The result implies that the availability of the sources of credit will make credit available for watermelon farmers in the study areas which will enhance their farm production activities.

Table 4.10: Distribution of respondents based on source of credit obtained

Source of credit	Frequency	Percentage
Commercial bank	9	5.6
Friends and relatives	37	22.8
Cooperative	30	18.5
Traditional savings	11	6.8
Total	162	100.0

4.1.11. Access to Extension Services

The result showed that most (75%) of the farmers had access to extension services while 25% had no access to extension services. This showed that majority (75%) of the farmers had access to the extension services and this will give the farmers good opportunity to get information on better managerial practices, new technology and other auxiliary services so as to boost production of watermelon

Table 4.11: Distribution of respondents based on access to extension

Access to extension	Frequency	Percentage
Yes	121	74.7
No	41	25.3
Total	162	100.0

4.1.12. Number of Extension Visits on Watermelon Production

The result in Table 4.12 revealed that most of the respondents involved in watermelon production (67%) had between 1- 3 number of visits with the extension agents, 25% had no contacts with the extension agents during the production season while 7% and 1% of the respondents had between 4 – 6 number of contacts with the extension agents respectively.

The result implied that most (67%) of the farmers had contacts with the extension agents. The extension contacts help farmers to access information on improved technologies which can also help in boosting watermelon production through appropriate resource allocation.

Table 4.12: Distribution of respondents based on number of extension visits

Extension visits	Frequency	Percentage
1 – 3	108	66.7
4 – 6	11	6.8
> 6	2	1.2
Total	162	100.
Minimum=0	Maximum=10	Mean=2

4.1.13. Farm Size of the Respondents

In Table 4.13, the result showed that most (75%) of the respondents had farm sizes between 0.1-1.0 hectare, 19% had between 1.1- 2.0 hectares, 5% had between 2.1- 3.0 hectares while 1% had over 3.0 hectares.

This simply implied that majority of the farmers in the study areas were small scale holders who depended on the use of manual labour. This was consistent with the findings of Maurice (2004) who reported that the average farm size of 0.30 hectares among watermelon farmers in Adamawa state and it was an indication that farm-families were small scale who cultivated their lands under fragmentation

Table 4.13: Distribution of respondents based on farm size

Farm size (ha)	**Frequency**	**Percentage**
0.1– 1	122	75.3
1.1– 2	31	19.1
2.1 – 3	8	4.9
> 3	1	0.6
Total	162	100.0
Minimum=0.2 ha	Maximum=6.0 ha	Mean =1.0 ha

4.1.14. Land Acquisition

The results in Table 4.14 showed that 78% inherited their land, 12% purchased their land, and 9% rented their land while 1% leased their land. The major means of land acquisition in the study areas is by inheritance which leads to land fragmentation over time. Therefore, the land available for watermelon production will tend to reduce with time due to the land fragmentation.

Table 4.14 Distribution of respondents based on method of land acquisition

Land acquisition	Frequency	Percentage
Inheritance	126	77.8
Purchase	20	12.3
Rent	15	9.3
Lease	1	0.6
Total	162	100.0

4.2. Costs and Returns in Watermelon Production

The result in Table 4.15 showed the costs and returns associated with watermelon production. The total variable cost (TVC) of hired labour, chemical fertilizer, manure, seeds insecticide amounted to ₦26, 126.78 while the total fixed cost (TFC) depreciated for farm implements amounted to ₦27, 095.28. Gross income (GI) from watermelon production was ₦169, 769.46. The net farm income (NFI) was ₦93,574.42 per hectare. Also, the average rate of return per naira invested (NFI/ TC) was ₦3.4 implying that for every one naira invested in watermelon production, there was a profit of ₦3.40 unit. Hired labour was the highest cost component with 62% of the total variable costs (₦26, 126.78). This confirms the claim that labour constitutes a high proportion of production costs in traditional agriculture (Sanni, 2000). The cost of chemical fertilizer with 26.04% implied that the appropriate application of fertilizer in the right proportion brings about increased yield and profit. The amount of seed required (usually 1-2 seeds per hectare) depends upon the seed size, germination and planting spacing, correctly labelled, uniform, disease free, certified seed with 85 to 90 percent germination is preferred. The maximum recommended amount of Nitrogen (N), Phosphorus (P_2O_5) and Potassium (K_2O) is 120 per hectare. The percentage of manure and seed were 6% and 3% respectively.

The least cost component of the variable costs was the cost of agrochemicals with 2% of the total variable costs (₦26, 126.78). This low cost of agrochemicals could be attributed to the fact that farmers are constrained with finance to purchases it. However, the yield depends on the size of watermelon and the climate as well. Large melon has 1-2 melons per plant and each plant requires a 4-foot/6-foot plot to have enough room to grow. The small melon has 3-4 watermelon (Jim *et a*l., 2012).The yield can be realized by increasing the level of resources committed to watermelon production especially by improving the farmer's access to inputs and supportive services.

Table 4.15: Average costs and returns of water melon production in the study areas (₦ per hectare)

Items	**Amount(₦)**	Percentage of cost
A. Variable cost		
Cost of hired labour	15, 345.00	61.48
Cost of chemical fertilizer	8,345.00	26.04
Cost of manure	945.90	6.20
Cost of seeds	840.20	3.03
Cost of insecticide (Herbicide)	650.68	2.30
Total variable costs(TVC)	26,126.78	99.05
B. Fixed cost		
Depreciation on:		
Farm implements (Hoe, cutlass etc)	968,50	0.95
Total fixed costs(TFC)	968,50	100.00
Total cost(TC)= TVC + TFC	27,095.28	
C. Revenue		
Yield (Kg/ha)	3,348.51	
Unit price (₦)	50.70	
Gross income(GI)	169, 769.46	
D. Net farm income		
NFI= GI - TC	93,574.42	
Returns to naira invested(NFI/TC)	3.4	

Hypothesis (i) Testing

The result in Table 4.16 shows the results for testing hypothesis (i) of the study. The calculated Z value was 8.97 and significant at 5% level of while the tabulated value was 1.65. The null (Ho) that water melon production is not profitable in the study areas is

rejected while the alternative (Ha) that watermelon production is profitable in the study areas was accepted.

Table 4.16: Z test result for the test of significance of the profitability (costs and returns) of water melon farmers

	Costs	**Returns**
Mean	13, 572.55	41, 399.26
Known variance	1.47891E+10	1566367345
Observations	162	162
Hypothesized mean difference	0	
Z	8.97	
P(Z<=z) one-tail	3.675568E-17	
z Critical one-tail	1.65	
P(Z<=z) two-tail	6.34556E-11	
z Critical two-tail	1.96	

4.3. Efficiency of Watermelon Production

4.3.1. Technical efficiency of the farms

Table 4.17 contain the estimates of the parameters for the frontier production function and the variance parameters of the model. The mean technical efficiency of the farmers was 84%. This implies that on the average the respondents were able to obtain about 84% of potential output from a given mix of production inputs. Thus, in the short-run, there was a scope for increasing watermelon production by 16%, by adopting the technology and techniques used by the best watermelon farmer. However, watermelon yield was not high as observed by the result of the technical inefficiency in the utilization of production input of agrochemical. However, the yield depends on the type

of watermelon and the climate as well. Large melon has 1- 2 melons per plant and each plant requires a 4-foot/6-foot plot to have enough room to grow. The small melon has 3-4 watermelon Jim *et al*., (2012).The yield can be realized by increasing the level of resources committed to watermelon production especially by improving the farmer's access to inputs and supportive services.

The estimated coefficient for farm size (0.5046) was positive and statistically significant at 1%. The 0.5046 elasticity of farm size with respect to output implied that a unit increase in farm size would *ceteris paribus* lead to an increase of 0.505% in watermelon output. This increase was inelastic because a unit increase in the input would lead to a less than a unit increases in the output. This was consistent with the findings of Adeoti and Olayemi (2003) who found out that increasing farm size was expected to increase crop output of *fadama* farmers in Northern Nigeria and Ukun *et al*., (2010) who reported a significant positive relationship between farm size and output for garden egg production in Akwa Ibom state, Nigeria. The coefficient of labour (0.1361) was positive and statistically significant at 1%.

The estimated 0.1361 elasticity of labour implies that increasing labour by 1 percent will increase watermelon output by 0.136%. The significance of labour is due to the fact that it determines to a large extent the output obtained.

The estimated coefficient for seed (0.1085) was positive and statistically significant at 1%. The estimated 0.1085 elasticity of seed implies that increasing seed by one percent will increase watermelon output by about 0.109%. The 0.1085 elasticity estimate implies that watermelon output is inelastic to changes in the quantity of seeds, *ceteris paribus.* The significance of seed quantity is due to the fact that seed determines to a large extent the output obtained. If correct seed rates and quality seeds are not used,

output will be low even if other inputs are in abundance. This is consistent with the findings of Shehu *et al*., (2010) among Benue Farmers where yam seed rate had a significant positive relationship with yam output.

The production elasticity of output with respect to quantity of fertilizer (0.0612) was positive and statistically significant at 10%. This implies that a 10% increase in fertilizer will increase output by 0.061%. Fertilizer is a major land augmenting input because it improves the quality of land by raising yields per hectare. This study is in agreement with the works of Maurice (2004) who found out that increasing fertilizer increases output among cereal crop farmers in Adamawa state and Oladiebo and Fajuyigbe (2007) that fertilizer significantly increase output in upland rice cultivation in Osun state.

The elasticity estimate of agrochemicals (Herbicides / insecticides) (-0.0107) was negative and not statistically significant. This implies that increase in the use of agrochemical will increase output of watermelon negatively and not significantly.

Table 4.17: Maximum Likelihood Estimates (MLE) of the Stochastic Frontier Production Function of water melon farmers

Variables	Coefficient	T-value
General model		
Intercept	3.2526	29.6454
Farm size	0.5046***	4.1565
Labour	0.1361	1.5972
Seed	0.1085	1.0011
Fertilizer	0.0612*	1.8545
Agrochemical	-0.0107	-0.3203
Inefficiency model		
Intercept	-8.9578	-4.7215
Age	0.1107***	4.9402
Household size	-0.1962***	-5.5356
Education	0.1055	0.9457
Experience	0.1206*	1.6782
Cooperative	-0.4707***	-7.7873
Credit	-0.1580E-04***	-4.1360
Extension	0.4275***	3.3317
Variance parameters		
Gamma	0.8635***	5.0107
Sigma	0.9577***	88.0753
Log likelihood Function	-15.893	
LR test	163.056	

NB: *** P < 0.01, ** P < 0.5, * P < 0.1

4.3.2 Test of hypothesis (ii) of the study

From the results of the estimates of the stochastic frontier production function presented in Table 4.17, the variance parameter of sigma (δ) was 0.9577 and statistically significant at 1%. This indicated a good fit and correctness of the distributional form

assumed for the composite error term. The gamma (γ) which was the proportion of deviation from frontier that was due to inefficiency estimate was estimated to be 0.8635 and was statistically significant at 1%. It shows the amount of variation resulting from the technical inefficiency of watermelon farmers. This meant that about 86% of the variation in farmers output was due to the difference in technical inefficiencies. A significant and high value of gamma (0.9577) indicated the presence of significant inefficiency in watermelon production and this supports the findings of Kaur and Sekhon (2005) that total factor productivity has shown a dismal performance in Pun jab agriculture since 1980's.

4.3.3. Technical inefficiency in watermelon production

The estimates of the coefficient of the technical inefficiency model is as shown in Table 4.17 Generally a negative sign on a parameter means that the variable reduces technical inefficiency, while a positive sign increases technical inefficiency. The result shows that age, level of formal education, years of experience and extension contact have positive signs while household size, membership of cooperative, amount of credit have negative signs.

The coefficient of education (0.1055) was positive and significant. This implies that high level of education attained increases the desire for farming. The positive significant coefficient of education suggests that the increase in education attained by farmers had bearing with their farm production (Tilak, 1993). The coefficient showed a positive relationship with the predicted technical inefficiency effect and was significant at 1% level. This implies that increase in years of schooling increases or improves efficiency and reduces technical inefficiency. This agrees with the findings of Adetiba (2005) and Ajibefun and Abdukadir (2004) and Kehinde (2005). They confirmed that education

was a key to enhanced productivity among farming households in the humid forest dry savannah and moist savannah agro-ecological zones of Nigeria.

The positive-e coefficient (0.1206) on the years of farming experience variable which was statistically significant at 10% indicates that an increase in the number of years in watermelon production increases technical inefficiency. This finding is contrary to a priori expression as it is expected that the higher the farming experience, the lower the technical inefficiency. This could probably be because the farmers held on to their old farming practices thereby not adopting new technologies which could lead to increase in technical inefficiency. This was in agreement with the findings of (Egwu, 2003) that years of farming experience was positive and statistically significant at 10% among rice farmers in Ebonyi state, Nigeria. This also conforms to the findings of Ajewole and Folayan (2008). They reported similar trend in dry season leaf vegetable production among small scale holders in Ekiti State, Nigeria.

The coefficient of household size was (-0.1962) negative but significant. The higher the household size, the lower the technical inefficiency. An increase in household size would decrease technical inefficiency by (-0.1962). The negative sign indicates that the smaller the household size, the lower the technical inefficiency. This was in line with the findings of (Kibaara, 2005) among maize farmers in Kenya.

The coefficient of extension contact (0.4275) was positive and statistically significant at 1%. This implies that a unit increase in extension contact of the farmer increases the technical inefficiency. This is contrary to apriori expectation. This could be attributed to the fact that the information passed across was not well comprehended and as such, the extension contact becomes counterproductive. This is in agreement with the works of

(Kudi, 2005) who found out that extension contact increased productivity among sesame farmers in Jigawa state.

The coefficient of years of cooperative membership was (–0.4707) and statistically significant at 1% meaning it reduced technically inefficiency of the farmers. A unit increase in the years of cooperative membership in watermelon production would decrease the technical inefficiency of the farmers by a magnitude of (-0.4707). Farmers should be encouraged to participate actively as this will help to decrease their inefficiency this was in line with the findings of Ogunyinka and Ajibefun (2003) among farmers in Ondo state who found out that active participation in cooperative societies increases productivity or yield.

Access to credit has a coefficient of (-0.1580) and was statistically significant at 1%. A unit increase in the amount of credit obtained by the farmers for watermelon production would decrease their technical inefficiency by a magnitude of (-0.1580) this was because farmers access to credit enhanced their timely acquisition of production inputs that world enhance productivity through reducing technical inefficiency. This was in line with earlier result by (Nwaru, 2004) among arable crop farmers in Imo State that access to credit enhances productivity and reduces inefficiency.

4.3.4. Elasticity of production and return to scale

The elasticity of production measures the responsiveness of output to a change (increase or decrease) in input. The main aim was to estimate the degree to which the inputs considered in the model affected output. Table 4.18 showed the results of the input elasticity for each input in the Cobb- douglas stochastic frontier production function.

The coefficient of the inputs with respect to output revealed that farm size, labour, seed and fertilizer explained output at 1% level of significance while Agrochemical is not

significant. The return to scale of 0.7997 was obtained from the summation of the coefficients of the estimated input elasticity which indicated that watermelon production in the study areas was in the stage II of the production surface. Stage II is the stage of decreasing positive returns to scale where resources and production were believed to be efficient. Hence, it is advisable that the production units should maintain the level of input utilization at this stage as this would ensure maximum output from a given level of inputs, all things being equal.

Table 4.18: Elasticity of production and Return to scale of water melon production

Variables	Elasticity of production
Farm size	0.5046
Labour	0.1361
Seed	0.1085
Fertilizer	0.0612
Agrochemical	-0.0107
Return to scale	0.7997

4.3.5. Frequency distribution of the technical efficiency of water melon farmers

Table 4.19 presented the technical efficiency distribution of the watermelon farmers in the study areas. The mean technical efficiency of the sampled farmers in the study areas was 84% with 95% for the most efficient farmer and 21% for the least efficient farmer. The mean technical efficiency is similar to that reported by Maurice (2004) of 80% among cereal crop fadama farmers in Adamawa state in Nigeria. This means that on the average output falls by 5% from the maximum possible level due to inefficiency. About 96% of the farmers were predicted to have technical efficiency exceeding 70%. The result also indicates that for the average farmer in the sample to achieve technical efficiency of his most efficient counterpart, he could realize about 13% [(1- 84 / 95) ×

100)] cost savings while the least technically efficient farmer would have 79% [(1 –21 / 95 × 100)] cost savings to become the most efficient farmer.

Table 4.19 Frequency distribution of the technical efficiency of water melon farmers

Efficiency range	**Frequency**	**Percentage**
0.20 – 0.29	1	0.6
0.30 – 0.39	1	0.6
0.40 – 0.49	1	0.6
0.50 – 0.59	-	-
0.60 – 0.69	2	1.2
0.70 – 0.79	22	13.6
0.80 – 0.89	94	58.0
0.90 – 0.99	41	25.3
Total	162	100.0
Minimum efficiency (%)	121	
Maximum efficiency (%)	95	
Mean efficiency (%)	84	

4.4. Constraints Associated with Watermelon in the Study Areas

The constraints identified by the respondents as given in Table 4.20 according to the level of severity. The study showed that inadequate storage facilities with 67% was the first most important constraint limiting watermelon production in the study areas. This was one of the major constraints that the farmers faced in the study areas. Farmers did not have enough and proper storage facilities to store their farm products this could lead to decay of farm products thereby reducing farmer's output.

4.20. Constraints Associated with Watermelon Production

Constraints	Frequency	Percentage	Rank
Inadequate storage facilities	108	66.7	1st
High cost of labour	92	56.8	2nd
Pest and diseases	80	49.4	3rd
Inadequate credit	78	48.1	4th
Inadequate extension	54	33.3	5th
Lack of improved seeds	46	28.4	6th
Poor market price	32	19.8	7th
Flooding	25	15.4	8th

NB: *Multiple responses allowed

The result also showed that high cost of labour was the second major constraint with 57% in the study areas. Farmers did not pull their resources together to acquire labour saving devices such as mechanized farm inputs so as to reduce the cost of labour for watermelon production and subsequently increase the profitability.

Pests and diseases was another constraints faced by farmers with 49%. This could be due to lack of frequent spraying with agrochemicals after (herbicides/insecticides) every rainfall. This affected production and the quality of product produced.

Inadequate credit was another constraint with 48%. The result revealed that the amount of credit was significant in reducing the technical inefficiency of the farmers. Farmers were not informed by the extension agents to participate actively in commodity associations so as to benefit from credit facilities and other benefits from the associations. Farmers were not thought by the extension agents to participate in farmer's associations especially in relation to watermelon production which could enable them have access to market outlet, information and interventions by

nongovernmental organizations or probably they were taught but were not convinced. Inadequate extension services were another major problem confronting watermelon farmers in the study areas with 33%. This could be that farmers did not have access to extension agents or services where they get necessary information technically to boost production, they produce little or no yield. This affected their level of production seriously.

Lack of improved seeds with 28% was one of the constraints faced by watermelon farmers in the study areas. This could be due to lack of accessibility of the farmers to improve

Poor market price was another constraint with 19.8%. This could be due to lack of capital or poor quality of product produced especially where there was excess supply in the market. This could be a serious problem as farmers could not have appropriate market value for their products so as to bring other necessary things for their families

Flooding was another major problem with 15.4%. This could wash away farm produce thereby, leaving the farmer with little or no yield at all. There should be good tillage facilities and border line so as to prevent flooding.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The broad objective of this study was to determine the production efficiency and profitability of watermelon in the study areas. The specific objectives were to describe the socio-economic characteristics of watermelon farmers, determine the profitability of watermelon production, to estimate the cost, returns and profitability from water melon production in the study areas; to determine the resource use efficiency for water melon production in the study areas and to identify the problems associated with water melon production in the study areas.

To achieve these objectives, primary data were collected with the aid of structured questionnaire administered to the respondents. Out of the 23 Local Government Areas (LGAs) of Kaduna state, two watermelons producing LGAs of Sabon-gari and Kudan were purposively chosen and six major watermelon producing villages were purposively chosen (three from each LGA). A simple random sampling technique was employed to select 20% of watermelon farmers from watermelon farmers' population from each selected village. 162 farmers formed the sample size for the study and each respondent interviewed. Descriptive statistics, net farm income and stochastic frontier production function were employed to analyze the data.

The results indicated that 38.9% of the respondents were within the ages of 30 – 39 years with mean age of 34 years implying that the farmers were in their most productive ages. 64% of the respondents had 1 - 5 persons in their household. The average household size was 5 persons. The study revealed that 52% of the farmers have been producing watermelon for 1 – 5 years ; 46% of the respondents had secondary education

while 75% of the respondents had farm size of 0.1 – 1 hectares and land acquisition was mainly through inheritance. 75% of the respondents had access to extension services and 54% had access to credit facilities. Gender of the respondents was 98% male and only about 42% of the respondent belonged to cooperative societies.

The result of farm budgeting analysis showed that total revenue of watermelon was ₦169, 769.46 per hectare while total cost of production was ₦27, 095.28 per hectare. This yielded a net farm income of ₦93, 574.42 per hectare. A mean technical efficiency of 84% was achieved by watermelon farmers in the study areas meaning that there was a scope for increasing watermelon production efficiency by 16% in the study areas. Household size, years of cooperative membership and amount of credit obtained were significant variables for improving technical efficiency while age, marital status, educational level, farming experience, and extension contact were observed to increase technical inefficiency. The return to scale was 0.7997 suggesting that the production function was characterized by decreasing positive returns to scale, hence watermelon producers operated in stage II of the production surface. This implied that production units should maintain the level of input utilization at this stage so as to ensure maximum output from a given level of inputs all things being equal.

The constraints faced by the respondents in the study areas include inadequate storage facilities, high cost of labour, pest and diseases, inadequate credit, inadequate extension, lack of improved, poor market price and flooding.

5.2 Conclusion

The study concludes that watermelon production is profitable as the net farm income was ₦93, 574.42 per hectare. The mean technical efficiency obtained was 84% implying that there is a scope for increasing watermelon production by 16%. The water melon output per hectare was not too high due to the observed inefficiency in the

utilization of production inputs. However, higher output of watermelon can be realized by increasing the level of resources committed to watermelon production especially by improving the farmer's access to inputs and supportive services. The future thus, holds promise for increasing watermelon production.

5.3 Recommendations

Based on the findings of this study, the following recommendations are hereby proffered:

i. Farm inputs such as improved seeds and agrochemicals should be made available in time and at affordable prices to the farmers by the government.

ii. Extension contact was a significant variable for improving technical efficiency; therefore, policies should be designed by the government to educate farmers through proper agricultural extension and support services.

iii. Farmers should be assisted to obtain credit facilities by reducing the bottlenecks associated with bank loans and more informal financial institutions should be established in rural areas by the government.

iv. The research on watermelon should be encouraged especially in the areas of pest and disease control. This would solve the problem of infestation during growing period.

v. There was need to find a way of improving labour availability through the provision of tractor hiring services to ensure adequate labour supply. Labour should be utilized more effectively on the farm, as this would improve the profitability of the enterprise.

vi. The accessibility of the farmers to improved seeds for watermelon production should be enhanced by linking the farmers to input market through the extension agents by the government.

5.4 Contribution to knowledge

i. The study revealed that watermelon production is profitable in the study areas with a farm income of ₦93, 574.42 per hectare.

ii. The study revealed that the mean efficiency of the farmer was 84% which implies that there is a scope of increasing watermelon efficiency by 16%.

iii. The study revealed that watermelon production in the study areas is at stage II of production as indicated by the decreasing return to scale of 0.7997.

iv. The study revealed that the most important constraint encountered in watermelon production in the study areas is the lack of improved seeds.

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APPENDIX

SECTION A: SOCIO-ECONOMIC CHARACTERISTICS OF WATERMELON FARMERS

1. Name of Respondent: ……...…….
2. Age: 20-29 ( ), 30-39 ( ), 40-49 ( ), 50-59
3. Sex: Male ( ) Female ( )
4. Village……..…….....
5. Local govt. Area……..
6. Marital status: Married ( ) Single ( )

   Others……..…….....
7. Household size:

   a. Number of male adults: …… b. Number of male children: ……..…… c. Number of female adults: …… d. Number of female children ……..……

   e. Total no in the household……..

8. How many members of the household go to work on the farm(s)…….....……
9. Educational status (No of years spent in school)

   a. Adult education ( ) b. Qur'anic education ( ) c. Primary school ( )

   d. Secondary school ( ) e. Tertiary school ( ) f. Total years spent ( )
10. Is watermelon farming your major occupation? Yes ( ) No ( )
11. If not farming, what other agricultural produce / inputs do you engage in?

    a. Trading ( ) b. Tailoring ( ) c. Civil servant ( ) d. Livestock farming ( )

e. others (specify)……

12. Number of years spent as a watermelon farmer ……..

13. Do you belong to a cooperative society? Yes ( ) No ( )

14. If yes to question 13 above, how many years of membership……..…

15. Do you have access to credit? Yes ( )No ( )

16. If yes to question 15 above, what is the source?

    a. Commercial banks ( ) b. Friends and relatives ( ) c. Cooperative ( )

    d. Traditional savings (adashe) ( ) e. Others (specify) ……..…..

17. How much credit did you use for watermelon production last season? ……..…

18. Have you been visited by an extension agent(s) last cropping season? Yes ( ) No ( )

19. If yes to question 18 above, how often did extension agent(s) visit your farm in your last cropping season? …….…….

SECTION B: FARMING ACTIVITIES

20. How did you acquire your farm land(s)?

    i Inheritance ( ) ii. Purchase ( ) iii. Rent ( ) iv. Gift ( ) v. Lease ( )

21. What is the total farm size owned?

    i . Farm no 1 …… (ha) ii. Farm no 2 ……. (ha)

22. If the land was rented, how much did you pay per season/ha……..…….

23. If the land was purchased, what was the amount paid/ha…….…….

24. What was the mode of land preparation on the watermelon field?

    i. Animal traction ( ) ii. Tractor hiring ( ) iii. Manual implements ( )

    iv. Others …….

25. If you employ any in question 24 above, how much do you pay per hectare ……..?

26. State the labour contribution of your family members and hired labour during the last cropping season……

……

a. Family labour:

Farm operations	No of workers by type of labour			Actual hours spent			No of days work		
	MA	FA	C	Q	FA	C	MA	FA	C
Land clearing									
Ridging/ploughing									
Planting									
Fertilizer application									
Weeding 1st weeding 2nd wedding									
Spraying									
Harvesting									
Transportation									
Others (specify)									

MA = Male adult (18 - 65yrs), FA = Female adult (18 - 65yrs), C = Children (7 - 15 yrs).

b. Hired Labour:

Farm operations	No of workers by type of labour			Actual hours spent			No of days work		
	MA	FA	C	MA	FA	C	MA	FA	C
Land clearing									
Ridging/ploughing									
Planting									
Fertilizer application									
Weeding 1st weeding 2nd wedding									
Spraying									
Harvesting									
Transportation									
Others (specify)									

MA = Male adult (18 - 65yrs), FA = Female adult (18 - 65yrs), C = Children (7 - 15 yrs).

27. Farm Input Record

Inputs	R7	Unit Price (₦)	Total (₦)
i. Seeds (kg)			
ii. Fertilizers (bags)			
iii. Agrochemicals (litres)			
iv. Farm implements			
v. Manure (kg)			
vi. Others (specify)			

28. Rop Output Data

No of heaps harvested	Price per heap	Total (₦)

29. What quantity of watermelon was consumed at home? .....

30. What quantity was given out as gifts? .....

SECTION C: MARKETING INFORMATION

31. Where do you sell your watermelon? i. On the farm ( )

ii. Village market ( ) iii. Urban market ( ) iv. Others (specify)……..

32. When do you sell your watermelon? i. Immediately after harvest ( )

ii. 1 week after harvest ( ) iii. Others (specify)……

33. Why do you sell your output? i. For school fees ( ) ii. Cloths ( )

iii. Transportation ( ) iv. Others specify ( )

34. Did you encounter any problems in watermelon production last cropping season?

Yes ( ) No ( )

35. If yes, what was the nature of the problems in order of importance? .....

……

……

36. What can you suggest for improvement with regards to the problems mentioned above? .....

……

……

37. What type of problems do you encounter in selling your watermelon?

……

……

38. What different cost items do you incur in selling your watermelon in the various farms?

……

……

……