CHANGES OF RETURN ON INVESTMENT OF POTATO PRODUCTION THROUGH CONTRACT FARMING

MD. ABDUR RAFIQ SARKAR

A DISSERTATION
FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY
IN
AGRICULTURAL EXTENSION AND INFORMATION SYSTEM

DEPARTMENT OF AGRICULTURAL EXTENSION AND INFORMATION SYSTEM
SHER-E-BANGLA AGRICULTURAL UNIVERSITY
SHER-E-BANGLA NAGAR, DHAKA-1207, BANGLADESH

JUNE 2019

CHANGES OF RETURN ON INVESTMENT OF POTATO PRODUCTION THROUGH CONTRACT FARMING

BY

MD. ABDUR RAFIQ SARKAR
REGISTRATION NO: 15-06895

A Dissertation
submitted to the Faculty of Agriculture
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SEMESTER: JANUARY - JUNE 2019

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CERTIFICATE

This is to certify that the Dissertation entitled "**CHANGES OF RETURN ON INVESTMENT OF POTATO PRODUCTION THROUGH CONTRACT FARMING**" submitted to the Department of Agricultural Extension and Information System, Faculty of Agriculture, Sher-e-Bangla Agricultural University (SAU), Dhaka in partial fulfillment of the requirements for the degree of **DOCTOR OF PHILOSOPHY IN AGRICULTURAL EXTENSION AND INFORMATION SYSTEM,** embodies the result of a piece of bonafide research work carried out by **MD. ABDUR RAFIQ SARKAR, Registration no. 15-06895** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged by the author.

Dated: June 30, 2020
Dhaka, Bangladesh

Prof. Dr. Md. Rafiquel Islam
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DEDICATED

To my divine parents, my wife Lina and to my lovable son Areeb

BIOGRAPHICAL SKETCH

The author born on 01 November 1968 at Village- Mahadipur, Upazilla- Palashbari, District- Gaibandha, Bangladesh. He came from a reputed and enlightened Muslim family. He passed the SSC examination from Palashbari SM Pilot High School in 1984 and the HSC examination from Palashbari College in 1986, Gaibandha. He obtained B. Sc. Ag. (Hons) degree in 1990 and MS in Agronomy degree in 1995 from Bangladesh Agricultural University, Mymensingh. He has completed MBA in Finance from American International University Bangladesh (AIUB) in 2001. Mr. Rafiq Sarkar is a GLOBALG.A.P. Licensed Farm Assurer in Bangladesh since 2017. He has received a number of training relevant to agricultural farming, agricultural extension services, agribusiness, and rural development. He has supported many interns in agriculture, agribusiness, BBA, MBA, and Nutrition students.

He is a Life Member of Krishibid Institution of Bangladesh (KIB), Bangladesh Agricultural Extension Network (BAEN), Bangladesh Fertilizer Association, and Bangladesh Society of Agronomy. He has established Palashbari Krishi Projukti Institute in Gaibandha, an Agricultural Technical Educational Institute, and a founder member of Dr. Wazed Miah Memorial Foundation. He is Managing Director of Matrix Business Development Ltd, Matrix Bazar, and Proprietor of Palashbari Krishi Sheba, Krishi Clinic, and General Agribusiness Bangladesh.

He has started his career with multinational conglomerate British American Tobacco Bangladesh Ltd. continued till 2001, then joined USAID supported project Agro-based Industries and Technology Development Project (ATDP-II) worked till 2005. From 2006 Mr. Sarkar worked with another USAID supported Improved Capacity for Energy Access (ICEA) till to 2009, then joined GIZ as Senior Advisor (Public-Private Partnership-PPP) till 2011. Intermittently he worked as International Consultant in Singapore, Malaysia, Afghanistan, Bhutan, Sri Lanka, India, and United Arab Emirates concerning agribusiness and agricultural advisor. Mr. Sarkar also worked with the Ministry of Agriculture in Bhutan as an International Agribusiness Expert. Since 2012 Mr. Sarkar is running his business Matrix Business Development as Managing Director and accomplished more than 120 assignments, researches, and policy strategies (nationally and internationally). Apart from this, currently, he is operating a contract farming system in agriculture with 2000 contract farmers in Bangladesh. He worked as a successful International Fruits and Vegetable Marketing Expert with the Ministry of Agriculture, Irrigation, and Livestock in Afghanistan.

He has visited different countries like USA, Germany, Netherland, Belgium, India, Malaysia, Singapore, Thailand, UAE, Sri Lanka, Afghanistan, Myanmar, Bhutan, and India.

The Researcher

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The Researcher

ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
AGEP	Agricultural Growth and Employment Programme
AI	Appropriateness Index
BARI	Bangladesh Agricultural Research Institute
BAU	Bangladesh Agricultural University
BBS	Bangladesh Bureau of Statistics
BEPA	Bangladesh Potato Exporters Association
BRRI	Bangladesh Rice Research Institute
CF	Contract Farming
CRSP	Collaborative Research Support Program (USA)
DAE	Department of Agricultural extension
DiD	Difference in Difference (Double Difference)
e.g.	exempli gratia (for example)
et.al.	et all (and other people)
etc.	et cetera (and the rest)
EPB	Export Promotion Bureau
FAO	Food and Agriculture Organization of the United Nations Organization
FGD	Focus Group Discussion
FY	Fiscal Year
FYP	Five Year Plan
GAP	Good Agricultural Practice
GDP	Gross Domestic Product
GED	General Economics Division
GLM	General Linear Model
GO	Government Organization
GoB	Government of Bangladesh
HACCP	Hazard Analysis and Critical Control Points
HSC	Higher Secondary Certificate
i.e.	id est (that is)
IFAD	The International Fund for Agricultural Development
IGA	Income Generating Activities
IPM	Integrated Pest Management
KII	Key Informant Interview
KMO	Kaiser – Meyer – Olkin (Statistical test)
MOA	Ministry of Agriculture
MOC	Ministry of Commerce
MRL	Maximum Residual Limit
MT	Metric Ton
NARS	National Agricultural Research System
NGO	Non-Government Organization
PRA	Participatory Rural Appraisal
PSM	Propensity Score Matching
ROI	Return on Investment
SDGs	Sustainable Development Goals
SPSS	Statistical Package of Social Sciences
UAO	Upazila Agriculture Officer
UNDP	United Nations Development Programme

SAAO	Sub Assistant Agriculture Officer
SSC	Secondary School Certificate
STATA	Statistical Software for Statistics and Data Science
USAID	U.S Agency for International Development
USA	United States of America
VIF	Variance Inflation Factor
viz.	videlicet (namely)
$Y_{1,2,3,4,5}$	Year 1,2,3,4,5

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CHANGES OF RETURN ON INVESTMENT OF POTATO PRODUCTION THROUGH CONTRACT FARMING

Md. Abdur Rafiq Sarkar

ABSTRACT

The research aims to determine the changes of Return on Investment (ROI) of potato production through contract farming and to explore the contribution of selected farmer characteristics in potato contract farming (CF). The research was carried out in Mithapukur Upazila under the Rangpur district and Birampur Upazila under Dinajpur district. From September to December 2019, a structured interview schedule was used to collect data from two hundred and sixty-two (262) potato contract farmers from a population size of eight hundred and twenty (820). A proportionate random sampling technique was used to select sample farmers from 3 potato CF companies. Data were also collected from 56 non-contractual potato farmers from Pirganj Upazila under Rangpur district, where no contractual potato farming had been established. Thirteen selected characteristics of the potato contract farmers, namely, age, education, farming land size, potato contract farming land size, potato CF experience, support services, training exposure, knowledge on CF, extension media contact, satisfaction on CF, innovativeness, commercialization, and business growth due to potato CF were considered as the independent variables. Changes of Return on Investment (ROI) of potato production through contract farming was the dependent variable of the research. The extent of changes of ROI of potato production through CF farming ranged from 5.30 to 96.21, indicating that the majority (79.01%) of the farmers attained a medium level of ROI, 10.31% attained a high level, and 10.69% attained low changes of ROI. It was discovered that 80% of the contract farmers had medium to large farming land for potato contract farming, 99% of farmers received support services from the contractor, 86.26% had medium to higher training exposure, 84% had good knowledge of potato contract farming, 87% had strong extension media contact. Commercialization of the potato farmers were medium to high found 89%, and 83.97% of respondent contract farmers showed medium to high-level growth of business due to potato contract farming. According to the stepwise regression, seven characteristics of potato contract farmers contributed 93.80% of the changes of return on investment of potato production through contract farming. Among them, business growth showed highest (84.9%) contribution, followed by extension media contact (5.6%), knowledge on contract farming (1.6%), effective land contract farming land size (0.8%), commercialization of potato farming (0.5%) and training exposure (0.3%) contributed to the changes of return on investment of potato production through contract farming. Results of path analysis revealed that knowledge on potato contract farming of the potato contract farmers had the highest total indirect effect (0.64), followed by Training exposure (0.58), extension media contact (0.52), support services (0.51), effective CF land size (0.30), business growth due to contract farming (0.29) and commercialization (0.18) on changes of return on investment of potato production through contract farming. Finally, contract farming is an appropriate farming model that has a positive increment of ROI on potato production. Bangladeshi planners and policymakers could use the evidence of the benefits of potato contract farming in other areas of farming.

Key words: Contract Farming (CF), Return on Investment (ROI).

Chapter 1
Introduction

CHAPTER 1
INTRODUCTION

1. INTRODUCTION

Agriculture plays a vital role in achieving Bangladesh's overall growth. Approximately 40.62% of the labor force is directly or indirectly dependent on agriculture. This sector is also important in ensuring food security for the country's growing population. It provides a primary source of income for the majority of the population and accounts for approximately 13.07% of total GDP in 2019 (BBS, 2019). Crops and the horticulture sub-sector contributed 8.32% of the national GDP (BBS, 2019). Bangladesh agriculture is transitioning from subsistence to commercial agriculture, with increased input use and cultivation of high-value crops, such as industrial and processing varieties, for value addition and market diversification. The Seventh Five-Year Plan promotes agribusiness, use of agricultural technology with supportive policies, regulations, and incentives in place to increase productivity and profitability; increasing production diversification in line with consumption diversification to encourage private sector participation and improving agro-processing value chains. Bangladesh's food processing industry is expanding quickly, and the government is encouraging contract farming to ensure high-quality raw materials.

1.1 Potato Production in Bangladesh

It was assumed that Portuguese navigators brought the potato to India for the first time in the early 17th century. In the 1770s, a British governor promoted potato cultivation in Bengal, and within a century, it had become a garden vegetable (Potatopro, 2020). The first potato cultivation was documented in The Gardening Monthly magazine, which was published in London in 1847. The potato was first cultivated in the surrounding areas of Calcutta, and from there it spread to Cherrapunjee and other areas. Governor Warren Hastings promoted potato cultivation in India's provinces (1772-1785) (Banglapedia, 2020). Bangladesh is the world's eighth-largest potato producer and Asia's third-largest. Potato is the third most important crop in Bangladesh. The Department of Agricultural Extension (DAE) reported that potatoes produced a record of 1.09 million tons in 2019. Contract farming has been made mandatory for exporters of potatoes by DAE. The varieties that are available are not suitable for processing. In 2019, only 2% of potatoes were processed for chips and crackers (DAE, 2019). Processors from industrial varieties of potatoes make chips and french fries with high dry matters. For decades, Bangladesh Agricultural Development Corporation (BADC) seed companies have

been producing potato seeds through contract farming in Bangladesh. Aside from that, contract farming is used to produce processed varieties of potatoes in Bangladesh. Agri-concern, Matrix, Seba, and Syngenta Foundation also produce processed varieties of potatoes through contract farming in this context, and these companies provide training, support, and field extension services to the contract farmers.

Table 1.1 Potato Production and Area Coverage in Bangladesh

Years	Area in Hectare	Production in Lakh MT	Export in MT
2012-2013	4.44	86.03	28,416
2013-2014	4.62	89.50	102,983
2014-2015	4.71	92.83	90,491
2015-2016	4.75	94.47	40,239
2016-2017	4.99	102.16	55,652
2017-2018	4.77	97.44	53,486
2018-2019	4.69	109.00	27,811 (till April)

Source: Department of Agricultural Extension (DAE), 2019

1.2 Concept of Contract Farming

A contract farming agreement is an agreement between farmers and a buyer that imposes conditions on the production and marketing of a specific commodity. Contract farming refers to institutional arrangements that coordinate production and distribution between farmers and agro-industrial firms. In most cases, the farmer agrees to supply agreed-upon quantities of a specific agricultural product, which the contractor purchases. Contract farming is an agreement between farmers and processing or marketing firms for the production and supply of agricultural products under forward contracts with a pre-determined fixed price (Sethboonsarng, 2008). According to Rehber (2007), contract farming is a verbal or written contractual agreement between farmers and other businesses that specifies one or more conditions of production and marketing of an agricultural product.

Contract farming, as defined by FAO (2015), is "Agricultural production carried out based on an agreement between buyers and farmers, which establishes conditions for the production and marketing of a farm product or products.

In most cases, the farmer agrees to provide agreed quantities of a specific agricultural product. These should meet the quality standards of the purchaser and be supplied at the time determined by the purchaser. The buyer in return commits to purchase the product and sometimes, to

support production through the supply of farm inputs, land preparation, and the provision of technical advice".

The key factors in any contract farming agreement are: (i) the farmer agrees to provide a specific agricultural product, (ii) the purchaser agrees in advance to buy the specified product, (iii) quality standards are agreed on, and (iv) the purchaser may provide support to the production process.

- It is an agreement. The agreement is made between two parties, the farmer and agri-business firm;
- The farmer handles the production of a particular agricultural product according to buyers' requirements and sells it to them; Agribusiness farm is responsible to supply guidelines, inputs, extension support services to the farmer and buy the product;
- Price is pre-fixed or determined on harvesting time;
- There is a specified time of contract farming of agreement.

1.3 Research Problem

There were few estimates of the prevalence of contract farming to increase income growth and, ultimately, return on investment. First, rapid income growth, especially in Asia, has shifted consumption away from staple grains and toward high-value commodities and processed foods (Minot and Roy, 2006). Second, income growth, urbanization, and foreign investment are driving retail food outlet consolidation, resulting in the supermarket revolution (Reardon et al., 2003). Third, lower trade barriers and improved communication technology are expanding trade linkages, connecting small farmers with high-income consumers in industrialized countries. The growth in high-value agriculture, supermarkets, processing, and export-oriented agriculture suggests the importance of contract farming. However, since a rapidly growing number of firms in modern market channels are increasingly relying on contract procurement, a relevant question for the researcher was whether contract farming made any changes in their return on investment (ROI) of potato production through contract farming. Furthermore, research on contract farming in Bangladesh is limited, with no studies on the ROI implications, contribution, or relationship with farmer characteristics and income found. This study attempted to comprehend the changes in ROI of potato production as a result of contract farming (CF).

More specifically, this research addressed the following research questions due to contract farming:

1. What was the extent of changes in Return on Investment (ROI) of potato production through contract farming?
2. What were the characteristics of the potato contract farmers?
3. What were the contributions of the selected characteristics of the farmers to their changes in ROI of potato production through contract farming?
4. What was the differences of ROI of the potato production between contractual and non-contractual farming?
5. What were the problems faced by the farmers in potato contract farming and their perceived solutions?

1.4 Justification of the Study

The above questions on changes in Return on Investment (ROI) of potato production through contract farming, and to explore the contribution of selected characteristics of the contractual potato farmers in contract farming (CF), was addressed based on the survey of the relevant stakeholders in the potato sector. This study aided in understanding the predictors of potato contract farming and their contribution to the changes in ROI of potato production as a result of potato contract farming. The findings of the study are expected to help the academicians, professionals, government policymakers, researchers, trainers, development practitioners, and potato related stakeholders.

1.5 Objectives of the Study

The overall objective of the study was to assess the extent of changes in Return on Investment (ROI) of potato production through contract farming in Bangladesh. The following specific objectives were formulated for this research:

1. To ascertain the extent of changes in return on investment of potato production through contract farming
2. To compare the ROI between contractual and non-contractual potato farming
3. To assess and describe some of the selected characteristics of the potato contract farmers
4. To explore the contribution of the selected characteristics of the farmers to their changes in Return on Investment (ROI) of potato production through contract farming
5. To identify the problems faced by the farmers in potato contract farming along with solutions as perceived by them

1.6 Assumptions of the Study

The following assumptions were made during the study:

- The selected respondents for the study were competent to answer the queries included in the interview schedule
- Data were free of bias and conformed to the objectives of the study
- The items, questions and scales used for measuring the variables were adequate to reflect the respondents' real views and opinions
- The data for the study were valid and reliable

1.7 Limitations of the study

The following limitations were faced during the study to complete the research:

- The study was conducted only in two upazilas of Bangladesh
- Small sample size was considered for the study
- There were no longitudinal or panel survey for the time series assessment
- Data were thoroughly analyzed using modern computer based statistical application packages
- Few information was collected on recall method
- Factors of the farmers were numerous, but only 13 characteristics of the farmers were considered for the study

1.8 Definition of Terms

Age: Age of respondent was stated their span of his/her life and was operationally measured by the number of years from his birth to the time of interview. It is measured as respondent's age in number of years at the time of data collection. Age is a quantitative variable.

Agricultural commercialization: The term agricultural commercialization means production of agricultural crops for sale in the market out of total production.

Agricultural experience: Agricultural experiences of a respondent farmer referred to the length of the time (year) s/he involved in agricultural activities up to the time of interview.

Contract farming experience: Contract farming experiences of a respondent farmer referred to the length of the time (year) s/he involved in any contractual farming activities up to the time of interview.

Contractor: Contractor is used to refer to a company that works with farmers in order to carry out contract farming.

Business Growth: The process of improving some measure of an enterprise's success. Business growth can be achieved either by boosting the top line of revenue of the business with greater product sales or service income, or by increasing the bottom line or profitability of the operation by minimizing costs and introducing new technologies. Business Growth is a stage where the business reaches the point for expansion and seeks additional options to generate more profit.

Education: Education is the number of completing school years by the respondents. Education is defined as the ability of an individual to read and write or as the formal education received up to a certain standard.

Effective farm size: It represents the total cultivable land area for a particular farmers and particular respondent.

Effective land for potato contract farming: A particular piece of land dedicated for the potato cultivation under formal contract with the buyer, or contractor.

Extension media contact: Extension media contact was expressed as the degree of contact of an individual with different extension media (individual, group and mass) for enhancement or improvement of farming practices visioning better productivity and income.

Experience in potato cultivation: Experience in potato cultivation refers to potential engagement in potato farming in his/her life.

Experience in contract farming experience: It was considered as the year of starting from first potato contract farming cultivation till the year of data collection.

Family size: Family size of a respondent referred to the total number of family members.

Farmers: The persons who were involved in potato contract farming activities are called farmers.

Farming: Farming may be defined as an activity carried out by household or holding that represent managerial units organized for the economic production of crops, livestock and fishes.

Income from potato: Income from potato of a respondent generally refers to the total earning by him and other members of his family from potato cultivation and sales in a year.

Innovation: In**novation** in its modern meaning is a new idea, creative thoughts, and new imaginations in form of device or method. Innovation is the process by which social actors create value from knowledge.

Knowledge: Knowledge is referring to understand, attitude and practices of particular item or things by the respondent.

Mass Media Contact: Mass contact of a respondent referred to the extent of contact with several mass communication media, viz. radio, television, daily newspapers, agricultural leaflet/folder, agricultural booklets/magazines, agricultural film show and agricultural fair for getting information.

Potato contract farming area: Respondent cultivate potato under contract farming agreement with a particular company referred to the area of land under his/her management only for potato contract farming area.

Personal Communication Exposure: Personal contact of a respondent referred to the extent of contact with different types of personal communication exposure, viz. with neighbors, experienced farmers, with relatives and other medias engaged in agricultural production.

Problem faced: Problem means any difficult situation which requires some actions to minimize the gap between “what ought to be” and “what is”. The term problem faced referred

to different problem faced by the value chain actors in potato production, harvesting and marketing.

Return on Investment (ROI): ROI is a performance measure used to evaluate the efficiency of an investment. To calculate ROI, the benefit (or **return**) of a business was divided by the cost of the **investment**. The result is expressed as a percentage or a ratio. It is a ratio that compares the gain or loss from an investment relative to its cost.

$$ROI = \frac{\text{Net income}}{\text{Investment}} x\ 100$$

Return on investment (ROI) is a ratio between net profit (over a period) and cost of investment. A high ROI means the investment's gains higher to its cost.

Support services: In order to grow potatoes, assistances or services were received from contractors by the respondent farmers.

Training exposure: Training exposure means training (type and days) received by the respondents during farming career.

CHAPTER 2

REVIEW OF RELATED LITERATURE

CHAPTER 2
REVIEW OF RELATED LITERATURE

2 Review of Related Literature

Contract farming is a commercial and institutional relationship between a firm and a group of farmers. It is an agreement in which farm production is bought in advance by a firm in exchange for certain services such as pre-financing of inputs. Contractual farming helped farmers to connect to output markets, often assisted inputs and agricultural extension services (Da-Silva and Rankin, 2013; Eaton and Shepherd, 2001). These services can be provided by private firms, multi-actor partnerships between companies, governments, and NGOs (Prowse, 2012). Firms in modern market channels are relying on contracts for the procurement of products from preferred suppliers like contract farmers (Da Silva & Rankin, 2013; Reardon et al., 2013).

Contract farming is a form of vertical coordination in which firms support farmers during the production and/or marketing process by providing them with improved access to high-quality agricultural inputs, technical support, and secured output markets (Ba *et al.,* 2019). Contract farming is considered to be a positive development for agricultural innovation in developing countries (Da Silva and Rankin, 2013; Eaton and Shepherd, 2001; Minot & Ronchi, 2015; Otsuka *et al.,* 2016). Contracting between producers on the one hand and processing or marketing agribusinesses on the other are viable methods to strengthen vertical coordination in the agrifood chain (Swinnen and Maertens, 2007). Rehber (2007) suggests that contract farming accounts for around 15% of agricultural output in developed countries. Contract farming accounts for 38% of the production of dairy, poultry, and sugar in Germany (Rehber, 2007). Contract farming also plays an important role within transitional economies. For example, Swinnen and Maertens (2007) suggest that the percentage of corporate farms using contracts varies between 60% to 85% in the Czech Republic, Slovakia, and Hungary. Further east, in Armenia, Georgia, Moldova, Ukraine, and Russia, the percentage of food companies utilizing contracts rose from 25% in 1997 to 75% in 2003 (*ibid*). However, there were no studies found related to return on the investment (ROI) of contractual production by the contract farmer, whether the contract farming changed their ROI or not.

2.1 Description and contribution of the selected characteristics of the farmers to their changes of Return on investment (ROI) of potato production through contract farming

The farmers' individual and socio-economic factors that influenced in changes of Return on investment (ROI) of potato production through contract farming viz. age, education, farm size, experience, support services received, knowledge on contract farming, training exposure, satisfaction, commercialization, innovations, and growth of the business are discussed in the following subheads as the variable of the study.

2.1.1 Age of the Contract Farmers

Kumar, *et al.,* (2013) investigated improving the supply chain efficiency of Marigold through contract farming in Tamil Nadu and the study revealed the majority of the contract farmers were relatively young who belong to the age group of 31-40 years. Similarly, Shamsudin and Nalini (2013) highlighted the attitude of rock melon growers towards contract farming practices and showed that most of the rock melon farmers were between 40-49 years. Shamsudin and Nalini (2013) highlighted the attitude of rock melon growers towards contract farming practices and showed that most of the rock melon farmers were between 40-49 years.

2.1.2 Education of the Contract Farmers

Kumar, *et al.,* (2013) found in Marigold contract faming educational level was higher than that of non-contract farmers. Arun, *et al.,* (2013) portrayed the socio-economic characteristic and knowledge level of contract farmers in broilers contract farming.

Pandit, *et al.,* (2009) found that most of the respondents were secondary school education in the potato growers in India.

Shamsudin and Nalini (2013) highlighted the attitude of rock melon growers towards contract farming practices and showed that 41% of the farmers went to secondary school. The findings also depicted that more promotion and awareness activities were conducted to encourage more young people to be involved in contract farming.

In a study conducted by Minot and Hu (2009) on apple and green onion contract growers in China, the results found that there was no bias of the level of education of the contractual farmers. The educational experience of interacting with an agribusiness partner can provide a

platform for farmers in developing countries who were attempting to convert from subsistence to commercial farming and educated farmers gained more and chosen by the contractor (Glover, 1984, 1994; Sofranko *et. al.*, 2000).

Therefore, both the age and education of the farmers influence to contribute in contract farming operation and the researcher considered and one of the independent variables for the study.

2.1.3 Farm Size of Contract Farming

Through contract farming companies preferred to work with medium-and large-scale growers (Little and Watts, 1994; Singh, 2002). Contract farming usually involves a large-scale buyer and large farmers, such as an exporter or a food processor that needs to ensure a steady supply of raw materials meeting certain quality standards. Various studies showed the exclusion of small farmers from the contractual arrangements because of higher transaction costs (Kumar, 2006; Glover and Kusterer, 1990; Singh, 2012; Singh, N. 2016). Sharma (2013) found that only 15 percent of the contract farmers belonged to the small and marginal farm category. The public agency in Haryana, India contracted for cottonseed only with medium and large farmers, while the private agency contracted with all categories of farmers (Kumar *et al*., 2007). In a study conducted by Minot and Hu (2009) on apple and green onion contract growers in China, the results found that there was no bias of farm size of the contractual farmers.

Guo *et al.*, (2005) analyzed the determinants of contract farming participation with farm-level survey data from China. They found that small farmers were less likely to participate in contract farming than larger farmers. In contrast, Key and Runsten (1996) found that multinational tomato processors in Mexico first contracted with large growers but then involved also the small growers because side-selling was a problem with their larger growers. Similarly, a horticultural exporter in Thailand started producing its horticultural products on company land and later shifted to smallholder contract production. The evolution of several contract farming schemes in Kenya, including one (Del Monte pineapple) that gave up on contract production and others, then shifted from large-scale to small-scale production. In Senegal, green bean exporters switched from small-scale contract production to large-scale production (Maertens and Swinnen, 2009). Minot and Hu (2009) conducted a study on empirical analysis of the impact of contract farming in China, the average farm size is less than 0.5 ha, which is much smaller than in other Asian

developing countries such as India (1.5 ha), Thailand (3.4 ha), and South Korea (1.5 ha), but they are doing contract farming and found that the effective contract farming land is important (Fan & Chan-Kang, 2005).

A study was conducted in China to compare contract and non-contract growers of apples and green onions in order to explore the constraints on participation and the impact of contract farming on income. They were little evidence that firms prefer to work with larger farms, though all farms in the area were quite small. These results suggest that contract farming can help raise small-farm income (Miyata *et. al.,* 2009).

When it comes to the financial viability of small farms, particularly in developing countries, and globalization, contract farming proved useful in achieving efficiency and profitability in smallholder lentil farms in Nepal, (Mishra *et al.,* 2018) and CF adoption by lentil producers in Nepal has a positive and significant effect on per-hectare revenues and profits. Michelson *et al.,* (2012) studied supplied to modern markets in México for potatoes sold to agro-processors in Peru identify a positive effect of farm size on access to the particular chain under analysis. Escobal and Cavero (2011) observed that farmers with a high concentration of medium- to large-scale growers were more likely to gain access. Some authors argue that contract farming is beneficial to the smallholder farmers since it enables farmers to access ready markets and also to access global markets (Key and Rusten, 1999; Gulati *et. al.*, 2005; Minot, 1986; Minot and Roy, 2006; Minot *et al.,* 2009).

These findings assumed that the comparative advantage of smallholders or large farmer are not a static concept, but it can change as farmers and buyers experiment and learn from their own experience. It also implies that there is no intrinsic advantage of large farmers, so that public policy may be able to play a role in supporting the participation of small farmers in these supply chains.

2.1.4 Experience in Contract Farming

Champika and Abeywickrama (2014) explored a study in Sri Lanka that revealed that full-time engaged farmers who made a higher proportion of agriculture income, higher agricultural landholdings as well as agricultural experience and family labour participation were more prominent in adopting the contract farming system. The adopters earned about two times higher agricultural income than non-adopter of the contract farming model.

Pandit, *et al.*, (2009) discussed the socio-economic profile of the potato growers in India. The results of the study portrayed that contract farmers were more experienced in farming. Social participation was significantly more in the case of contract farmers. Social participation, i.e., extension communication helped farmers to venture out for a new scheme of production like contract farming. Porter and Phillips-Howard (1997) concluded that farmers were generally better off as a result of their participation and higher experience in contract farming. It reveals that more experience in farming gets strong engagement and better benefits during contract farming and it is significant choosing variable and contribute to changes of ROI of potato production through contract farming.

2.1.5 Support Services from Contractor on Contract Farming

The public provision of extension services is often lacking in developing countries and, as part of contract farming agreements, processors often provide their private extension services to the contractual farmers. Those private extension services are often more trusted by farmers than public extension services. Bellemare (2010) found that yields are positively and significantly related to the number of such private extension visits to the grower by a technical assistant working for the processor.

In contract farming arrangements, it is often the case that the processor advances inputs that would otherwise be difficult or impossible for the grower to obtain, and the contracted crop was used as collateral, for example, seeds, pesticides, and fertilizer were often provided by the processor to the grower (Bellemare, 2012).

Kaur (2014) in his case study of contract farming of potato by PepsiCo plant in Punjab revealed that contract was in written commitment, the firm (PepsiCo) provided certain facilities and technical advice to the farmers such as inspection by the field officer after fifteen days, the arrangement of meetings and lectures through seminars by technical staff members in the villages, to promote contract farming.

Minot and Hu (2009) studied contract farming support services by the contractor to the grower and found in the case of apple growers, contract farmers benefited from higher yields, due to the technical assistance and specialized inputs provided by the contractor.

The prices contract farmers received from the contractor were higher than the regular market.

Miyata *et al.*, (2009) found increased access to training, credits, production quantity and production acreage, timely purchase, and timely payment were beneficial for contract farming.

Farmers can access improved agricultural inputs, agricultural equipment and machinery, credit, and technical know-how (Cai *et al.*, 2008; Glover, 1984; Sethboonsarng, 2008). They can also reduce the uncertainty of their earnings from the farming business.

Farmers usually enter into contract production to reduce cost and gain access to information, technology, marketing channels, managerial skills, technical expertise, access to plant and equipment, and patented production procedures (Carney, 1988; Glover, 1994; Clapp, 1994; Jackson and Cheater, 1994; Little, 1994; Royer, 1995; Pasour, 1998; Delgado, 1999; Vellema, 2000).

Contracting farmers can reduce production costs and increase production and income as a result of their use of new technology and their access to company inputs (Watts, 1994; Clapp, 1994). The cost reduction is due to better technology, better collective decisions, and reduced transport and marketing costs (Hennessy, 1996; Pasour, 1998), cheap inputs from the integrator, and, as a result of this, the ability to increase economies of scale (Royer, 1995), or technology developed by the integrator that can reduce cost (Pasour, 1998).

Contracting farmers can reduce marketing risk and stabilize income and, in this sense, the integrator provides a form of insurance (Featherstone and Sherrick, 1992; Watts, 1994; Jackson and Cheater, 1994; Runsten and Key, 1996; Colchao, 1999; Sofranko *et. al.*, 2000). At the same time, contracts may simplify production and marketing decisions, thus improving the farmer's effectiveness (Hudson, 2000).

Farmers also get access to new technology and inputs, including credit, through contracts that otherwise may be outside their reach (Glover, 1987; Eaton and Shepherd, 2001). Due to contract farming, the farmers were able to receive benefits, not only in income but were also able to gain access to credit and technical knowledge (Minot, 1986; Little & Watts, 1994).

From the above reviews, it is shown that the support services provided by the contractor are significantly beneficial for the contract farmers and it has a positive impact on production, income, and changes of return on investment.

2.1.6 Training Exposure

Miyata *et al.,* (2009) found that there were certain benefits of contract farming to receive training on production and farming management. Sultana (2009) discussed the baby corn business under the contract farming system. The finding of the study revealed that contract farmers received training on production technology and support from the company. Moreover, the farmers had to strictly follow the conditions and the practices set by the company and had no opportunity to bargain on the price.

Kaur (2014) did a case study of contract farming of potato by PepsiCo plant in Punjab revealed that contract provided technical advice to the farmers such as the arrangement of training, meetings, and lectures through seminars by technical staff members for the contract farmers to promote contract farming, as result increase production and income of the potato growers.

2.1.7 Contract Farming Knowledge

A study by Olounlade *et al.,* (2020), on rice contract farming knowledge, found that those who had good knowledge of the contract farming system have an impact on decisions, income, and satisfaction. Farmers with more knowledge of the contract farming system can participate in contract farming and better off in net income and growth. Farmers knowledge on the contract farming system was higher than that of non-contract farmers (only are able to participate in contract farming (Olounlade, *et. al.* 2020). Masakure and Henson (2005) and Guo *et al.* (2006) point out that stability and technical knowledge were, *inter alia,* cited as the most important reasons why farmers join contract-farming initiatives (Bijman, 2008). Contract farming can also provide many additional benefits and opportunities: it can increase on-farm diversification; technical assistance and knowledge transfer can spill over onto adjacent fields and into nearby villages; by-products from contract farming can be used for other farming activities, thus improving efficiency; it can stimulate the broader commercialization of smallholder farming. According to Asenso-Okyere *et al.* (2008), knowledge plays an important role in agricultural development including contract farming. Contract farming helps pass on knowledge of modern technological inputs and its applications to farmers which they would use for other crops (Glover and Kusterer, 1990). Contract farming is expected to increase farmer's efficiency

either through exploiting economies of scale (Macdonald, 2006) or through providing better knowledge and inputs (Key and MacBride, 2003; Ramaswami *et al.*, 2005) that would not be otherwise available. Contract farmer in nurturing the contract crop could improve farmer's knowledge and have positive impact on non-contract crops.

2.1.8 Extension Media Contact

A study was done by Sharma (2008) and described the reasons for participating in contract farming in three districts in India. The study revealed that access to assured market was the most opted reason with 76% respondents followed by assured price, higher returns, access to better seed, better extension services, and inspiration from fellow farmers who had adopted contract farming motivated the other farmers to participate in contract farming.

Perera *et.al*. (2003) found contract farmers were solely dependent on their Field Assistants deployed by the contractor for the information and services whereas non-contract farmers used other sources. The majority of contract farmers attributed high credibility to the Field Assistant as well as higher rating role on extension services and for input services. The extension communication activities were significantly related to farmer's knowledge and adoption. Farmers' technical knowledge and adoption were also interrelated. However, in the non-contract situation where extension service was poor, a dominant role of personal factors concerning knowledge and adoption was observed in contract farmers.

In Punjab, Pepsico first started contract farming for tomatoes in the early 1990s and now contracts farmers for potatoes and chilies. Pepsi's research and development activities helped develop and disseminate new technologies, including agricultural practices such as deep chiseling and new seed varieties, through Pepsi field officers, field demonstrations, and booklets (Singh, 2002). Therefore, extension media contact contributed to contract farming and the researcher found this variable was one of the influencing factors for the study and sought to address these issues in the current study.

2.1.9 Satisfaction on Contract Farming

A study was conducted by Pouncgchompu *et al.,* (2016) found that the farmers were able to improve their lives and satisfaction, and approximately 57% of the farmers involved in contract farming had better living standards which are consistent with the results of Singh's (2002) study.

Prasad's (2013) research report revealed that the contract farmers were highly satisfied with an assured income, timely availability of quality inputs, assured price and ready market, getting transport arrangement, and increased employment at the village level.

2.1.10 Innovativeness on Contract Farming

Contract farming is considered by most authors to be a positive development for agricultural innovation in developing countries (Da Silva & Rankin, 2013; Eaton & Shepherd, 2001; Minot and Ronchi, 2015; Otsuka *et al.,* 2016; Saenger *et al.,* 2013). Kumar, *et al.,* (2013) found adoption of new technologies and great innovation of contract farming.

To meet global demands towards food security, safety as well as sustainable agriculture and food systems innovative approaches are inevitable, that various types of innovation are needed to ease this sustainable transformation in agriculture, especially in contract farming. Both have a positive relationship with each other Walder *et al.,* (2019).

Many studies address farmers' innovativeness from diverse perspectives, one of the most important incentives for raising farmers' innovation activities seems to be a more-or-less explicitly stated economic consideration. For instance, the spatial dependence of innovation activities is pointed out in several studies and found innovation spectrum of farmers was a positive yardstick for income enhancement (Walder *et.al.* 2019).

Sharma (2008) study aims to express certain reasons for the adoption of contract farming by the sunflower farmers which was conducted in Bojalana District of Northwest Province in India. Access of farmers to improved new technologies and new policies were certain reasons which motivated farmers to join contract farming.

Studies indicated that contract farming showed that contract farming helps smallholder farmers to improve their cultivation practices, new technologies, and marketing of agricultural produces (Birthal *et al.,* 2008, Glover and Kusterer (1990), Miyata *et al.,* (2009), and Warning and Key (2002).

Technology transfer and innovative institutional arrangements in contract farming have shown a positive impact on the agricultural sector. Contract farming in particular is an effective way to transfer technologies to farmers (Glover, 1984).

The adoption of such innovations, new technologies (new varieties and new production techniques) helps small farmers to meet the quality standards that are required by the contractor in the lucrative market (Eaton & Shepherd, 2001).

2.1.11 Commercialization of Agriculture due to Contract Farming

Zhou *et al.,* (2013) argue that agriculture commercialization can significantly increase the income and welfare of smallholder farmers as well as contribute to economic growth and poverty alleviation. Agwu *et al.,* (2012) refer to agricultural commercialization as the process of increasing the proportion of agricultural production that is sold by farmers. A key premise of commercialization as a development strategy is that markets provide increased income to households who could maximize the returns to land and labour through market opportunities, using earned income for household consumption in ways that are more efficient than subsistence production (Brempong *et al.,* 2013).

Commercialization refers to the degree of engagement with markets, either for inputs, outputs, or both and it positively impacted their net income and return on investment (Okezie *et al.,* 2012; Panashat, 2011; Yoon-Donn & Yoon, 2009; Pingali and Rosegrant, 1995). Therefore, for subsistent agricultural producers, commercialization implies 'increased participation or improved ability to participate in both input and output markets' (Chirwa and Matita, 2012).

Okezie *et al.,* (2012) surmised a view held by several authors that the commercialization of agricultural systems leads to the greater market orientation of farm production, progressive substitution out of non-traded inputs in favor of purchased inputs, and the gradual decline of integrated farming systems and their replacement by specialized enterprises.

The impacts of commercialization can be categorized into first, second, and third orders (Jaleta *et al.,* 2009). First-order effects are mainly income and employment effects that are directly reflected in the household welfare, the second-order effects include health and nutrition aspects, usually contingent on the level of income attained through the existing

level of commercialization. Third-order effects (higher-order) are the macro-economic and environmental effects that go beyond the household level.

Agricultural commercialization usually takes a long transformation process from subsistence to semi-commercial and then to fully commercialized agriculture (Pingali and Rosegrant 1995). In fully commercialized agriculture, however, inputs are obtained predominantly from markets, and profit maximization becomes the farm household's return on investment (Pingali and Rosegrant 1995).

2.1.12 Business Growth due to Contract Farming

The performance of contract farming depends to a large extent on income and overall return on investment, make contract farming more profitable; thus, more reliable business partners, preference for contract farming, and a much better foundation for future business growth and success (Wuepper and Sauer, 2016).

2.1.13 Production and Yield Effect by Contract Farming

Participation in contract farming operations has changed the farmers' attitudes to adopt a modern potato cultivation practice which has increased their yield from 5.0-5.5 MT to 7.5- 10 MT per acre on average. That caused an additional income of about BDT 15,000-20,000 per acre of land compared to the previous year without contract farming (Katalist, 2012).

Singh, *et al.,* (2006) examined the costs and returns of potato crops under contract and non-contract farming systems in India. The results indicated that the potato production was observed to be 8.33 percent higher on contract farms against non-contract farms.

2.1.14 Changes of Return on Investment (ROI) of potato production through Contract Farming

Throughout the world, contract farming is practiced in various ways and means to link smallholders to a lucrative market for increased incomes (Barrett *et al.,* 2012; Birthal *et al.,* 2008; Kumar *et.al.* 2010; and Saenger *et al.,* 2013), this income raised their farms' productivity and return on investment.

The financial viability of small farms, contract farming (CF) proved useful in achieving efficiency and profitability in smallholder lentil farms in Nepal, (Mishra *et. al.* 2018). CF

adoption by lentil producers in Nepal has a positive and significant effect on per-hectare revenues, profits, and yield.

Contract farming with farmer organizations significantly raises farmers' income. The econometric model and qualitative data show that contract farming can attribute to an increase in farming productivity, quality of produce, and farming cost efficiency (Sokchea and Richard, 2015). Wang *et al.,* (2014) reviewed the literature on the effect of contract farming on-farm productivity and household income. They found that 92% of studies estimate a positive effect of contract farming participation on productivity, and 75% estimate a positive effect on income.

Roopa, *et al.,* (2013) observed the economic analysis of baby corn under contract and non-contract farmers in Karnataka, India, and revealed that the farmers under contract produced higher productivity. Wainaina, *et al.,* (2012) investigated the impact of contract farming on smallholder poultry farmers' income in Kenya. The results showed that on average contract farmers were significantly higher (27%) levels of farm income as compare to independent growers. Bellemare (2012) studied contract farming over more than 10 contracted crops across six regions of Madagascar. He found that contract farming appeared to lead to a 10-percent increase in income.

A study was conducted by Minot and Hu (2009), results suggested that contract farmers earn more than their neighbors growing the same crops even after controlling for household labour availability, education, farm size, share of land irrigated, and proximity to the village leader. In the case of apple growers, contract farmers benefit from higher yields and higher income (Minot and Hu, 2009).

Brithal (2008) examined that contract farming was found to be more profitable than independent production. Birthal *et al.,* (2005) found that the gross margins for contract dairy farmers in India were almost double compared to those of independent dairy farmers, largely because contract growers had lower production and marketing costs.

Miyata and Minot (2007) studied the participation of contract farming in green onions and apples in Shandong Province in China. The results revealed that contract farmers' income was significantly higher than independents farmers.

Contract farming is beneficial to the smallholder farmers since it enables farmers to access ready markets and also to access global markets (Key and Rusten, 1999; Warnings and Key, 2002; Gulati *et al.*, 2005; Minot, 1986; Minot and Roy, 2006; Minot *et al.*, 2009). Contract farming enhances the income of farmers which attribute to the economies of scale enjoyed in contract farming.

The impact of CF's on income in Indian context found positive; Dev and Rao (2005); Nagaraj *et al.,* (2008); Kumar and Kumar (2008); Ramaswami, Birthal and Joshi (2006); Tripathi, Singh, and Singh (2005); Birthal, Joshi, and Gulati (2005); Kalamkar (2012); Kumar (2006); and Dileep *et. al.*, Grover and Rai (2002) all found that contract producers earned profits almost three times higher than those of independent producers, owing to the former's higher yields and assured output prices.

Singh (2002) compares contract farming arrangements in the Indian state of Punjab, and he also finds that those smallholder farmers who participate in contract farming shown higher incomes. Warning and Key (2002) were the first to attempt to deal with the self-selection of growers into contract farming in a study of peanut contract farming in Senegal, and they find that participants in contract farming did, indeed, significantly higher incomes than nonparticipants.

Little and Watts (1994) compiled a set of seven case studies of contract farming in sub-Saharan Africa and concludes that "incomes from contract farming increased for a moderate (30–40%) to a high (50–60%) proportion of participants". Minot (1986) found improved income of participants of contract farming schemes.

Other reviews relevant to the study

Study/Author	Country	Crops	Results
Narayanan, 2014	India	Gherkins, Papaya and Poultry	Participation in contract farming increased profits of gherkin farmers by 21%, papaya farmers by 32%, poultry farmers by 150%.
Cahyadi and Waibel, 2013	Indonesia	Palm Oil	Estimated contract participation increased net household income by 60% (significant at the 10% level). Results show that while contract

Study/Author	Country	Crops	Results
			farming has a significant positive effect on smallholder income overall, poorer smallholders are less likely to benefit.
Bellemare, 2012	Madagascar	Vegetables, Fruit, and Grain	A 1% increase in the likelihood of participating in contract farming is associated with a 0.5 percent increase in household income. This implies that the average effect has an upper limit of 50% of income. The study also found that participation also increases income from noncontract crops and livestock production.
Miyata, Minot, and Hu, 2009	China	Apples and Green Onions	The treatment effects model finds a 38% increase in income associated with contract farming. For apples, additional income is attributed to higher yields; in the case of green onions, prices received by contract farmers were higher than those received by non-contract growers
Birthal Jha, Tionco, and Narrod, 2008	India	Dairy, Poultry, Vegetables	The treatment effects model finds that participation in contract production increases net revenue by more than 80% compared to the average.
Ramaswami, Birthal, and Joshi, 2006	India	Poultry	Based on IV regression analysis, contract poultry growers earn 36% more per kilogram per production cycle than independent growers. They also had lower variability in gross margins between production cycles.
Simmons, Winter, and Patrick, 2005	Indonesia	Poultry, Maize, Rice	Contracting improves returns to capital for poultry and maize seed, but not for rice seed. Contract farmers had 71% and 160% increase in gross margin for seed corn and poultry, respectively, over sample average.
Warning and Key, 2002	Senegal	Groundnuts	Heckman selection model used to estimate increased income. Increases in gross agricultural

Study/Author	Country	Crops	Results
			revenues are 55% greater than average non-contacting farmer. Participation in contract farming associated with 39% increase in gross agricultural income over non-contract farmers.
Cahyadi and Waibel, 2013	Indonesia	Palm Oil	Migrant status, household head age, plot size, and time since farm establishment are all significant predictors of participation in contract farming.
Wang *et al.*, 2011	China	Vegetables	Risk attitudes are found to be a significant determinant of contract farming, with more risk tolerant farmers preferring contracts.
Miyata, Minot, and Hu 2009	China	Apples and Green Onions	A Probit model for the participation in contract farming shows no preference for larger farmers.
Birthal *et al.*, 2008	India	Dairy, Poultry, Vegetables	Experience and non-farm income are found to be significant indicators of contract farming for the dairy, vegetable, and poultry industries.
Simmons *et al.*, 2005	Indonesia	Poultry; Maize; Rice	Irrigation, age of head of household, and education were all found to be positive indicators of participation in contract farming across three sites in the country.
Guo *et al.*, 2005	China	Fruits, Vegetables, Tea, Livestock	Specialization and commercialization along with the distance from market and government support are shown to be significant predictors of the likelihood that farmers engage in contract farming.
Warning and Key, 2002	Senegal	Groundnuts	Asset ownership is not a significant predictor of contract participation.
Saenger *et al.*, 2013	Vietnam	Dairy	The experimental design shows that contract farmers invest significantly more inputs into production and produced higher levels of output in the presence of independent quality verification.

Study/Author	Country	Crops	Results
Torero and Viceisza, 2013	Vietnam	Dairy	Male and female dairy farmers are found to differ in trusting the presence of a third-party observer on product quality in the face of potential collusion. Male contract farmers are more likely to trust the third party than female contract farmers.

Source: The World Bank Group (2014), Trade and Competitive Practices, No. 344

2.2 Problems and Constraints of Potato Contract Farming

Babita, *et al.,* (2013) analyzed that poor quality and untimely availability of inputs, untimed payments and lack of extension services were the major problem faced by the farmers. Nagaraj *et al.,* (2008) observed that the farmers faced constraints in contract farming were delay in payment and delivery of inputs, delay in the lifting of produce, manipulation of quality standards, and higher cost of inputs.

The unequal relationship between parties to the contract, an imbalanced bargaining power (Cai *et al.*, 2008; Eaton and Shepherd, 2001; MacDonald *et al.,* 2004; Sivramkrishna and Jyotishi, 2008; Warning and Key, 2002), and the exclusion of smallholder farmers (Baumann, 2000; Cai *et al.*, 2008; CREM, 2008; Glover and Kusterer, 1990; Key and Runsten, 1999; Sartorius and Kirsten, 2007) are among the negative characteristics of contract farming. Agricultural inputs and credit provision from contractors also contribute to the imbalance of power relations between contractor and farmer, leading to the accumulation of debts (Eaton and Shepherd, 2001; Glover, 1984; Glover and Kusterer, 1990). While contract farming's lack of flexibility was one of its main liabilities, and coordination problems were faced during contract farming implementation (Glover and Kusterer, 1990; and Little and Watts, 1994).

Sharma (2008) identified that the high rejection rate, the distance of sales/ delivery point from the farm, and delay in payments were reasons for discontinuing contract farming. Different literature on contract farming consistently raises the problem of exclusion of small farmers who had small productive assets in conventional contract farming. Cai *et al.,* (2008), Glover and Kusterer (1990), and Key and Runsten (1999) found that firms prefer medium and large scale farmers because contracts are easier to arrange, coordinate, and administer at this scale, and the

cost of these transactions is also low, compared with the arrangement of the contract with smallholder farmers.

Farmers may breach the contract by diverting inputs supplied on credit to other purposes or selling outside the contract for higher prices, while contractors may breach the contract (e.g. with unfair quality standards, low-quality inputs, poor technical assistance, incomplete purchases, delayed payments, etc.) because of inefficient management or marketing problems (Glover, 1984, 1987; and Singh, 2002).

Some studies indicated that contract farming has negative impacts on farmers' income (Cai *et al.,* (2008), Glover and Kusterer (1990), and Zola *et al.,* (2007). Cai *et al.,* (2008) found that contract farmers earn a lower income than former-contract farmers, the noncontract farmers who used to join the contract.

In summary, Contract farming (CF) has long existed, particularly for perishable agricultural products supplied for the processing industry. The extant review of literature on contract farming at the international and national level reveals the diversity among contracting firms about the farming and procurement operations and linkage building with the farmers as the contracting practice differs from crop to crop. The expansion of agribusiness companies in Bangladesh has enhanced vertical coordination in the agricultural sector by ensuring market and price for the farm produce. By opening new markets, new products for high-value farm produce, contract farming has built up the scope for the resources of poor farmers to cultivate risky crops earlier than they might avoid producing. Several studies showed that returns to contract farmers were higher than non-contract farmers due to provision of technical guidance and quality inputs by the contracting companies. There are few estimates of the prevalence of contract farming and no estimates of trends over time. No specific attempt has been made in the earlier studies in the context of return on investment. Many of the researchers studied about income, profit, none found changes of return on investment over time (before and after). Therefore, it is necessary to study or research on effect or changes of return of investment of contract farming module, that impacts and acceptability to the rural farmers, researchers, and academicians.

2.3 Conceptual Framework of the Study

The hypothesis of this research was constructed on two important elements i.e. “a dependent variable” and “an independent variable”. A dependent variable was taken as a factor that appears, disappears, or varies on the effect of independent variables. The independent variables were the factors that were manipulated to ascertain their relationships to an observed phenomenon. Given the prime theme of the study, a conceptual framework that is self-explanatory is presented in Figure 2.1.

There were selected characteristics of the contract farmers (Independent variables) that contributed to their perceived effects of a contractual farming system that changes of return on investment of potato production through contract farming as the dependent variable. The following table has shown the variables of the study.

Types of variables	**Name of the variables**
Independent	1. Age 2. Education 3. Household effective farm size 4. Effective potato contract farming land size 5. Potato contract farming experience 6. Support services from contractor 7. Training exposure 8. Contract farming knowledge 9. Extension media contact 10. Satisfaction on potato contract farming 11. Innovativeness in potato contract farming 12. Commercialization of potato contract farming 13. Business growth due to potato contract farming
Dependent	1. **Changes of Return on investment** of potato production through contract farming

2.4 Thematic sketch of the study

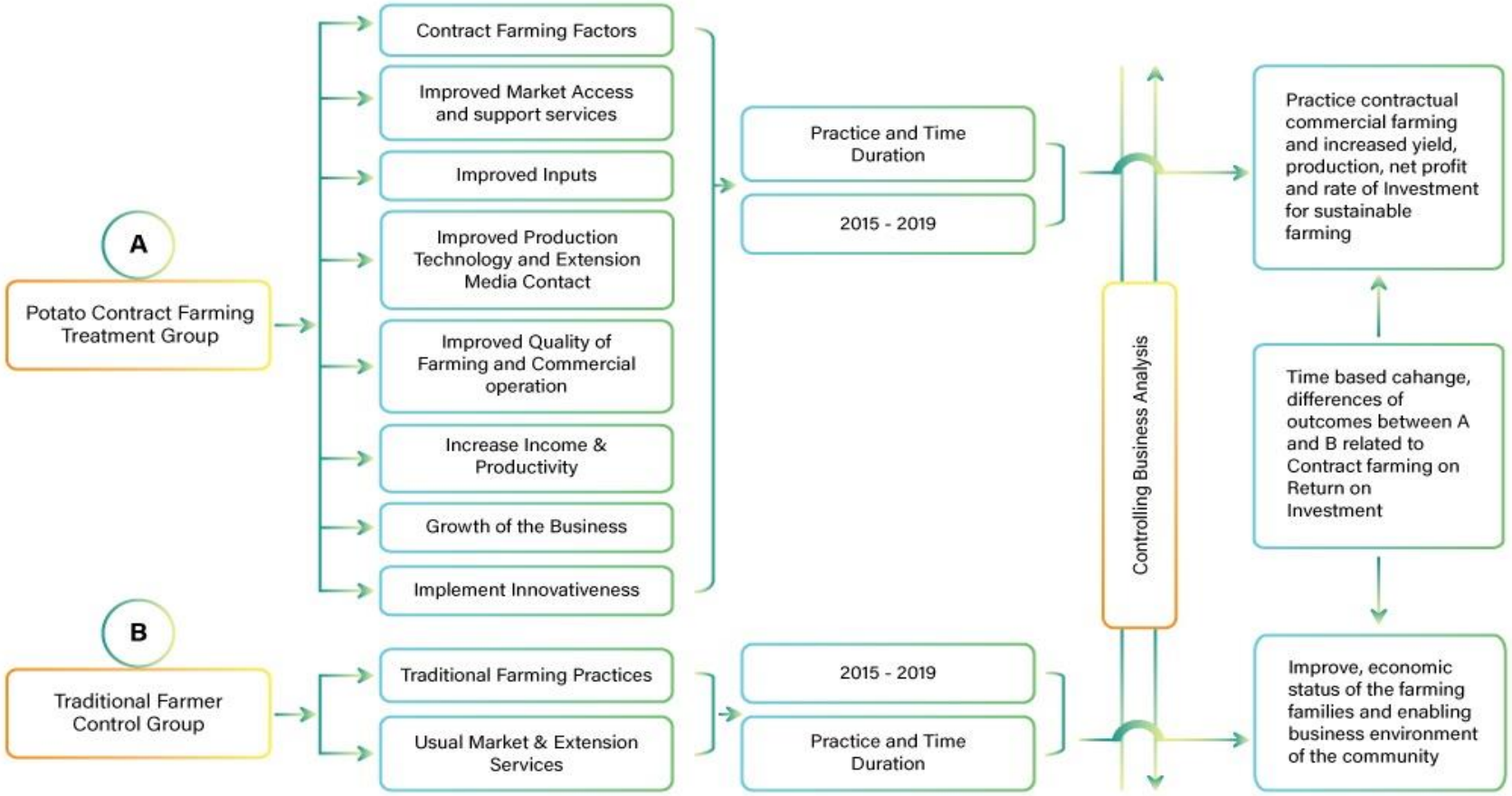

Figure 2.1 Theme of the research

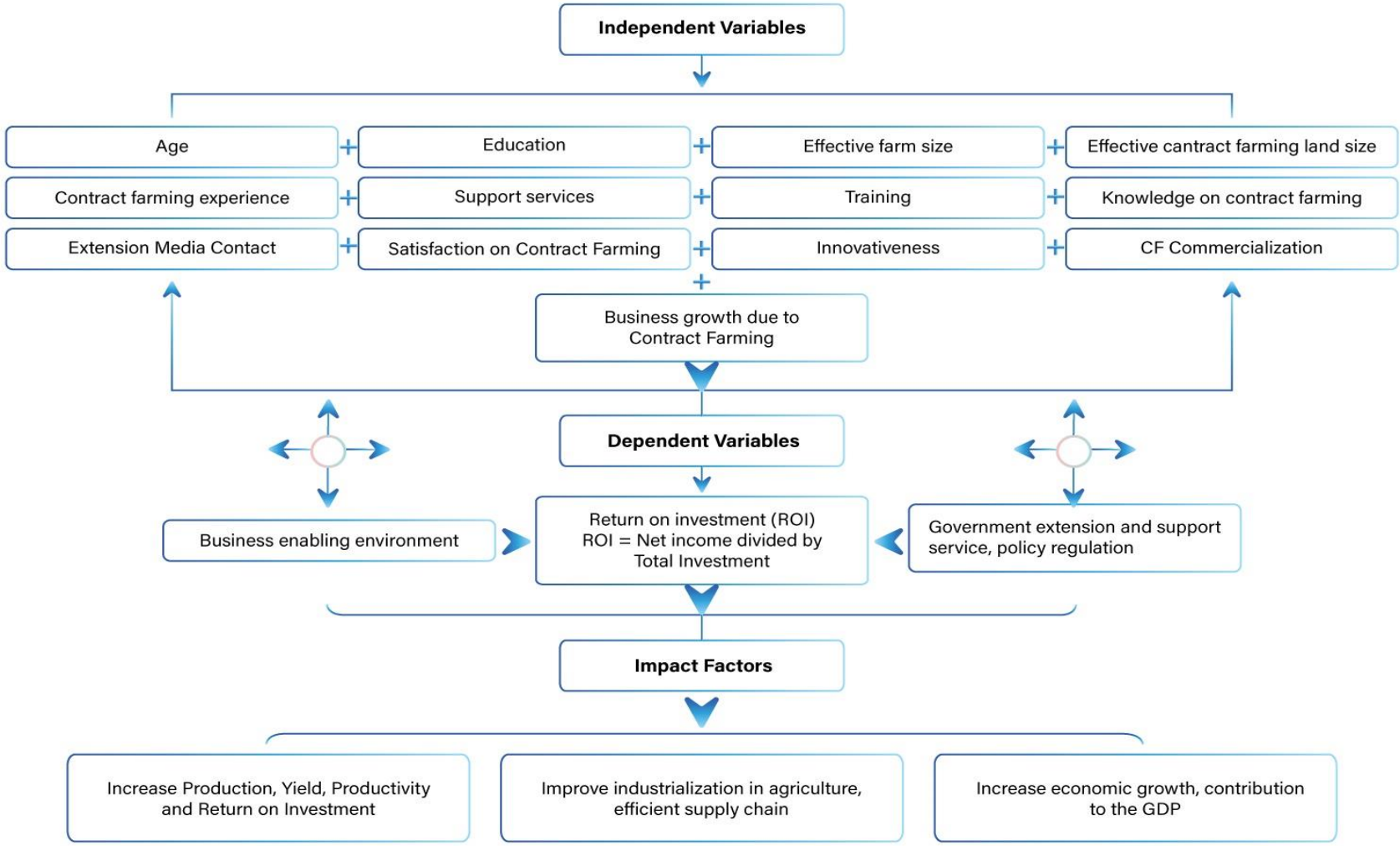

Figure 2.2 Conceptual approach of the research

CHAPTER 3

MATERIALS AND METHODS

CHAPTER 3
MATERIALS AND METHODS

3.1 Research design

The research design was mainly to determine the extent of changes of ROI of potato production through potato contract farming in Bangladesh.

3.2 Locale of study

The study was conducted in two (2) Upazila namely, Mithapukur Upazila in Rangpur district and Birampur Upazila in Dinajpur district, as the treatment group. As the study group, the study was conducted in two Upazilas: Mithapukur Upazila in Rangpur district and Birampur Upazila in Dinajpur district. All contract farmers were cultivated in both areas, processing a variety of potatoes. Furthermore, Pirganj Upazila in the Rangpur district was chosen as the control study area because there is no potato contract farming there.

Therefore, three Upazila were selected purposively as the locale of the study and they are:

- Mithapukur Upazila, Rangpur – Study group, potato contract farmer;
- Birampur Upazila, Dinajpur – Study group, potato contract farmer;
- Pirganj Upazila, Rangpur – Control group, the traditional farmer for potato cultivation.

A map of Bangladesh showing the study area is shown in Figure 3.1.

Table 3.1 Profile of the selected Upazila for the study

	Total area	Land area	Union	Village	Population	Farm holding	Potato area (acre)	Potato production (MT)
Mithapukur	515.62	483.16	17	315	527457	75673	18416	206,688
Birampur	212.88	212.44	7	169	42140	42140	11109	12,529
Pirganj	411.35	403.93	15	332	385499	65529	11314	83,980

Source: BBS, 2019

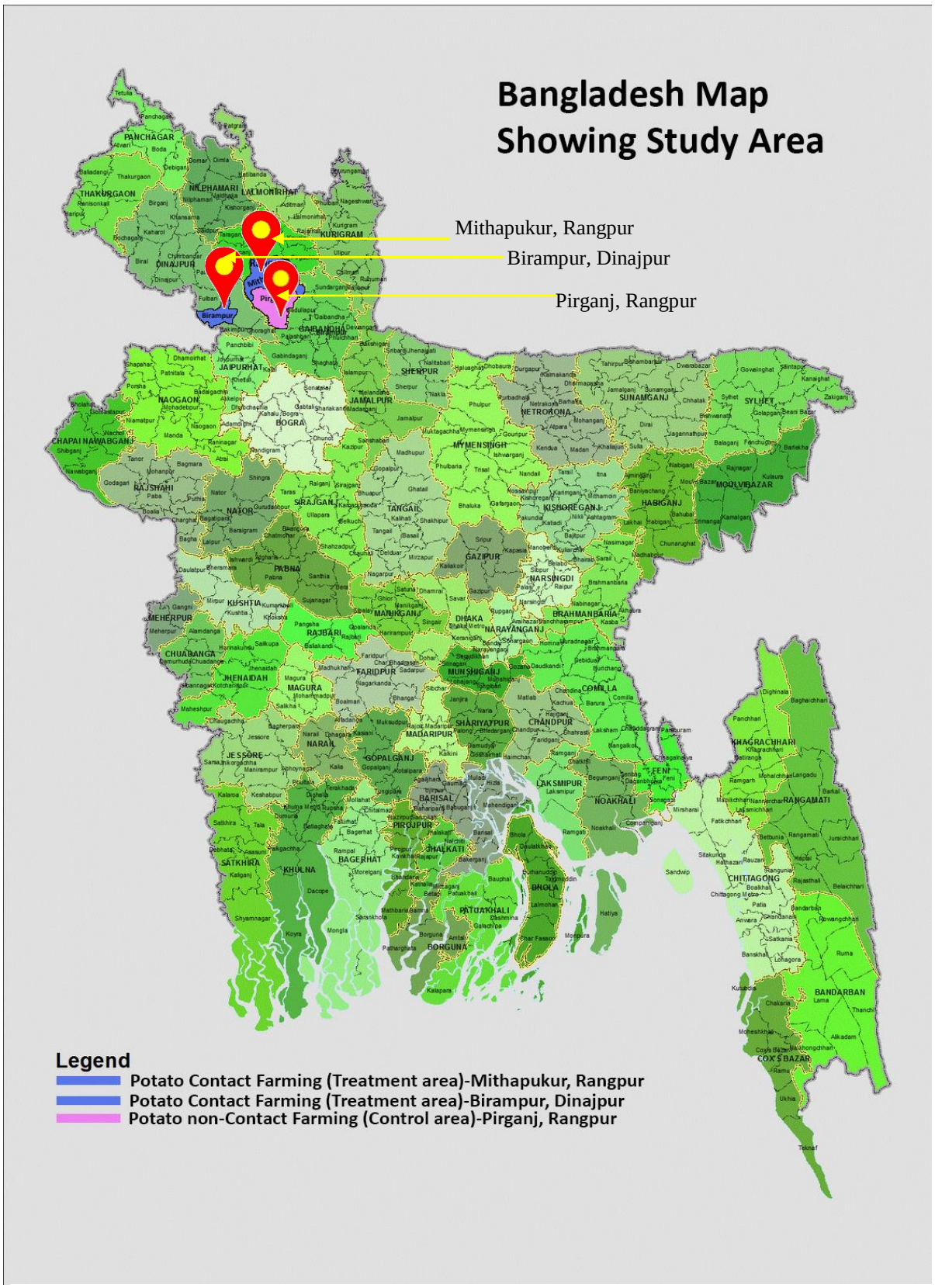

Figure 3.1.Map of Bangladesh showing the study area

Mithapukur Upazila: Mithapukur is one of Bangladesh's potato-growing clusters. In 2018, a total of 75,673 farms produced 206,688MT of potatoes. The farmers were involved in contract farming for both export quality potatoes and processed varieties. Respondents from this area were considered as the research's treatment group.

Birampur Upazila: Birampur is a potato cultivation area that specializes in processing varieties through contract farming. This Upazila has 42,140 households, the majority of which are engaged in farming. A large number of farmers were involved in contract farming for both export quality potatoes and processed varieties. Respondents from this area were considered as the research's treatment group.

Pirganj Upazila: Pirganj is a potato farming cluster, but there are no potato farming contractors there. This Upazila has 65,529 households, the majority of which are engaged in farming. Farmers were treated as the control group because they did not produce a processed variety of potato and there was no contract farming by the contractor.

3.3 Population, Sample, and Sampling of the Study

3.3.1 Population

The population of the study consisted of 820 potato contract farmers from two Upazilas, Mithapukur and Birampur. Non-contractual farmers were chosen at random from the unknown and indefinite population of Pirganj Upazila in the Rangpur district.

3.3.2 Sample and Sampling of the Study

Data were gathered from a sample rather than the entire population. The sample size was determined based on several factors, including the study's purpose, contractual agreement, company preference, population size, risk of selecting a bad sample, and allowable sampling error.

There were several methods for determining the sample size, but the sample size was determined using the following formula developed by Yamane (1967):

$$n = \frac{z^2\, p(1-p)N}{z^2 p(1-p) + N(e)^2}$$

Where:

n = Sample size;

N = Population;

e = Level of precision (5%);

Z = Value of the standard normal variable at the chosen confidence level (e.g. z = 1.96 with a CL = 95%).

p = the Proportion or degree of variability = 50%

In calculating sample size 5% precision level, 50% degree of variability, and 1.96 as the value of Z at 95% level were chosen.

By putting the values in the above formula, the sample size was determined as follows:

$$n = \frac{0.25\,(Z^2)\,N}{0.25\,(Z^2) + N\,(e)^2}$$

$$= \frac{0.25 \times 1.96 \times 1.96 \times 820}{0.25 \times 1.96 \times 1.96 + 820 \times 0.05 \times 0.05}$$

$$= \frac{787.528}{0.9604 + 2.05}$$

$$= \frac{787.528}{3.0104}$$

$$= 261.6 \approx 262$$

As a result, the sample size was 262.

The Creative Research System (1984) was also used to calculate the sample size; by using a 5% confidence level, 820 was the total population size, and the same sample size of 262 was calculated. Similarly, RAOSOFT received the same number as 262.

3.3.3 Steps of samples selection

Farmers were chosen from the target population who had a contractual agreement with any of the selected 3 companies for potato cultivation. Figure 3.2 shows the flow of sampling method. A total of 820 potato contract farmer lists were obtained from the companies. Proportionate random sample methods were used to determine the sample based on the population of contractual farmers from each company. As a result, the total sample list includes 157 (59.92%) from Agriconcern, 56 (21.37%) from Seba, and 49 (18.71%) from Matrix. For the study, 262 contract farmers from two Upazilas (Mithapukur and Birampur) and 56 non-contract farmers from Pirganj Upazila were chosen as treatment respondents.

The following steps were adopted for sample selection in the study:

- Step 1: A comprehensive master list of all potato contract farmers from 3 companies was compiled and created.
- Step 2: A sequential number was assigned to each of the potato contract farmers (1,2,3…820) from which a sample was drawn by simple random sampling method
- Step 3: The sample size was calculated as 262
- Step 4: A random number generator was used to select the sample, using sampling frame (population size) from Step 2 and sample size from Step 3. SPSS was used to calculate the sample.

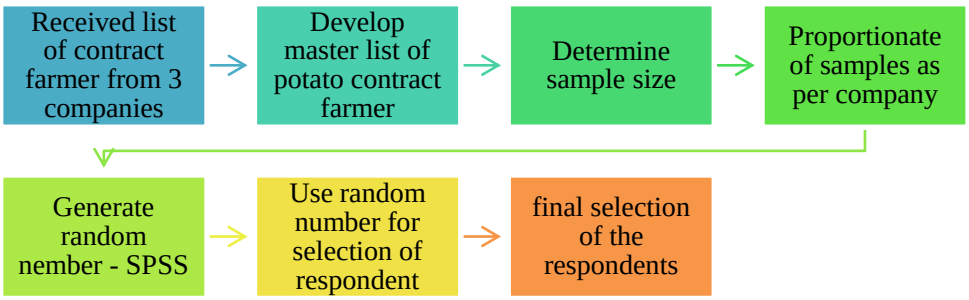

Figure 3.2 Process flow of sampling method

Control group sample: Control farmers were chosen from similar geographical areas, but there was no contractual agreement with the chosen contractors in nearby Upazila. A purposively total of 56 non-contractual farmers were selected as the control group. Farmers' list was collected from the DAE office, in consultation with SAAO and then farmers were selected for the interview.

Table 3.2 Sample determination of the research

Sl. No.	Company	Total population	Proportion of total	Potato contract farmer – Treatment			Reserve list	Non-contract potato farmer-control group
				Mithapukur	Birampur	Total		
1	Agriconcern	492	60%	133	24	157	13	
2	Seba	172	21%	54	2	56	9	
3	Matrix	156	19%	47	2	49	6	
4				Non contract farmer – Control group				56
	Total	820	100%	234	28	262	28	56

3.4 Data Collection Instruments

Based on the study's objectives and variables, a draft interview schedule was developed in consultation with advisory committee members, experts, and secondary review. To obtain the desired information, direct questions and different scales were included in the questionnaire. The primary method used was a face-to-face personal interview according to the study's interview schedule. The draft interview schedule was pretested with 36 potato contract farmers non-sampled from selected 2 Upazila. The final interview schedule was created after the necessary additions, deletions, corrections, and modifications were made based on the pre-test results and in consultation with the supervisor. The interview schedule was written in English and translated into Bangla to facilitate rapport building and spontaneous questioning. Appendix-I contains an English version of the interview schedule.

3.5 Data Collection Procedure

A face-to-face interview was conducted for quantitative data collection through a structured interview schedule in Bangla during the period from September 10, 2019, to December 31, 2019. With the assistance of a respected company representative who had made a prior appointment, the researcher visited each selected sample respondent. In the event that the sample farmers were unavailable, the researcher paid a make-up visit at a convenient date and time.

3.6 Variables of the Research

The variable is a characteristic that can take on varying or different values in different cases. Variables are measurable characteristics of a population that can differ in magnitude or quality from one element to the next (Ahmed et al., 2004). Ezekiel and Fox (1959) defined a variable

as any measurable characteristics which can assume varying or different values in successive individual cases.

A comprehensive review on contract farming, research, operation, systems and framework, and examples studied both in online-based and library works and hard copies. As a result, the variables of the study were chosen after a thorough search of the literature and discussions with Advisory Committee Members and relevant experts from home and abroad. There are two types of variables in any relationship study, viz. independent variable and dependent variable. An independent variable is the presumed cause of the dependent variable, the presumed effect (Kerlinger, 1973). The dependent variable is often called the criterion or predicted variable, whereas the independent variable is called the treatment, experimental, and antecedent variable (Dalen, 1977).

The researcher reviewed the literature to understand the nature and scopes of the variables relevant to this study. The 13 selected characteristics of the farmers were considered as independent variables of the study and these were (i) age, (ii) education, (iii) effective farm size, (iv) effective contractual potato farming land, (v) potato cultivation experience, (vi) support services received from the contractor, (vii) training exposure, (viii) knowledge on potato contract farming, (ix) extension media contact, (x) satisfaction on potato contract farming, (xi) innovativeness through potato contract farming, (xiii) commercialization of potato cultivation, and (xiii) business growth due to potato contract farming. The dependent variable of the study was changes in ROI of potato production through contract farming.

The variables of the study were operationalized through direct questions, developing relevant scales by the researcher, and scales developed by others as shown in Table 3.3.

3.7 Measurement of Independent Variables

It was necessary to follow the methodological procedure for measuring the selected variables in order to carry out the study in accordance with the objectives. The following procedures are described for measuring the independent (causal) variables:

3.7.1 Age

The age of a respondent refers to the period from his/her date of birth to the time of the interview. It was measured in terms of actual years based on his/her response. A score of one (1) was considered for each complete year of their age.

Table 3.3 Summarized operationalization of the variables of the study with measuring unit

Variables	Measuring unit	Operationalization
Independent variables		
1. Age	Actual years	Direct question
2. Education	Schooling years	Direct question
3. Effective HH farm size	Hectare	Direct question
4. Effective potato contract farming area	Hectare	Direct question
5. Potato cultivation experience	Years	Scale developed for this study
6. Support services from the contractor	Scores	Scale developed for this study
7. Training exposure	Days	Scale developed for this study
8. Knowledge on contract farming	Numerical value	Scale developed for this study
9. Extension media contact	Scores	Scale developed for this study
10. Satisfaction on potato contract farming	Scores	Scale developed for this study
11. Innovativeness on potato contract farming	Scores	Scale developed for this study
12. Commercialization of contract farming	Scores	Scale developed for this study with the help of Ali, M.S. (2008); Scale developed by Kashem (1986)
13. Business Growth due to potato contract farming	Scores	Scale developed for this study
Dependent variable		
1. Changes of Return on Investment (ROI) of potato production through contract farming	Percentage (After – before ROI)	used ROI formula

3.7.2 Education

The education of the respondents was measured in terms of successful years of schooling, one (1) score given for passing each year in an educational institution and a score of 0.5 (half) given to the farmer who could only sign his/her name. A score of zero (0) was given to a respondent who could not read and write. Mazumder (2014), Ali (2008), and Amin (2004) followed this procedure for measuring education score. For example, if the farmer passed the HSC examination, his education score was given as 12 (10+2); if the farmer passed the final examination of class Eight (VIII), his education score was given as 8. If the farmer did not know how to read and write, his education score was given as '0' (zero). Farmers who learned only reading and writing on a basic level from the adult learning center received a score of 0.5. Non formal education was also scored as 0.5 for each year of learning.

3.7.3 Farm size

The following formula was used to calculate a respondent's farm size:

Farm size $= A_1 + A_2 + \frac{1}{2}(A_3 + A_4)$

Where

- $A_{1=}$ Own cultivated land area
- A_2 = Cultivated area leased in
- A_3 = Area under sharecropping (In)
- A_4 = Area under sharecropping (Out)

The farm size of the farmers was measured in hectares (ha).

3.7.4 Effective Land Area for Potato Contract Farming

This is the effective land area for potato contract farming by the respondent for potato cultivation assigned for contract farming. Land area for potato contract farming of the respondents was measured in hectares.

3.7.5 Potato Contact Farming Experience

The potato contract farming experience of the respondents was measured in terms of cultivating potato in the year directly involved in his/her life. A score of one (1) was assigned for each year of experience for potato contract cultivation. This type of measurement was used in Islam's (2006) study. Potato farming experience was categorized as a score by multiplying the number of years of experience by the types of potato production, i.e. local variety = 1, HYV variety = 2, and processing variety = 3, and calculating the total score as shown in Table 3.4.

Table 3.4 Calculation of potato contract farming experience

Types of potato growing	Duration (year of experience)	Basis of potato contract farming effective score(s) (1 for 1 year engaged in local potato cultivation; 2 for 1 year engaged in HYV/hybrid potato cultivation; 3 for 1 year engaged in processing potato cultivation)	Potato contract farming effective score
1	2	3	4
Local variety potato production experience	1	1	1x1=1
HYV/ Hybrid variety	1	2	1x2=2
Processing/ industrial variety	1	3	1x3=3
Total score			6

3.7.6 Support Service(s) from Contractor

Respondents' support services were defined as the extent to which they received assistance from their respective contractor on a 4-point scale, i.e. High was assigned a score of 3, medium was assigned a score of 2, low was assigned a score of 1, and no support was assigned a score of 0. Twelve (12) types of supports were provided by the contractor to the potato contract farmers. Each of the support items was administered to the respondents with four (4) alternative extent of responses as high, medium, low and no support, and scores were assigned to these alternatives responses as 3, 2, 1, and 0, respectively. Individual answers/frequencies of the support were considered for each of the alternative 12 types of responses. Finally, a respondent's support services are measured by adding all of his or her scores from the 12 questions. As a result, the respondents' possible score ranged from 0 to 36, with 0 indicating no support and 36 indicating the most support received from the contractor for potato cultivation.

The selected support services were:

- Information on land preparation and techniques
- Inputs related information
- Inputs support (seed)
- Inputs support (pesticides)
- Inputs support (fertilizers)
- Information on production techniques
- Field support services – pest and diseases
- Harvesting technology - Haulm pulling
- Post-harvest technology - sorting
- Post-harvest technology - grading
- Sales and marketing, and
- Financial support and linkages

3.7.7 Training Exposure on Potato Cultivation

Training exposure on potato cultivation refers to the extent to which farmers participate in formal training programs on potato cultivation offered from time to time by various organizations and agencies. It was considered by the respondents' total number of days of participation in the training program. A score of one (1) was assigned for one day of training

experience. A zero (0) score was assigned for no training exposure. Ali (2008) and Mazumder (2014) used this type of measurement in their studies.

3.7.8 Knowledge of Potato Contract Farming

Knowledge, was defined in this study as "those behaviors and test situations that emphasized the remembering of ideas, material, or phenomena either by recognition or recall" (Bloom, 1956). This variable indicated the extent of contract farming operation, system, implication on the potato cultivation, potato farming, and supply chain knowledge of the respondents at the time of interview as evidenced by their responses to a set of logically and scientifically prepared questions for this purpose. There were 20 questions related to contract farming issues, cultivation practices, inputs, sales, and marketing, each question scored 0-2 marks (if positive obtains 2, somewhat understandable obtains 1, and no knowledge obtains zero), at the end the total score was calculated and ranged from 0-40. Thus, the possible score of the respondents ranged from 0 to 40, where 0 indicated no knowledge as per questions asked and 40 indicated highest knowledge on potato cultivation.

3.7.9 Extension Media Contact

Extension media contact was the source of information received for technologies, advice/ advisory support on potato cultivation. Some of the information was received from an individual, personal contact, group contact, and mass contact for potato cultivation and its practices. The extension media contact of a respondent was measured by the extent of contact with 17 selected agricultural extension media. The degree of communication was scaled by 3, 2, 1, and 0 weights as per the responses for high, medium, low, and not at all, respectively. A similar scale was developed by Ali (2008) for measuring extension contact used in this study.

In the end, the extension contact score of a farmer was computed by summing all the scores of 17 types of selected extension media by the respondent. Thus, the extension contact score of a farmer ranged from 0 to 51 while '0' indicated no extension contact and '51' indicated the highest extension contact.

3.7.10 Satisfaction on Potato Contract Farming

It consisted of information about the measured individual satisfaction of the respondents on engaging contract farming system for potato production. The method was given by Likert

(1967) and Ali (2008) and used for the construction of the scale to measure the satisfaction of the contract farmers towards contract farming for the present study.

The level of satisfaction on potato contract farming of a respondent was measured by the 33 selected items of potato contract farming activities. The extent of satisfaction scale was developed arranging the weights as 3, 2, 1, and 0 for the responses for high, medium, low, and not at all, respectively.

Finally, the extent of satisfaction was computed by summing all the scores for contact with 33 types of selected items by the respondent. Thus, the satisfaction of contract farming score of a farmer could range from 0 to 99, with '0' indicating no satisfaction and '99' indicating the highest level of satisfaction.

3.7.11 Innovativeness of the Potato Contract Farming

Innovation consisted of information about the measured individual innovativeness of the respondents after engaging contract farming system for potato production. The scale of the innovativeness was developed by Likert (1967) and Ali (2008) and used for the construction of the scale to measure the innovation of the contract farmers towards contract farming for this study. Ten (10) items were used to assess the level of innovativeness in a 5-point scale i.e., used within 1 year of hearing = 4, used within >1-2 years of hearing =3, used within >2-3 years of hearing =2, used after 3 years of hearing =1 and never used = 0 on potato contract farming. For each item, logical frequencies of contact were assigned to each type of response.

In the end, the total score was computed by summing all the scores for contact with 10 types of selected items by the respondent. Thus, the total score of a farmer ranged from 0 to 40, while '0' indicated no innovativeness, and '40' indicated the highest level of innovativeness.

3.7.12 Commercialization of Potato Contract Farming

The term "agricultural commercialization" refers to the production of crops for market sale rather than family consumption. It was calculated in this study using the value of production after family consumption. A respondent's commercialization was determined based on his total production from that unit of land and the amount of potato sold from the production.

A respondent's commercialization of potato farming was defined as the ratio of total selling

price to total value of potatoes produced by the respondent in a year. It was expressed as a percentage.

$$Commercialization = \frac{Value\ of\ sold\ Potato}{Value\ of\ Produced\ Potato} \times 100$$

Commercialization of an individual referred to the ratio of the value of crops sold and the total value of crops raised. It was expressed in percentage. The commercialization score of a respondent farmer was determined based on the value of crops sold out of the total value of crops raised. The following formula was used by Ali (2008) to calculate a farmer's commercialization score:

$$Commercialization\ Score = \frac{Value\ of\ sold\ crops}{Total\ value\ of\ raised\ crops} \times 100$$

The commercialization score could be 0 to 100, with 0 indicating no commercialization and 100 indicating extremely high commercialization (Dube and Guveya, 2016; Ele *et al.*, 2013).

Finally, the following formula was used in this study:

$$Commercialization\ Score = \frac{Qantity\ of\ \ sold\ potato}{Quantity\ of\ total\ produced\ potato} \times 100$$

3.7.13 Business Growth due to Potato Contract Farming

This is the process of increasing an enterprise's success and revenue, as well as its competitiveness in production, sales, and profitability. Business growth can be achieved by increasing the top line or revenue of the business through increased product sales or service income, or by increasing the bottom line or profitability of the operation through cost reduction. Business growth is a stage in which a company has reached the point of expansion and is looking for new ways to generate more profit. Business growth is determined by the business lifecycle, industry growth trends, and the owner's desire to create equity value. Business growth capital is essential for all businesses looking to scale up. A growth company was defined as

one whose operations generate significant positive cash flows or earnings that grow at significantly faster rates than the overall economy. A growing company usually has a lot of profitable reinvestment opportunities with its own retained earnings.

After extensive consultation with relevant experts and searching the literature, ten (10) items of Business Growth due to potato contract farming were chosen. Respondents were asked to indicate the Business Growth with four alternative responses as high, medium, low and no growth due to potato contract farming enumerated, and scores were assigned as 3, 2, 1, and 0, respectively for the responses. The total Business Growth score of the respondents was measured by adding all the scores against all the 10 items. Thus, the total score of a farmer could range from 0 to 30 while '0' indicated no growth and '30' indicated the highest growth of the potato contract farming business.

3.8 Measurement of changes of Return on Investment (ROI) of potato production through Contract Farming

Return on Investment (ROI) is expressed in terms of a percentage of increase or decrease in the value of the investment. ROI is a simple ratio of the gain or loss from an investment relative to its cost. ROI is the amount of profit earned, expressed as a percent of the total investment. It is also expressed as the ratio of net income to common equity, which measures the rate of return on investment (Brigham and Huston, 2001).

ROI of potato farming was measured using the formula:

$$ROI = \frac{Net\ Profit}{Total\ cost\ of\ production} \times 100$$

Where:

Net profit = Total Income from potato production – Total cost of potato production

Total Cost = Addition of all production related cost (land lease, labour, land preparations, seeds, fertilizers, pesticides, irrigation, intercultural operation, harvesting, post-harvest, transportation, and marketing, etc.).

Total Income = Total potato production in kg × price per kg of potato

The change in ROI of potato production of a farmer was computed by deducting the ROI of the potato farmers before engagement of contract farming (in 2014) from the ROI after engagement of potato contract farming (in 2019). The differences in ROI were considered as the main focus or the dependent variable of this study.

A simple t-test was applied to compare ROI between the contractual and non-contractual potato farmers in 2019 (during data collection).

3.9 Problems of Contract Farming Faced by the Farmers in Potato contract farmers

The respondents' problems with potato contract farming were graded on a four-point scale. Following a thorough search of existing literature, consultation, and discussion with relevant experts and farmers, thirteen (13) items of production, market, quality compliances, and overall operation problems were used to collect data. The respondent farmers were asked to indicate their extent of the problem against each of the problems. Each problem scores of 3, 2, 1, and 0 were assigned to indicate the extent of problems as high, moderate, low, and not at all problem, respectively. The problem faced in the potato contract farming score was computed for each respondent by adding his/her scores against all 13 problems. Thus, the possible range of problems faced in the agriculture score of the respondent farmers could range from 0 to 39, where 0 indicated no problem at all and 39 indicated the highest problem faced by the contractual farmers in potato production activities. To ascertain the severity of the problems, Problem Faced Index (PFI) was computed by using the following formula for each problem item:

$PFI = P_s \times 3 + P_m \times 2 + P_l \times 1 + P_n \times 0$

Where:
PFI = Problem Faced Index;
P_s = Number of farmers who faced high problem;
P_m = Number of farmers who faced moderate problem;
P_l = Number of farmers who faced low problem;
P_n = Number of farmers who faced no problem at all.

$$PFI = P_s \times 3 + P_m \times 2 + P_l \times 1 + P_n \times 0$$

Given the total number of respondents (262), the PFI of each item could thus range from zero (0) to 786, where 0 indicated no problem at all and 786 indicated the most serious problem.

Rank order was also made based on the descending order of PFI of the problem items to compare the problems. Respondent farmers were asked to indicate three important suggestions against each of the problems to mitigate the problem. Based on the highest citation number, three important solutions were identified for each problem in potato contract farming.

To express the problem faced index (PFI) in a meaningful way, it was necessary to convert and standardize the problem index (SPI) by using the formula:

$$Stabdardized\ Problem\ Index\ (SPI) = \frac{Computed\ Problem\ Faced\ Index}{Possible\ Highest\ Problem\ Faced\ Index} \times 100$$

The SPI of each of the items of the problem could range from 0 to 100, where zero (0) indicated no problem and 100 indicated a very serious problem faced.
The thirteen (13) selected problem items are listed below:

- Lack of information
- Lack of price bargaining power
- Substandard quality of inputs
- Difficult to collect prescribed inputs
- Poor support and agricultural extension services
- Lack of commitment of the contractors
- Complicated compliances
- Tight crop scheduling
- Delay in arranging inputs
- Delay payment by the contractor
- Side selling/ purchasing by the contractors
- Lack of credit for crop production
- High price of inputs

3.10 Validity and Reliability of the variables

Regarding validity, Kaiser – Meyer –Olkin (KMO) measure of Sampling Adequacy was measured for data adequacy of further statistical analysis. As per KMO and Bartlett's test, a measure of >0.9 is marvellous, >0.8 is meritorious, >0.7 is middling, >0.6 is mediocre, >0.5 is miserable and <0.5 is unacceptable. After running the test, it was found that the overall KMO of the variables was 0.883, which indicated the selected variables were meritorious. The KMO of individual variables are presented in Table 3.6.

Table 3.5: KMO measurement and sampling adequacy

Entered Variable for KMO measure of sampling adequacy	KMO
Age of the contract farmers	0.3872
Education of the contract farmers	0.9269
Effective HH farm size	0.3904
Effective potato contract faming land size	0.6875
Potato farming experience	0.9241
Contract farming support services	0.9622
Training days	0.9666
Knowledge on contract farming	0.9228
Agricultural extension communication	0.9296
Contract farming satisfaction	0.972
Contract farming innovativeness	0.9633
Changes of Return on investment (ROI) of potato production through contract farming	0.9582
Commercialization difference (before after)	0.8569
Business growth due to contract farming	0.8606
Overall	0.883
Average inter item covariance	

Test scale = mean (unstandardized items)
Reversed item: effective land size
Average inter item covariance: 57.17283
Number of items in the scale: 14
Scale reliability coefficient: 0.8839

According to KMO analysis through SPSS-26 the data returned a value sampling adequacy of 0.883 indicating Bartlett's test of Sphericity is a measure of the multivariate normality of the set of distributions. The data within this study returned a significance value of 0.00, indicating that the data was acceptable for analysis. The Kaiser-Mayer-Olkin (KMO) index was 0.883, exceeding the recommended value of 0.6 (Kaiser 1970), and Bartlett's test of Sphericity (Barett 1954) reached significance χ^2=3646.205, p<.001), indicating that our data were suitable for factor analysis and appropriate for further statistical and econometric analysis. As per KMO score 88.3% of the factors were explained the objective of the research.

3.11 Research Hypothesis

In light of the objectives of the study, the following research hypotheses were formulated for the statistical test:

- Selected characteristics of the potato contract farmers' had significant contribution to the change in ROI of potato production through contract farming
- There was a significant difference in ROI between contractual and non-contractual potato farming

3.12 Null Hypothesis

The aforesaid research hypotheses were converted into the following null hypothesis for testing:

- There was no significant contribution of the selected characteristics of the potato contract farmers to the changes in ROI of potato production through contract farming
- There was no significant difference in ROI between contractual and non-contractual potato farming

3.13 Data Processing

3.13.1 Editing, Coding, Cleaning and Tabulation

The raw data was thoroughly examined for errors, completeness, and omissions before being cleaned. The completed interview schedule was scrutinized, i.e. complete, coding, and correct data were entered into the database for analysis and tabulations. Local unit scales were converted to standard unit whenever necessary. In the case of qualitative data, appropriate scoring techniques were used to assign appropriate weights to each of the traits to convert the data into quantitative forms. Several tables and figures were prepared to keep the study's

objective in mind for better clarity and understanding. Then, in accordance with the study's objectives, relevant tables and figures were created.

3.13.2 Statistical Analysis

Data were coded, tabulated, compiled, and analyzed according to the objectives of the study. SPSS-26 and MS Excel were used for data analysis. Descriptive statistical measures including number, percentage distribution, range, rank order, mean, and standard deviation were used for describing both the independent and dependent variables. Different statistical models and tests (stepwise multiple regression model, path analysis, DiD, and simple t-test) were used for testing the null hypothesis. Five percent (0.05) level of probability was used as the basis for rejection of any null hypothesis throughout the study. Co-efficient values significant at 0.01 confidence level was indicated by one asterisk (*), at 0.05 level by two asterisks (**), and at 0.001 level or above by three asterisks (***).

To make valid inferences from stepwise regression analysis, the residuals of the regression followed a normal distribution through collinearity test to understand if any error occurred in the database and selection of the variables. In the stepwise regression model, R-squared values are usually too high. Adjusted r-squared values might be high and then dip sharply as the model progresses. The researcher examined the normal Predicted Probability (P-P) plot, and confirmed there was no collinearity error in the database (acceptable level of variance inflation factors - VIF below 5). The data were normally distributed as indicated in Table 3.5. Homogeneity of variances are shown in the context of *t*-tests, ANOVA and collinearity VIF. Linearity methods revealed a straight-line relationship between the predictor variables in the regression and the outcome variable difference in ROI of potato contract farming. Multi-collinearity refers to the selected predictor variables that were highly correlated with each other. This study showed the VIF correlation coefficient value of the variables ranged from 1.13 to 5.00, which is the best fit for further analysis (Hair et al., 2013). A value of VIF 1 indicates that there was no correlation between this independent variable and any others. VIFs between 1 and 5 suggest a moderate correlation. None of the variance proportions yielded the same result, and all were less than 0.9, indicating that there was no multi-collinearity problem or error in the study's chosen predictors (Hair et al., 2013). Several eigenvalues close to 0 (zero) are an indication of multi-collinearity (IBM, n.d., 2019). Since "close to" is somewhat imprecise, it is better to use the next column with the Condition Index for the diagnosis. Most of the condition

index between 8-40 means there was collinearity but acceptable fit analysis (IBM, 2019; Snee, 1983). In this study, all variables were shown to be less than 30, which was completely acceptable. As a result, there was no multi-collinearity among the variables chosen, and the analysis was suitable for stepwise regression and provided genuine inference.

Table 3.6 Coefficient of multi-collinearity analyses of the selected variables

Coefficients[a]							
Variable			**Standardized coefficients**	**t**	**Sig.**	**Collinearity statistics**	
						Tolerance	**VIF**
(Constant)	-21.35	3.45		-6.19	0.00	-	-
1.Age	-0.03	0.03	-0.02	-1.07	0.29	0.88	1.14
2.Education	-0.14	0.10	-0.03	-1.48	0.14	0.74	1.36
3.Effective Farm Size	-0.19	0.32	-0.02	-0.60	0.55	0.20	5.00
4.Effective CF land size	3.05	0.89	0.11	3.44	0.00	0.22	4.63
5.CF Experience	-0.24	0.10	-0.05	-2.44	0.02	0.65	1.53
6.Support service	0.18	0.07	0.05	2.46	0.01	0.62	1.61
7.Training exposure	0.29	0.14	0.04	1.97	0.05	0.51	1.95
8.Knowledge on CF	0.26	0.08	0.10	3.14	0.00	0.22	4.51
9.Extension media contact	0.37	0.06	0.15	6.66	0.00	0.46	2.17
10.CF_ Satisfaction	0.04	0.02	0.06	2.09	0.04	0.27	3.64
11.CF_Innovativeness	0.12	0.06	0.06	2.19	0.03	0.27	3.67
12.Commercialization	0.14	0.03	0.08	4.94	0.00	0.82	1.21
13.Business Growth due to CF	1.70	0.07	0.63	25.19	0.00	0.38	2.63

CHAPTER 4

CHANGES OF RETURN ON INVESTMENT OF POTATO PRODUCTION THROUGH CONTRACT FARMING

CHAPTER 4

CHANGES OF RETURN ON INVESTMENT OF POTATO PRODUCTION THROUGH CONTRACT FARMING

4.1 Extent of Changes of Return on Investment of Potato production through Contract Farming

The extent of changes of Return on Investment (ROI) of potato production through contract farming of the farmers ranged from 5.30 to 96.21, with the mean, standard deviation, and coefficient of variance of 52.69, 16.91, and 32.08 respectively. The contract farmers were classified into three categories based on their changes of ROI of potato production through contract farming as presented in Table 4.1.

Table 4.1 Distribution of farmers according to the changes of ROI of potato production through contract farming

Changes of ROI	Frequency	Percent (%)	Mean	SD	CV (%)
Low changes of ROI (up to 35.78; <Mean – 1SD)	27	10.31			
Medium changes of ROI (≥35.78 – 69.60; Mean ± 1SD)	207	79.01	52.689	16.905	32.085
High change of ROI (> 69.60; Mean +1SD)	28	10.69			
Total	262	100			

According to data presented in Table 4.1, the majority (79.01%) of potato contract farmers' ROI was mediumly changed (improved) as a result of contract farming, while 10.31% changed (improved) a high level of ROI and 10.69% increased a low level of change of ROI of potato production as a result of contract farming. No negative change in ROI of potato contract farming was found in the study. Co-efficient of Variance (32.08%) of ROI differences of the potato contract farmers indicated that the farmers were homogenous, based on the ROI of potato contract farming.

Gulati et al. (2005) discovered a similar result, that the gross margins for contract farmers in India were nearly double that of independent farmers. Singh (2002) compared contract farming arrangements in the Indian state of Punjab and discovered that smallholder farmers who participate in contract farming had higher incomes. According to Brithal (2008), contract farming is more profitable than independent production. Contract farming (CF) proved useful in achieving efficiency and profitability in smallholder lentil farms in Nepal when it comes to the financial viability of small farms, particularly in developing countries, and globalization (Mishra et al., 2018). Miyata et al. (2007) examined apple and onion contract farming arrangements in China and discovered that contract farming participation was associated with higher incomes. Contract farming, according to the econometric model and qualitative data, can increase farming productivity, produce quality, and farming cost efficiency (Sokchea and Richard, 2015). Wang et al. (2014) investigated the impact of contract farming on farm productivity and household income. As a result, the study discovered a positive change in the ROI of potato production through contract farming model.

4.2 Extent of Changes of ROI of potato production through contract farming by DiD method

The Difference in Difference (DiD) method was also used to calculate the ROI of potato contract farming. The DiD method is based on comparisons of after vs. before and treatment vs. control groups. The DiD method was used to calculate the ROI of potato contract farming using time series data. Initially, contract farmers were considered prior to contract farming engagement, and ROI of the treatment group versus a control group was compared. Contract farming ROI was better in the treatment group after the contractual arrangement. Similarly, ROI was compared after contract farming and before contract farming taking into account the time differences of control respondents.

Changes in contract farming ROI were calculated using the after-before and treatment-control differences, as well as the DiD impact measure, as shown in Tables 4.2, 4.3, 4.4, and 4.5. ROI of potato contract farming gap between before and after was 4 years, i.e. before contract farming engagement in 2014 and present means 2019 data. An independent sample t-test was conducted along with regression analysis to determine the extent of changes in ROI of potato production through contract farming as dependent factors.

Table 4.2 Mean and standard deviations of the dependent factors as per longitudinal perspective in potato contract farming

Time difference of potato contract farming engagement	Types of group	N	ROI of potato production	
			Average	Standard deviation
Before potato contract farming	Treatment	262	13.717	11.936
	Control	56	7.016	4.733
After potato contract farming	Treatment	262	66.406	12.733
	Control	56	25.078	8.960
Difference	Treatment	262	52.689	16.905
	Control	56	18.344	9.275

Table 4.2 shows that the difference in ROI after 4 years differs significantly between the control and treatment groups, with the treatment group having a much higher ROI than the control group. Table 4.3 shows that the DiD estimator showed that the ROI on potato contract farming engagement was significantly higher than that of the non-contract farmer in potato farming. It was found that ROI of potato production through contract farming increased by 3.84 times in the treatment group (contract farming) and by 2.57 times in control farmer (traditional) in the course of time series data, thus the DiD ROI results shows a positive change of 1.27 times than the comparison group in potato contract farming engagement compared to the non-contractual farmers. Figure 4.1 illustrates the sharp stiff trend of the DiD in the positive growth of ROI of potato production through contract farming, which is 3.84 times faster than the control group i.e. intervention effect through contract farming is faster. The calculation of the constant difference revealed that the ROI had increased by 384% compared to before contract farming. Similarly, the impact of CFs on income was found to be positive in the Indian context; Dev and Rao (2005); Nagaraj et al. (2008); Kumar and Kumar (2008); Ramaswami et al. (2006); Tripathi et al. (2005); Birthal et al. (2005); Kalamkar (2012); Kumar (2006); and Dileep et al. (2002) all found that contract producers earned profits almost three times higher than those of independent producers, owing to the farmer's higher yields and assured output prices.

The results of the regression analyses, as shown in Tables 4.4 and 4.5, revealed significant changes in the ROI of potato production as a result of contract farming intervention at the 95% or higher level of significance. The independent simple t- test (Tables 4.4 and 4.5) also showed significant differences in ROI of potato production through contract farming during the before and after mean differences at 99.99% level of significance. Therefore, the results and findings

of the DiD method found that the potato contract farming made significant positive increment (changes) in ROI of potato production through contract farming.

Table 4.3 Extent of changes of ROI of potato production through contract farming by DiD analysis method

Farmers group	ROI mean			Change (%)
	Before (2014)	After (2019)	Difference	
Treatment	13.72	66.41	52.69	384
Control	7.02	25.08	18.06	257
Difference	6.70	41.33	34.63	127

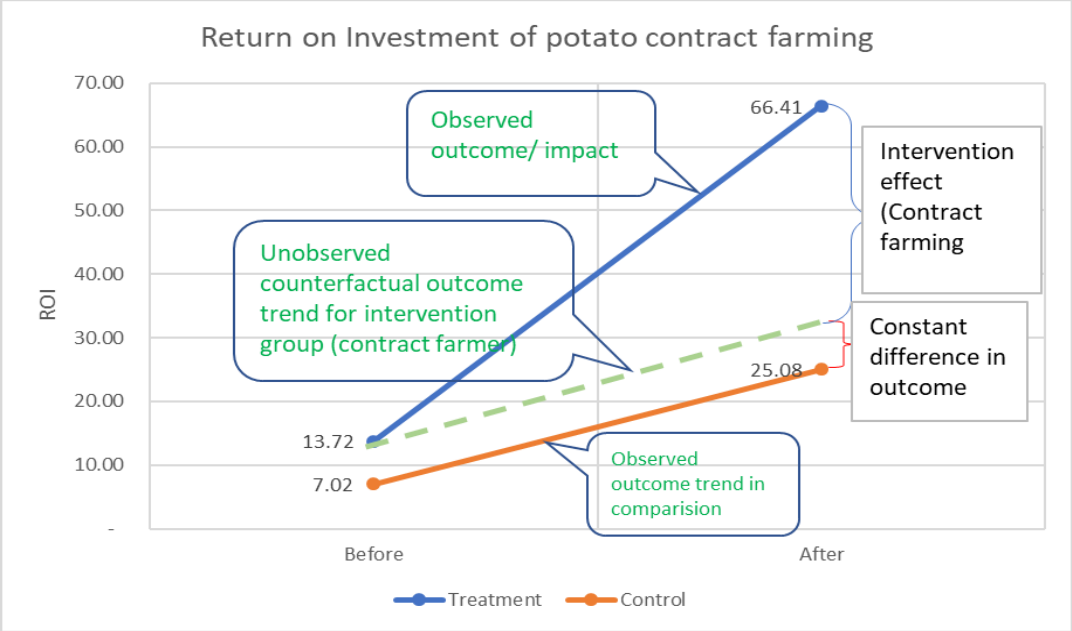

Figure 4.1 ROI of potato contract farming

Table 4.4 Independent Simples Test – ROI

Levene's test for equality of variances			t-test for equality of means						
Variable	F	Sig.	t	df	Sig. (2-tailed)	Mean difference	Std. error difference	95% Confidence interval of the difference	
								Lower	Upper
ROI Before	20.548	0.000	4.128	316	0.000	6.701	1.623	3.507	9.895
ROI after	5.097	0.025	23.084	316	0.000	41.327	1.790	37.805	44.850
ROI Difference	9.273	0.003	14.724	316	0.000	34.344	2.332	29.755	38.934

Table 4.5 Extent of changes of ROI of potato production through contract farming on treatment and control group - Regression analysis (t-test)

ROI difference	Coeff.	Std. Err.	t	P>t	[95% Cf]		R^2	Adjusted R^2	*F*	*P*
Treatment vs Control	-34.34	2.33	-14.72	0.00***	-38.93	-29.76	0.41	0.41	216.81	0.00***
Constant	87.03	2.88	30.18	0.00***	81.36	92.71				

4.3 Compare the ROI between Contractual and Non-Contractual Potato Farming

Data was collected from both sampled potato contract farmers and non-contract potato farmers to calculate ROI in the same year, same time, and same season of potato cultivation, i.e. 2019. As a result, the mean ROI was compared between two groups (contractual and non-contractual farmers) using SPSS-26 for a simple t-test (unequal respondent) and a significant mean difference was discovered between the groups. This meant that potato contract farmers earned a higher ROI than control farmers (non-contract farmers). The ROI in the treatment group was higher. Tables 4.6 to 4.8 shows that the calculated t-value was higher than table values, and potato contract farming ROI and non-contract farmers' ROI were not in the same order, as they differed significantly. Therefore, the ROI of potato production through contract farming was much higher than that of the non-contract farmer.

Table 4.6 Comparison of the ROI between contractual and non-contractual potato farming

t-Test: Two-sample assuming unequal variances			
Variable	**ROI Control group**	**ROI Treatment group**	**Difference**
Mean	25.28	66.41	41.13
Variance	80.07	162.13	
Observations	56	262	
Hypothesized mean difference	0		
P(T<=t) one-tail	0.000		
P(T<=t) two-tail	0.000		

Table 4.7 Comparison of the ROI between contractual and non-contractual potato farming

One-sample statistics				
Variable	**N**	**Mean**	**Std. deviation**	**Std. error mean**
ROI Control	56	25.28	8.95	1.20
ROI Treatment	262	66.41	12.73	0.79

Table 4.8 Regression analysis for simple t-test to compare the ROI between contractual and non-contractual potato farming

One-sample test						
Variable	Test value = 0					
	T	df	Sig. (2-tailed)	Mean difference	95% Confidence interval of the difference	
					Lower	Upper
ROI Control	21.14	55.00	0.00	25.28	22.88	27.67
ROI Treatment	84.42	261.00	0.00	66.41	64.86	67.95

Similarly, Khan et al. *(*2019) conducted a study in Pakistan on the impact of contract farming on land productivity and income of potato growers, and found that potato contracting was associated with significantly higher income for participating farmers. They also discovered that there was no negative relationship between contract participation and other sources of income. In India, the impact of contract farming has been quite visible and remarkably favorable on the yield and profitability of potato production at the existing pattern of resource-use and production technology prevalent in the Haryana farming system (Tripathi et al. (2005). The yield uncertainty was less in contract than non-contract potato production. These findings have underlined the superiority of contract farming over the non-contract farming system in potato production, indicating tremendous scope to increase the profitability in potato production under contract farming situation compared to the non-contract system. Therefore, potato contract farming has a positive and significant ROI than that of the non-contract farmer.

Chapter 5

CHARACTERISTICS OF THE POTATO CONTRACT FARMERS

CHAPTER 5

CHARACTERISTICS OF THE POTATO CONTRACT FARMER

5. Characteristics of potato contract farmer

Certain characteristics, criteria, and/or attributes were required of an individual farmer for potato contract farming to be successful. Every individual is distinct. According to the contractor, farmers require some special qualities to form a formal relationship and produce specific potatoes. Some of the characteristics are related to human behavior, such as a person's personal, economic, and professional characteristics. As stated earlier, 13 characteristics such as age, education, effective farming land size, effective contract farming land size, potato contract farming experience, support service received from contractor, training exposure, knowledge on contract farming, extension media contact, satisfaction on potato contract farming, innovativeness in potato contract farming, commercialization of potato, and business growth due to potato contract farming, were selected for this study. Additionally, one dependent (focused) variable changed the ROI of potato production through contract farming. Table 5.1 displays the salient characteristics of the farmers, including the measuring unit, possible and observed score, range, mean, standard deviation (SD), and coefficient of variance (CV) of the selected potato contract farmers.

Table 5.1 Distribution of selected characteristics of the potato contract farmers including measuring unit, possible and observed range, Mean, Standard Deviation (SD), and Co-efficient of variance (CV)

S. No	Potato contract farmers characteristics	Measuring unit	Possible range	Observed range	Mean	SD	CV (%)
1	Age	Actual years	Unknown	24-59	45.31	8.75	19.31
2	Education	Schooling years	Unknown	0.5-12	7.00	3.00	42.39
3	Effective farming land size	Hectare	Unknown	2.0-15.25	4.46	1.81	40.55
4	Effective contract farming land size	Hectare	Unknown	0.5-5.5	1.71	0.63	36.86
5	Potato contract farming experience	Year	Unknown	8-20	16.40	3.28	20.02
6	Support service received from contractor	Score	Unknown	10-34	25.30	4.51	17.83
7	Training exposure	Score	Unknown	2-12	7.05	2.51	35.56
8	Knowledge on contract farming	Score	Unknown	14-38	32.54	6.74	20.71
9	Extension media contact	Score	Unknown	14-48	36.57	6.81	18.62
10	Satisfaction on contract farming	Score	Unknown	8-94	67.18	27.69	41.22
11	Innovativeness in Contract farming	Score	Unknown	9-39	29.79	8.98	30.13

S. No	Potato contract farmers characteristics	Measuring unit	Possible range	Observed range	Mean	SD	CV (%)
12	Commercialization of potato	Unknown	Unknown	50-98	86.35	10.22	11.84
13	Business growth due to potato contract farming	Score	Unknown	7-28	17.00	6.00	35.95
Dependent variable							
1	Changes of ROI of potato production through contract farming	Score	Unknown	5.30-96.21	52.69	16.91	32.08

5.1 Age of the potato contract farmers

Age was one of the major independent characteristics of the potato contractual farmer for the study. It was observed that the age of the potato contract farmers' ranged from 24 to 59 years, where the mean age was 45.31 years, standard deviation was 10.31, and coefficient of variation was 19.31%. The distribution of the farmers according to their age is shown in Table 5.2.

Table 5.2 Distribution of the farmers according to their age

Age of the respondents	Number	Percent (%)	Minimum	Maximum	Mean	SD	CV
Young age (up to 35 year)	44	16.79					
Middle age (35-50 year)	164	62.60	24	59	45.31	8.75	19.31%
Old age (>50 years)	54	20.61					
Total	262	100					

The information in Table 5.2 revealed that 62.60% of the potato contract farmers were middle-aged, 20.61% were old aged and 16.79% were young people. The coefficient of variation (19.31%) of the age of the respondents indicated that the sample farmers were homogenous. According to the regression analysis, the farmer's age was not a significant variable ($r=0.29^{NS}$) in changes of return on investment to operate potato contract farming in Bangladesh for processing variety potato cultivation. The general idea is that the introduction of contract farming is a new business model in Bangladesh's farming system, ensuring extension services, market information, and a return on investment. Arumugam and Shamsudin (2013) examined rock melon growers' attitudes toward contract farming practices and discovered that the majority of melon farmers were between the ages of 40 and 49.

It was found that middle-aged farmers were involved in potato contract farming in Bangladesh and the age of the farmers was not an important factor for the smooth operation of the potato

contract farming in Bangladesh. From this study, it is evident for the companies and contractors that middle-aged and young farmers should be given preference to engage in contractual farming. Policy should be implemented to encourage more young people to participate in Bangladesh's new farming and procurement systems in the food value chain.

5.2 Education of the contract farmers

According to the study, the contract farmers' schooling years ranged from 1.0 to 12.0, with a mean of 7.0, a standard deviation of 3.0, and a coefficient of variation of 42.39% (Table 5.3). Table 5.3 shows how the sample farmers were divided into three (3) categories based on their level of education.

Table 5.3 Distribution of the farmers according to their education

Level of education	Number	Percent (%)	Min	Max	Mean	SD	CV
Can sign only	22	8.4					
Primary (up to 5 years of schooling)	55	20.99					
Secondary (6-10 years of schooling)	161	61.45	0.5	12.0	7.0	3.0	42.39%
Above secondary (>10 years of schooling)	24	9.16					
Total	262	100					

Data shown in Table 5.3 indicated that the highest proportion (61.45%) of the farmers had a secondary level of education, followed by 20.99% primary level, and 9.16% higher secondary level of education, while the remaining 8.4% respondents can sign only. These findings indicated that the majority (92%) of the respondents were literate with primary to HSC level of education; where the national average literacy rate is 72.8% (BBS, 2018[a]). The sample farmers were selected for potato contract farming based on relatively educated (above primary level) farmers. Farmers, according to the contracting companies, needed some sort of education to understand the training, contract farming production practices, contract farming knowledge, and potato farming knowledge. Shamsudin and Nalini (2013) discovered that 41% of rock melon contract growers had a secondary education.

Coefficient of variation (CV) of education of the sample potato contract farmers (42.39%) indicated they were a homogenous and similar group of respondents. But the education of the respondent farmers was insignificant related ($r = 0.139^{NS}$ at 0.05 level of probability) to changes of return on investment. The findings indicated that the education of the farmers was not an important factor for changing the return on investment of potato cultivation. Miyanta et al. (2009) found that the level of education had no effect on income among apple and green onion contract growers in China.

5.3 Effective farm size

It was observed that the farm size of the potato contract farmers varied from 2.0 to 15.25 ha. The average farm size was 4.46, standard deviation 1.81, and coefficient of variation 40.55% (Table 5.4). The respondent farmers were classified into three categories based on household farming land area:

Table 5.4 Effective household land size of the farmers

Effective land size	Freq.	Percent (%)	Min	Max	Mean	SD	CV
Large farmer (>3 ha)	16	6.11	2.0	15.25	4.46	1.81	40.55
Medium farmer (1-3 ha)	240	91.6					
Small farmer (0.2-1 ha)	6	2.29					
Total	262	100					

Data presented in Table 5.4 indicated that the highest proportion (91.60%) of the farmers had the medium size of farming land, followed by 6.11% having large farm, and 2.29% small or marginal farm. The coefficient of variation (40.55%) of the total farming land size indicated that the sample farmers were homogenous based on their land. The relevant contractors also mentioned that for contract farming they preferred to engage medium to the large size of farmers for potato cultivation. However, effective farming land size is highly significant and positively associated with changes in return on investment (r = 0.001**, significant at 0.001 level) for potato contract farming to produce an industrial variety of potato. A similar result was found by Little and Watts (1994) and Singh (2002) in their studies that companies preferred to work with medium- and large-scale growers for contract growing, because the contracts often involve the provision of seed, fertilizer, and technical assistance on credit and a guaranteed price at harvest. This form of vertical coordination simultaneously solves several constraints on small-farm productivity, including risk and access to inputs, credit, and information.

Guo et al. (2005) found that small farmers are less likely to participate in contract farming than large farmers. In Senegal, green bean exporters switched from small-scale contract production to large-scale production (Maertens, 2006) due to better income. Contract farming usually involves a large-scale buyer, such as an exporter or a food processor that needs to ensure a steady supply of raw materials meeting certain quality standards.

According to Escobal and Cavero (2011), potatoes sold to agro-processors in Peru have a positive effect on access to the particular chain under study. Furthermore, Escobal and Cavero (2011) discovered that farmers in districts with a high concentration of medium- to large-scale growers have a higher chance of gaining access.

Therefore, the choice of potato contract farming in processing variety cultivation was considerably influenced by the medium and large farmers. Policymakers, especially DAE may take initiative to make formal exportable and processing variety farming with medium to large scale farmers.

5.4 Potato contract farming land size

The potato contract farming land size ranged from 0.5 to 5.5 ha, with a mean of 1.71 ha, standard deviation of 0.63, and coefficient of variation of 36.86% (Table 5.5). The sample farmers were classified into three categories based on their processing variety of potato cultivation area and presented in Table 5.5.

Table 5.5 Effective potato contract farming land size of the potato contract farmers

Effective contract farming land	Number	Percent (%)	Min	Max	Mean	SD	CV
Large potato farming land	48	18.32	0.50	5.50	1.71	0.63	36.86%
Medium potato farming land	213	81.3					
Small potato farming land	1	0.38					
Total	262	100					

Data presented in Table 5.5 indicated that the highest proportion (81.30%) of the farmers had the medium size of potato farming land, followed by 18.32% having the large land size and 0.38% having small piece of land for potato cultivation, which was above 0.50 ha. The coefficient of variation (36.86%) of total potato farming land size indicated that the sample

farmers were homogenous based on their land. It was found that large household farmers were engaged in potato contract farming, which has a positive correlation with farm size.

Companies preferred medium to large size contractual farmers for potato cultivation due to easy communication, a bulk volume of production, cost-effective transportation and provision of the necessary support services. Large farms, according to the company representative, were easier to monitor, supervise, and predict the volume of production. However, for potato contract farming to produce the industrial variety of potatoes, potato land size is highly significant and positively associated with return on investment (r = 0.001***, significant at the 0.001 level).

5.5 Potato contract farming experience

The experience levels varied widely from farmers with no prior experience to farmers born and raised on farms farming. The majority of potato farmers had been in business for more than 13 years. The observed range of potato cultivation experience of the respondents ranged from 8 to 20 years, with a mean of 16.4, standard deviation of 3.28, and coefficient of variation of 20.02% (Table 5.6). The contract farmers were classified into three categories based on the experience in potato cultivation.

Table 5.6 Distribution of the farmers according to experience in potato cultivation

Categories of experience	Freq.	Percent (%)	Min	Max	Mean	SD	CV
Short potato farming experience (< Mean - SD i.e. < 13.40)	50	19.08					
Medium potato farming experience (Mean ± SD i.e. 13.4 – 19.68)	158	60.31	8.0	20.0	16.04	3.28	20.02%
Long potato farming experience (> Mean + SD i.e. > 19.68)	54	20.61					
Total	262	100					

Table 5.6 indicated that the majority (60.31%) of the potato farmers had medium farming experience in potato cultivation, followed by 20.61% having long farming experience and 19.08% having short farming experience in potato cultivation. The findings again revealed that the majority (80.92%) of the farmers had medium to long potato farming experience.

Coefficient of Variation (CV) (20.03%) of experience in potato cultivation of the farmers indicated that the sample farmers were homogenous based on their experience in potato cultivation. However, experience in contractual potato cultivation of the sample farmers was significantly related ($r = 0.001^{***}$ at 0.001 level of probability) with changes of return on investment in potato contract farming. Experienced farmers were found to engage in potato contract farming, adopt new technologies and understand the quality issues of the potatoes.

The findings indicated that the farmers' experience in potato cultivation was an important factor for contract farming, producing exportable potatoes, and processing. Companies and policymakers should place a greater emphasis on experienced farmers.

5.6 Support services received from contractors

The observed support services received score of the respondent farmer on contractual potato cultivating ranged from 10 to 34, while the mean was 25.30 with a standard deviation of 4.61 and coefficient of variation of 18% (Table 5.7).

However, the potato contract farmers support services were classified into three categories based on the support services in potato cultivation as presented in Table 5.7.

Table 5.7 Distribution of the farmers according to support services in potato cultivation

Support service by the contractor	Number	Percent	Min	Max	Mean	SD	CV
Lower support services (< Mean - SD i.e. < 20.69)	2	0.76					
Medium support services (Mean ± SD i.e. 20.69 – 29.91)	229	87.4	10.0	34.0	25.30	4.61	17.83%
High support services (> Mean + SD i.e. > 29.91)	31	11.83					
Total	262	100					

Table 5.7 indicated that the majority (87.4%) of the potato contract farmers received medium level of support services, followed by 11.83% that received high level of support services, and only 0.76% that received low level of support services for potato cultivation. The farmers' coefficient of variation (17.83%) of support services in potato cultivation indicated that the sample farmers were homogeneous based on contractors' offer of support services and received by contract farmers in potato cultivation. However, receiving the support services by the

sample farmers was significantly related (r = 0.015*** at 0.001 level of probability) to changes in return on investment for engagement in potato contract farming and operating the business with their contractors.

According to Bellemare (2010), the number of private extension visits to the grower by a technical assistant working for the processor was positively and significantly related to yields. In contract farming, the farmers were able to receive benefits, not only in income but were also able to gain access to credit, technical knowledge, and support services from the contractors (Minot, 1986; Little and Watts, 1994). Farmers also gained access to new technology and inputs, including credit, through contracts that otherwise may be outside their reach (Glover, 1987; Eaton and Shepherd, 2001).

Public extension services are often lacking in potato contract farming, therefore, companies/ contractors often provide their private extension services to ensure quality and on-time delivery. The private extension services are more trusted by the farmers than public extension services. Finally, the findings imply that farming support services are required for contractual and specialized potato cultivation to produce exportable potatoes and process them.

5.7 Training exposure

The observed training exposure score on potato cultivation of the respondent contract farmers ranged from 2 to 12 days, while the mean was 7.05 with a standard deviation of 2.5, and coefficient of variation of 35.56% (Table 5.8). The sample farmers were classified into the following three categories based on their training exposure to potato farming practices as shown in Table 5.8.

Table 5.8 indicated that two-thirds (67.94%) of the farmers had medium training exposure, followed by 18.32% with high training exposure and 13.74% with lower training exposure on potato contract farming operation. The findings again revealed that the overwhelming majority (86.26%) of the farmers had medium to high training exposure in potato cultivation.

Table 5.8 Distribution of the farmers according to their training exposure on contractual potato cultivation

Categories of training exposure	Number	Percent	Min	Max	Mean	SD	CV
Low Training Exposure (< Mean - SD i.e. < 4.55)	36	13.74					
Medium Training Exposure (Mean ± SD i.e. 4.55 – 9.55)	178	67.94	2	12	7.05	2.5	35.55%
High Training Exposure (> Mean + SD i.e. > 9.55)	48	18.32					
Total	262	100					

Coefficient of variation (35.55%) of training exposure on potato cultivation of the contract farmers indicated that the sample farmers were homogeneous based on their training exposure on potato contract farming practices. However, training on potato cultivation of the sample contract farmers was positively associated ($r = 0.049^{**}$, significant at 0.005 level) with changes in return on investment. Logically, there was a relationship between training, exposure, and knowledge on potato cultivation that produces a higher yield and higher income. Sultana (2009) discovered a similar result in Bangladesh for the baby corn business using a contract farming system. According to the study's findings, contract farmers received training in production technology as well as company support. It is concluded that businesses and relevant public extension services should provide more training to farmers in order to increase their income and improve their return on investment.

5.8 Knowledge of potato contract farming

The observed knowledge on potato contract farming was assessed using 20 questions about contract farming issues, cultivation practices, inputs, grading, sorting, sales, and marketing, with each question scoring 0-2 marks (if positive answer obtained 2, somewhat understandable get 1, and no knowledge get zero). In the end, the total score was calculated to range from 14 to 38 out of a possible range of 0-40, with the mean being 32.54, the standard deviation being 6.74, and the coefficient of variation being 20.70% (Table 5.9). The farmers were classified into three categories based on their knowledge of potato contract farming and presented in Table 5.9.

Table 5.9 Distribution of the farmers according to their knowledge on potato contract farming

Level of knowledge	Freq.	Percent	Min	Max	Mean	SD	CV
Low knowledge (< Mean - 1SD i.e. < 25.79)	42	16.03					
Medium knowledge (Mean ± 1SD i.e. 25.79- 37.39)	205	78.24	14	38	32.54	6.74	20.70%
High knowledge (> Mean + 1 SD i.e. > 37.39)	15	5.73					
Total	262	100					

Data presented in Table 5.9 indicated that the majority (78.24%) of the farmers had medium knowledge, followed by 16.03% having low knowledge, and 5.73% having a high level of knowledge on the potato contract farming system. The finding revealed that the majority (83.97%) of the farmers had medium to high knowledge of contract farming.

Coefficient of Variation (20.70%) of knowledge on potato contract farming of the farmers indicated that the selected farmers were homogenous based on their knowledge of contract farming. However, knowledge on potato contract farming of the sample farmers was positively associated ($r = 0.002^{***}$, significant at 0.001 level) with changes in return on investment of potato production in potato contract farming, with their perceived knowledge effects of potato contract farming practices to strengthen the potato export market and processing industries. Ali (2008) discovered a link between ecological agricultural knowledge and the use of ecological agricultural practices. A study conducted by Olounlade *et al.* (2020) and found positive relation with contract farming knowledge on production, income, and output of contract farming. As a result, contractors, policymakers, and public extension services should work to improve farmers' knowledge of good agricultural practices and the contract farming system.

5.9 Extension Media Contact

The observed extension media contact score ranged from 14 to 48 out of a range of 0-51, with a mean of 36.57, a standard deviation of 6.81, and a coefficient of variation of 18.62% (Table 5.10). The sample farmers were classified into three categories based on extension media contact score and presented in Table 5.10.

Table 5.10 Distribution of the farmers according to their extension media contact

Extension media contact	Frequency	%	Min	Max	Mean	SD	CV
Low level agricultural extension and communication (< Mean - 1SD i.e. < 29.76)	34	12.98					
Medium level agricultural extension and communication (Mean ± 1SD i.e. 29.76 – 43.38)	210	80.15	14	48	36.57	6.81	18.62%
High level agricultural extension and communication (> Mean + 1 SD i.e. > 43.38)	18	6.87					
Total	262	100					

According to the data in Table 5.10, the majority of farmers (80.15%) had medium extension media contact, while 12.98% had low extension media contact, and 6.87% had high-level extension media contact. According to the findings, more than 87% of the farmers had medium to high extension contact.

Coefficient of variation (18.62%) of extension media contact of the farmers indicated that the farmers were homogenous based on their extension contact. However, the extension contact of the farmers was positively associated ($r = 0.000^{***}$, significant at 0.001 level) with the changes in return on investment of potato contract farming.

Perera et al. (2003) discovered similar results in contract farming farmers who were solely reliant on their Field Assistants for information. The majority of contract farmers gave the Field Assistant high marks for credibility, as well as higher marks for their role in extension and input services. Farmers' knowledge and adoption were significantly related to extension communication activities. Technical knowledge and adoption among farmers were also linked. According to qualitative information from companies, each company had a field staff and a technical person to support field-level extension services linked with DAE field frontiers (SAAO), and provided news, media, and television programs on a regular basis. Contract farmers were also given company production leaflets.

As a result, extension media contact is a critical factor for contract farming to increase yield, thus increasing income and changing the return on investment.

5.10 Satisfaction on potato contract farming

The observed satisfaction score of the sample farmers ranged from 8 to 94 out of a possible range of 0-99, with a mean of 67.18, a standard deviation of 27.69, and a coefficient of variation of 41.90% (Table 5.11). Table 5.11 shows how the sample farmers were divided into three groups based on their level of satisfaction.

According to Table 5.11, more than half of the farmers (65.65%) had a medium level of satisfaction with potato contract farming, 17.56% had a high level of satisfaction, and 16.79% had a low level of satisfaction. More than 83.21% of farmers reported a medium to high level of satisfaction, according to the findings.

Table 5.11 Distribution of the farmers according to their satisfaction on potato contract farming

Level of satisfaction	Number	Percent	Min	Max	Mean	SD	CV
Low Level of Satisfaction (< Mean - 1SD i.e. < 39.49)	44	16.79					
Medium Level of Satisfaction (Mean ± 1SD i.e. 39.49 – 94.87)	172	65.65	8	94	67.18	27.69	41.22%
High Level of Satisfaction (> Mean + 1 SD i.e. > 94.87)	46	17.56					
Total	262	100					

Coefficient of variation (41.22%) of contract farming satisfaction of the farmers indicated that the farmers were homogenous based on their satisfaction. However, level of contract farming satisfaction of the farmers was positively associated ($r = 0.038^{**}$, significant at 0.005 level) with the changes in return on investment of potato production following the potato contract farming model.

According to the findings of a study conducted by Pouncgchompu et al. (2016), farmers were able to improve their lives, and approximately 57% of farmers involved in contract farming

had higher living standards and were more satisfied, which is consistent with the findings of Singh's (2002) study. Kumar et al. (2013) investigated the study on improving marigold supply chain efficiency through contract farming. According to Prasad et al. (2013), farmers were extremely satisfied with an assured income, timely availability of quality inputs, an assured price and ready market, obtaining transportation arrangements, and increased employment at the village level. Farmers faced constraints such as high-cost inputs, a lack of government support, and risky management. As a result, contractors should prioritize building trust and satisfying contract farmers in order to ensure the success and sustainability of contract farming. At the policy level, the government should create a monitoring mechanism for the benefit of farmers in the contract farming system.

5.11 Innovativeness on contract farming

The observed innovativeness score of the sample farmers ranged from 9 to 39 out of a range of 0-40, with the mean being 29.79, the standard deviation being 8.97, and the coefficient of variation being 30.13% (Table 5.12). Table 5.12 shows how the sample farmers were divided into three categories based on their innovativeness in contract farming:

Table 5.12 Distribution of the farmers according to their innovativeness

Level of innovativeness	Freq.	Percent	Min	Max	Mean	STDV	CV
Low level innovativeness (< Mean - 1SD i.e. < 20.81)	45	17.18					
Medium level innovativeness (Mean ± 1SD i.e. 20.81 – 38.77)	164	62.6	9	39	29.79	8.97	30.13%
High level innovativeness (> Mean + 1 SD i.e. > 38.77)	53	20.23					
Total	262	100					

According to data presented in Table 5.12, the majority of farmers (62.60%) had a medium level of innovativeness on potato contract farming, with 20.23% having a high level of innovativeness and 17.18% having a low level of innovativeness. According to the findings, more than 82.81% of farmers were innovative on a medium to high level.

Coefficient of variation (30.13%) of innovativeness of the farmers indicated that the farmers were homogenous based on their innovativeness on potato contract farming. However,

innovativeness of the farmers was positively associated (r = 0.029**, significant at 0.005 level) with return on investment for potato contract farming.

Contract farming, in particular, is an effective method of transferring new technologies to farmers, as well as agricultural innovation for increasing farm income and return on investment. Earlier studies indicated and substantiated that contract farming assisted farmers in improving their cultivation practices, new technologies, and agricultural produce marketing (Birthal *et al* 2008; Glover and Kusterer, 1990; Miyata *et. al.*, 2009; Warning and Key, 2002). As a result, individual farmer and contractor innovation and innovativeness are essential components of the contract farming system in order to compete for the market and increase the productivity of potato contract farming.

5.12 Commercialization of agriculture due to contract farming

The observed commercialization score of the sample farmers ranged from 50 to 98 out of a possible range of 0-100, with the mean being 86.34, the standard deviation being 10.22, and the coefficient of variation being 11.84% (Table 5.13). The sample farmers were classified into three categories based on the commercialization of agriculture due to contract farming and presented in Table 5.13.

According to data presented in Table 5.13, the majority of farmers (85.88%) had a medium level of commercialization on potato contract farming, followed by 11.07% who had a low level of commercialization and 3.05% who had a high level of commercialization. Through contract farming, more than 88.94% of farmers had a medium to high level of farming commercialization, according to the findings.

Table 5.13 Distribution of the farmers according to their commercialization of potato farming

Level of commercialization	Freq.	Percent	Min	Max	Mean	SD	CV
Low level of commercialization (< Mean - 1SD i.e. < 76.12)	29	11.07					
Medium level of commercialization (Mean ± 1SD i.e. 76.12 – 96.56)	225	85.88	50	98	86.34	10.22	11.84%
High level of commercialization (> Mean + 1 SD i.e. > 96.56)	8	3.05					
Total	262	100					

The coefficient of variation (11.84%) of commercialization of the farmers indicated that the farmers were homogenous based on their commercialization on potato contract farming. However, commercialization of the farmers was positively associated ($r = 0.000^{***}$, significant at 0.001 level) with the changes in return on investment for potato contract farming.

Contract farming, in particular, is an effective way to increase agricultural commercialization; therefore, policymakers, contractors, and other public service providers should prioritize increasing agricultural commercialization.

5.13 Business growth due to contract farming

The observed score of business growth due to potato contract farming of the sample farmers ranged from 7 to 28 against the possible range of 0-30, with the mean being 17.0, the standard deviation being 6.0, and the coefficient of variation being 35.95% (Table 5.14). The respondent farmers were classified into three categories based on business growth due to potato contract farming and presented in Table 5.14.

According to data presented in Table 5.14, more than half of the farmers (58.4%) had achieved a medium level of business growth as a result of potato contract farming, followed by a 25.57% high level of business growth and a 16.03% low level of business growth. Findings revealed that more than 83.97% of the farmers had a medium to the high level of business growth due to contract farming.

Table 5.14 Distribution of the farmers according to their growth of the business due to potato contract farming

Level of business growth	Freq.	Percent	Min	Max	Mean	SD	CV
Low level of business growth (< Mean - 1SD i.e. < 11)	42	16.03					
Medium level of business growth (Mean ± 1SD i.e. 11 – 23)	153	58.4	7	28	17	6	35.95%
High level of business growth (> Mean + 1 SD i.e. > 23)	67	25.57					
Total	262	100					

Coefficient of variation (35.95%) of growth of the business of the farmers indicated that the farmers were homogenous based on their business growth due to potato contract farming. However, the growth of the business due to potato contract farming of the farmers was positively associated ($r = 0.000^{***}$, significant at 0.001 level) with changes in return on investment for potato contract farming. Business growth is the ultimate target of contract farming, commercialization, and return on investment, therefore, farmers should be more attentive to grow more business. Policymakers, contractors, and other public service providers should prioritize increasing business for local economic development.

Chapter 6

CONTRIBUTION AND EFFECT OF THE SELECTED CHARACTERISTICS OF THE FARMERS TO/ON THEIR CHANGES OF RETURN ON INVESTMENT OF POTATO PRODUCTION THROUGH CONTRACT FARMING

CHAPTER 6

CONTRIBUTION AND EFFECT OF THE SELECTED CHARACTERISTICS OF THE FARMERS TO/ON THEIR CHANGES OF RETURN ON INVESTMENT OF POTATO PRODUCTION THROUGH CONTRACT FARMING

The purpose of this chapter is to examine the contribution and effect of selected characteristics of the farmers to/on their changes of return on investment of potato production through contract farming. For this study thirteen (13) independent variables / characteristics of the potato contract farmers were considered. The changes (difference) in ROI of potato production through potato contract farming (Y) was the dependent variable of the study.

Initially, Pearson product-moment correlation was run with all selected the 13 characteristics of the potato contract farmers with the changes in ROI of potato contract farming. Table 6.1 shows the results of the correlation coefficient of each of the selected characteristics of the farmers with their changes of return on investment of potato production through contract farming.

The correlation analysis showed that out of thirteen (13) characteristics of the farmers, twelve (12) had a significant relationship with their changes in ROI of potato production due to contract farming. Among all characteristics, education (X_2), effective farm size (X_3), effective contract farming land Size (X_4), contract farming experience (X_5), contract farming support services (X_6), training exposure (X_7), knowledge of contract farming (X_8), extension media (X_9), contract farming satisfaction (X_{10}), contract farming innovativeness (X_{11}), commercialization (X_{12}) and business growth due to contract farming (X_{13}) had shown significant positive relationship at 0.01 level of significance, but age (X_1) of the farmers had no significant relationship with changes of return on investment. The correlation matrix is given in Annexure-II.

Table 6.1 Results of correlation coefficient of each of the selected characteristics of the farmers with their changes of ROI of potato production through contract farming

Focus variable	Sample farmers characteristics	Value of coefficient of correlation (r)
Changes of ROI of Potato contract farming (difference: after – before potato contract farming)	Age (X_1)	0.055^{NS}
	Education (X_2)	0.384**
	Effective farm size (X_3)	0.428**
	Effective CF land size (X_4)	0.386**
	CF Experience (X_5)	0.372**
	CF Support services (X_6)	0.553**
	Training exposure (X_7)	0.640**
	Knowledge on CF (X_8)	0.805**
	Extension media contact (X_9)	0.671**
	CF Satisfaction (X_{10})	0.767**
	CF Innovativeness (X_{11})	0.770**
	Commercialization (X_{12})	0.273**
	Business growth due to CF (X_{13})	0.922**

^{NS}Not significant, *Significant at 0.05 Level, **Significant at 0.01 Level

Again, all the selected thirteen (13) independent variables were fitted together in the set of multiple regression and 10 variables were significant (Table 6.2) to the changes of ROI of potato production due to contract farming. These variables were 10 in number namely, effective contract farming land size (X_4), contract farming experience (X_5), contract farming support services (X_6), training exposure (X_7), knowledge on contract farming (X_8), extension media contact (X_9), contract farming satisfaction (X_{10}), contract farming innovativeness (X_{11}), commercialization (X_{12}) and business growth due to CF (X_{13}), and they all showed significant contribution to the changes in return on investment. The remaining three variables, i.e., age of the potato contract farmer (X_1), education of the Farmer (X_2), and household farm size (X_3) were not significant.

The independent variables in isolation would not give a comprehensive picture of the contribution of independent variables to the changes of return on investment of potato production through contract farming (Y). The different characteristics of the farmers may interact together to make a combined contribution to the changes of return on investment of potato production through contract farming. Keeping this fact in view linear multiple regression

analysis was used to assess the contribution of the independent variables to changes of return on investment of potato production through contract farming.

It was observed that the full model regression results were misleading due to the existence of interrelationships among the independent variables. It was evident from correlation matrix showing the interrelationships among the independent variables and existence of contradiction in the sign of correlation co-efficient and regression coefficient. Droper and Smith (1981) suggested running stepwise multiple regression analysis to insert variables in turn until the regression equation is satisfactory. Therefore, in order to avoid the misleading results due to the problem of multi-collinearity and to determine the best explanatory variables, the method of step-wise multiple regression was employed by involving the three (3) sets of independent variables with the changes of return on investment of potato production through contract farming model.

Table 6.2 Summary of Regression analysis for the contribution of the selected characteristics of the farmers to their changes of ROI of potato production through contract farming

S/No	Variables	Standardized coefficients	t	Sig.
		Beta		
	(Constant)	-21.34	-6.194	.000
1	Age (X_1)	-0.017	-1.066	.288
2	Education (X_2)	-0.027	-1.483	.139
3	Effective farm size (X_3)	0-.021	-.598	.550
4	Effective CF land size (X_4)	0.114	3.445	.001***
5	CF Experience (X_5)	-0.046	-2.438	.015**
6	CF Support services (X_6)	0.048	2.456	.015**
7	Training exposure (X_7)	0.042	1.971	.049**
8	Knowledge on CF (X_8)	0.103	3.145	.002**
9	Extension media contact (X_9)	0.151	6.656	.000**
10	CF Satisfaction (X_{10})	0.061	2.091	.038**
11	CF Innovativeness (X_{11})	0.065	2.192	.029**
12	Commercialization (X_{12})	0.084	4.940	.000***
13	Business Growth due to CF(X_{13})	0.627	25.188	.000***

*= Significant at 90% confidence Interval
**=Significant at 95% confidence Interval
***=Significant at 99% confidence Interval

Where R= 0.970, R^2 = 0.041, Adjusted R^2 = 0.938, F = 306.929 and P = 0.000

To avoid misleading results due to the problem of multicollinearity and to determine the best explanatory variables, three sets of stepwise multiple regression were used, involving all 13 independent variables to assess the extents of contribution to changes in ROI of potato production through contract farming.

To assess the contribution of the selected variables (characteristics) Age (X_1) Education (X_2), Effective Farming Land Size (X_3), Effective contract farming land size (X_4), CF experience (X_5), Support service (X_6), Training exposure (X_7), Knowledge on contract farming (X_8), Extension media contact (X_9), Satisfaction on contract farming (X_{10}), Innovativeness (X_{11}), Commercialization (X_{12}), and Business growth due to potato contract farming (X_{13}), the stepwise multiple regression analysis was done which is discussed in Section 6.1 and Indirect effects of the selected characteristics of the potato contractual farmers on changes of return on investment of potato production through contract farming discussed in the Section 6.2.

6.1 Contribution of Selected Characteristics of the Farmers to their Changes of Return on Investment of Potato production through Contract Farming

To avoid misleading results due to the problem of multicollinearity and to determine the best explanatory variables following 3 sets of stepwise multiple regression were used, involving all 13 independent variables to assess the extents of contribution of the selected characteristics of the farmers their changes of ROI of potato production through contract farming.

The objective of the stepwise multiple regression models was to find out the contribution of the variables, which were significant only. Results of these three sets of stepwise multiple regression analysis in the form of table or equation have been discussed below:

- **Set-I: All the 13 (thirteen) independent variables:** Age (X_1) Education (X_2), Effective Farming land size (X_3), Effective contract farming land size (X_4), CF experience (X_5), Support Service (X_6), Training exposure (X_7), Knowledge on contract farming (X_8), Extension media contact (X_9), Satisfaction on contract farming (X_{10}), Innovativeness (X_{11}), Commercialization (X_{12}), and Business growth due to potato contract farming (X_{13}).

- **Set-II: 12 significant variables after correlation test:** Education (X_2), Effective farming land size (X_3), Effective contract farming land size (X_4), CF experience (X_5), Support

Service (X_6), Training exposure (X_7), Knowledge on contract farming (X_8), Extension media contact (X_9), Satisfaction on contract farming (X_{10}), Innovativeness (X_{11}), Commercialization (X_{12}), and Business growth due to potato contract farming (X_{13}).

- **Set III: 10 significant variables from full model linear regression analysis:** Effective Contract farming land size (X_4), CF experience (X_5), Support service (X_6), Training exposure (X_7), Knowledge on contract farming (X_8), Extension media contact (X_9), Satisfaction on contract farming (X_{10}), Innovativeness (X_{11}), Commercialization (X_{12}), and Business growth due to potato contract farming (X_{13}).

All the three sets of stepwise multiple regression analysis showed same results which is presented in Table 6.3 and discussed below:

After running all the three sets of stepwise multiple regression analysis, it was found that 7 individual variables, namely Effective contract farming land Size (X_4), Support service (X_6), Training exposure (X_7), Knowledge on contract farming (X_8), Extension media contact (X_9), Commercialization X_{12}), and Business growth due to contract farming (X_{13}) were significant. Table 6.3 revealed the summarized results of step-wise multiple regression analysis of the contribution of those seven (7) independent variables to their changes of return on investment of potato production through contract farming.

Data presented in Table 6.3 indicated that the multiple R, $R^{2,}$ and adjusted R^2 in the stepwise multiple regression analysis was 0.969, 0.938, and 0.936, respectively, and the corresponding F-ratio was 550.297 was significant at 0.000 level. Thus, the regression equation as below:

$$Y = - -28.209+0.635(X_{13}) + 0.154(X_9) + 0.161(X_8) + 0.092(X_{12}) + 0.089(X_4) + 0.060(X_7) + 0.041(X_6)$$

Where: $R^2 = 0.938$, Adjusted $R^2 = 0.936$; F-ratio = 505.297; Constant = - 28.209.

Table 6.3: Final Summary of stepwise multiple regression analysis showing the contribution of significant variables after running stepwise multiple regression analysis to changes of ROI of potato production through contract farming

S/No	Variable entered	Standardized coefficients (b)	Value of "t"	Probability	Adjusted R square	Variation explained	
						Increased R Square	Percent (%)
1	Business growth due to potato contract farming (X_{13})	0.635	26.94	0.00	0.849	0.849	84.9
2	Extension media contact (X_9)	0.154	7.32	0.00	0.905	0.056	5.6
3	Knowledge on CF (X_8)	0.161	6.36	0.00	0.920	0.016	1.6
4	Commercialization (X_{12})	0.092	5.45	0.00	0.925	0.005	0.5
5	Effective CF land size (X_4)	0.089	5.14	0.00	0.933	0.008	0.8
6	Training exposure (X_7)	0.060	2.90	0.004	0.936	0.003	0.3
7	Support services (X_6)	0.041	2.16	0.032	0.936	0.001	0.1
					Total	0.938	93.8

a. Predictors: (Constant), 13. Business Growth due to CF

b. Predictors: (Constant), 13. Business Growth due to CF, 9. Extension media contact

c. Predictors: (Constant), 13. Business Growth due to CF, 9. Extension media contact, 8.Knowledge on CF

d. Predictors: (Constant), 13. Business Growth due to CF, 9. Extension media contact, 8.Knowledge on CF, 12.Commercialization

e. Predictors: (Constant), 13. Business Growth due to CF, 9. Extension media contact 8.Knowledge on CF, 12.Commercialization, 4.Effective CF Land Size

f. Predictors: (Constant), 13. Business Growth due to CF, 9. Extension media contact 8.Knowledge on CF, 12.Commercialization, 4.Effective CF Land Size, 7.Training exposure

g. Predictors: (Constant), 13. Business Growth due to CF, 9. Extension media contact 8.Knowledge on CF, 12.Commercialization, 4.Effective CF Land Size, 7.Training exposure, 6.Support Services

Where, Multiple R = 0.97; R-square = 0.938; Adjusted R - square = 0.936; F-ratio = 505.297 at 0.000 level of significance, constant -28.209

This indicated that the whole model of 7 independent variables explained 93.6 percent of the total variation in changes of return on investment of potato production through contract farming. But since the standardized regression coefficient of 7 variables formed the equation and were significant, it might be assumed that whatever contribution was there, it was due to these 7 variables.

According to the results of stepwise regression analysis, the contributions of seven independent variables of potato contract farmers to their changes in the ROI of potato production through contract farming are discussed below:

Business growth due to potato contract farming (X_{13})

The first variable entered into a stepwise multiple regression equation to calculate the extent of contribution on changes in ROI of potato production through contract farming was business growth due to contract farming (X_{13}). The correlation matrix revealed that farmers experiencing business growth as a result of potato contract farming have a positive correlation on changes in return on investment and have significantly contributed to changes in ROI and have a positive impact on it. The determinant potato contract farming has contributed the most to business growth, accounting for 85% of changes in return on investment of potato production through contract farming.

Stepwise regression analysis revealed that the potato contract farmers' business growth had a highly significant and positive influence on their chances of return on investment in potato production through contract farming. Farmers received inputs supports, training on potato production, appropriate extension media support, training, premium price, on-time payment, and ensured buyer impacted to their net earnings as a result of the contractual agreement, which motivated the growth of the business and ROI. Farmers were encouraged to expand their potato contract farming areas and invest more money.

Extension media contact (X_9)

The correlation matrix revealed that extension media contact shown positive correlation on changes in return on investment and significantly contributed to changes in ROI of potato production through contract farming.

The second variable, extension media contact (X_9) entered into stepwise regression analysis indicated that extension media contact (X_9) of the potato contract farmers had a significant and positive influence on changes in return on investment of potato production through contract farming, which contributed 5.6% in predicting the dependent variable changes in ROI. The variable business growth due to contract farming (X_{13}) and extension media contact of potato contract farming ($X_{9)}$ jointly contributed 90.6% in predicting the dependent variable changes of ROI of potato production through contract farming. This was due to contractual farmers received effective extension services, field support services, and training on potato production, that contributed to changes of ROI of potato production through contract farming.

Knowledge of potato contract farming (X_8)

The correlation matrix revealed that knowledge of potato contract farming has positive correlation with return on investment and has significantly contributed to changes in ROI of potato production through contract farming.

Knowledge on potato contract farming (X_8) entered into stepwise regression analysis indicated that knowledge on potato contract farming had a strongly significant and positive influence on their changes in return on investment; which contributed 1.6% in predicting the dependent variable changes in ROI of potato production through contract farming. The variables business growth due to contract farming (X_{13}), extension media contact ($X_{9)}$, and knowledge on potato contract farming (X_8) jointly contributed 92.1% in predicting the dependent variable changes of ROI of potato contract farming. Farmers gained good knowledge and implemented it to their potato field as a result of contract farming knowledge potato, extension services, field support services, which contributed to changes of ROI of potato production through contract farming.

Commercialization (X_{12})

The correlation matrix revealed that commercialization had positive and significant correlation on changes of return on investment of potato production through contract farming.

The fourth variable, commercialization (X_{12}) entered into **s**tepwise regression analysis indicated that commercialization of the potato had a strongly significant and positive contribution on changes of return on investment of potato production through contract farming, which contributed 0.5% in predicting the dependent variable. The variables business growth due to contract farming (X_{13}), extension media contact ($X_{9)}$, knowledge on potato contract farming (X_8) and commercialization (X_{12}), jointly contributed 92.6% in predicting the dependent variable changes of ROI of potato production through contract farming.

Effective potato contract farming land size (X_4)

According to SPSS analysis, effective land size for potato contract farming found positive correlation on changes in return on investment of potato production through contract farming and significantly contributed to changes in ROI of potato production.

The fifth variable, effective contract farming land size (X_4) entered into stepwise regression equation analysis indicated that effective contract farming land size for potato contract farming

had a significant and positive influence on their return on investment, which contributed 0.8% in predicting the dependent variable changes of return on investment of potato production through contract farming. The variables business growth due to contract farming (X_{13}), extension media contact (X_{9}), knowledge on potato contract farming (X_8), commercialization (X_{12}), and effective contract farming land size (X_4) jointly contributed 93.4% in predicting the dependent variable changes in ROI of potato production through contract farming. Similar findings indicated that cultivated land size is positively significant in Cambodian rice contract farming (Sokchea and Claus, 2015**)**.

Training exposure (X_7)

The correlation matrix revealed that training exposure has positive correlation with return on investment and significantly contributed to changes in ROI of potato production through contract farming.

The sixth variable, Training exposure **(X_7)** entered into stepwise regression analysis indicated that training exposure (received training days) of the potato contract farmers had a significant and positive influence on their return on investment, which contributed 0.3% to changes in return on investment of potato production through contract farming. The variables business growth due to contract farming (X_{13}), extension media contact (X_{9}), knowledge on potato contract farming (X_8) commercialization (X_{12}), effective contract farming land size (X_4), and training exposure (X_7) jointly contributed 93.7% in predicting the dependent variable changes of ROI of potato production through contract farming.

Support services (X_6)

Support services were a requirement for contract farming; however, the correlation matrix revealed that support services had a positive correlation to changes in ROI of potato production through contract farming.

The seventh variable, Support services (X_6) entered into stepwise regression equation analysis indicated that support services to the potato contract farmers had a strongly significant and positive influence on their return on investment, which contributed 0.1% to changes of return on investment of potato production through contract farming. The variables business growth due to contract farming (X_{13}), extension media contact (X_{9}), knowledge on potato contract farming (X_8) commercialization (X_{12}), effective contract farming land size (X_4), training

exposure (X_7) and support services (X_6) jointly contributed 93.8% in predicting the dependent variable changes of ROI of potato production due to contract farming.

The remaining variables like age (X_1), education X_2), effective household farm size (X_3), potato contract farming experience (X_5), satisfaction on contract farming (X_{10}), and contract farming innovativeness (X_{11}), were not entered into the stepwise regression equation. Each of these variables contributed a negligible percentage and were regarded as less important in predicting the dependent variable changes of return on investment of potato production through contract farming.

In conclusion, the selective factors and variables significantly contributed to the changes in return on investment of potato production due to potato contract farming and carries significant impact. However, all the variables did not contribute equally. Seven variables like business growth due to potato contract farming (85%), extension media contact (5.6%), knowledge on contract farming (1.60%), effective contract farming land size (0.8%), commercialization (0.5%), training exposure (0.3%), and support services (0.10%) and all these together contributed the most (93.8%), rest of 6.2% may contributed from other factors.

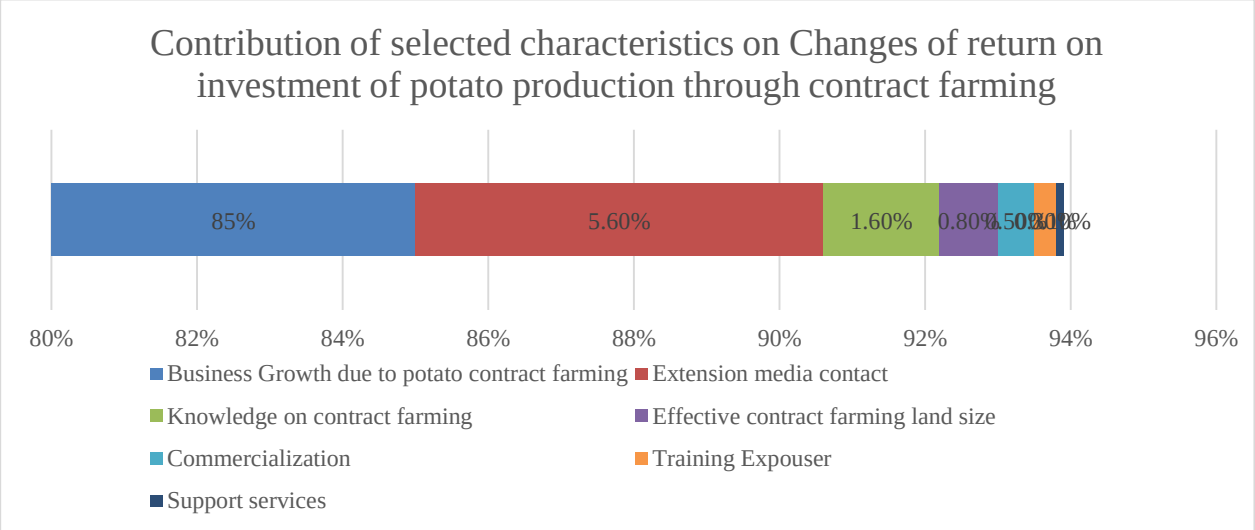

Figure 6.6: Contribution of selected characteristics of the farmer to their changes of ROI of potato production through contract farming

This is a strong indication for companies, farmers, and other relevant stakeholders to place a greater emphasis on these characteristics of potato contract farmers. Similarly, the government or policymakers may take the necessary actions to include the contract farming policy to strengthen local economic development (business growth), agricultural productivity through

improved extension media contact, an enabling business growth environment, agricultural commercialization, contractor support services, and need-based training.

6.2 Direct and Indirect effects of the selected characteristics of the potato contractual farmers on their changes of return on investment of potato production through contract farming

In the present study Pearson product moment correlation test, full model linear multiple regression and stepwise multiple regression were conducted. It may be worthwhile to find out the direct effects and indirect effects separately by path analysis tests. Path coefficient is simply a standardized partial regression coefficient and as such measures the direct influence of one variable upon another and permits the separation of the correlation coefficient into components of direct and indirect effects (Dewey and Lu, 1959). This allows the reflection of direct effect of an independent variable and its indirect effect through other variables on the dependent variable (Sasmal and Chakrabarty, 1978).

Direct effect of an independent variable on the dependent variable is the standardized beta co-efficient (value of 'b' of regression analysis) of the respective independent variable. Whereas indirect effect of an independent variable through a channeled variable is measured by the following formula:

$e = \Sigma\ b\ X\ r$

Where,

e = Total indirect effect of an independent variable

b = Direct effect of the Variable through which indirect effect is channeled

r = Correlation co-efficient between respective independent variable and variable through which indirect effect is channeled.

Path coefficient analysis was employed in order to obtain clear understanding of the direct and indirect effects of selected independent variables. Path analysis was done involving the significant variables of step-wise multiple regression analysis. Path coefficients showing the direct and indirect effects of significant 7 independent variables of stepwise multiple regression analysis on the changes of return on investment of potato production through contract farming presented in Table 6.4.

Analysis of data furnished in Table 6.3 and Table 6.4 indicated the independent variables viz., The variable growth of business due to contract farming (X_{13}), extension media contact of potato contract farming (X_9), knowledge on potato contract farming (X_8), commercialization (X_{12}), effective contract farming land size (X_4), training exposure (X_7), and support services (X_6). Among these, growth of business due to contract farming (X_{13}) of the potato contract farmers had the highest direct effect (0.635) in the positive direction effect on changes of return on investment of potato production through contract farming model. Extension media contact of potato contract farming (X_9), knowledge on potato contract farming (X_8), commercialization (X_{12}), effective contract farming land size (X_4), training exposure (X_7), and support services (X_6) and their direct effect were 0.154, 0.161, 0.092, 0.089, 0.060 and 0.041 respectively.

Here, it may be mentioned that without path co-efficient analysis it is not possible to know the indirect effects of an independent variable through other variables on the dependent variable. Therefore, emphasis has been given on the indirect effects which have been obtained from path co-efficient analysis (Table 6.4).

All of the significant independent variables (stepwise regression model) entered into path co-efficient analysis and discussed here. That the variable growth of business due to contract farming (X_{13}), extension media contact of potato contract farming (X_9), knowledge on potato contract farming (X_8), commercialization (X_{12}), effective contract farming land size (X_4), training exposure (X_7), and support services (X_6) had appreciable total indirect effect on changes of return on investment of potato production through contract farming. On the basis of path analysis, the independent variables having indirect effects on changes of return on investment of potato production through contract farming has shown in Table 6.4.

Knowledge on contract farming (X_8): Path analysis (Table 6.4) showed that knowledge on potato contract farming (X_8) of the sample potato contract farmers had the highest (First highest) total indirect effect (0.64) and a positive direct effect of 0.161 on changes of return on investment of potato production through contract farming. The indirect effect was mostly channeled positively through growth of business due to contract farming (X_{13}), extension media contact of potato contract farming (X_9), commercialization (X_{12}), effective contract farming land size (X_4), training exposure (X_7), and support services (X_6). It may be inferred that other

variables remaining constant, knowledge on contract farming (X_8) had an influence on changes of return on investment of potato production through contract farming.

Table 6.4: Path coefficients showing the direct and indirect effects of 7 significant independent variables of stepwise multiple regression analysis on changes of return on investment of potato production through contract farming

Independent variables	Variables through which indirect effects are channeled	Indirect effects	Total indirect effect	Direct effect
Knowledge on CF (X_8)	Business growth due to contract farming (X_{13})	0.450	0.64	0.161
	Extension media contact (X_9)	0.096		
	Training exposure (X_7)	0.035		
	Effective CF land size (X_4)	0.026		
	Commercialization (X_{12})	0.021		
	Support services (X_6)	0.018		
Training exposure (X_7)	Business growth due to contract farming (X_{13})	0.356	0.58	0.06
	Knowledge on CF (X_8)	0.093		
	Extension media contact (X_9)	0.075		
	Effective CF land size (X_4)	0.024		
	Support services (X_6)	0.019		
	Commercialization (X_{12})	0.014		
Extension media contact (X_9)	Business growth due to contract farming (X_{13})	0.321	0.52	0.154
	Knowledge on CF (X_8)	0.100		
	Training exposure (X_7)	0.029		
	Effective CF land size (X_4)	0.028		
	Commercialization (X_{12})	0.021		
	Support services (X_6)	0.017		
Support services (X_6)	Business growth due to contract farming (X_{13})	0.307	0.51	0.041
	Knowledge on CF (X_8)	0.071		
	Extension media contact (X_9)	0.064		
	Training exposure (X_7)	0.028		
	Effective CF land size (X_4)	0.022		
	Commercialization (X_{12})	0.021		
Effective CF land size (X_4)	Business growth due to contract farming (X_{13})	0.189	0.30	0.089
	Extension media contact (X_9)	0.049		
	Knowledge on CF (X_8)	0.046		
	Training exposure (X_7)	0.016		
	Support services (X_6)	0.010		
	Commercialization (X_{12})	-0.013		
Business growth due to contract farming (X_{13})	Knowledge on CF (X_8)	0.114	0.29	0.635
	Extension media contact (X_9)	0.078		
	Training exposure (X_7)	0.034		
	Effective CF land size (X_4)	0.026		
	Support services (X_6)	0.020		
	Commercialization (X_{12})	0.015		
Commercialization (X_{12})	Business growth due to contract farming (X_{13})	0.105	0.18	0.092
	Knowledge on CF (X_8)	0.036		
	Extension media contact (X_9)	0.035		
	Training exposure (X_7)	0.009		
	Support services (X_6)	0.009		
	Effective CF land size (X_4)	-0.013		

Training exposure (X_7): Path analysis (Table 6.4) showed that Training exposure (X_7) of the sample potato contract farmers had the 2nd highest total indirect effect (0.58) and a positive direct effect of 0.060 on changes of return on investment of potato production through contract farming. The indirect effect was mostly channeled positively through growth of business due to contract farming (X_{13}), extension media contact of potato contract farming (X_9), knowledge on potato contract farming (X_8), commercialization (X_{12}), effective contract farming land size (X_4), and support services (X_6). It may be inferred that other variables remaining constant, training exposure ((X_7) had an influence on changes of return on investment of potato production through contract farming.

Extension media contact (X_9): Path analysis (Table 6.4) showed that extension media contact (X_9) of the sample potato contract farmers had the 3rd highest total indirect effect (0.52) and a positive direct effect of 0.154 on changes of return on investment of potato production through contract farming. The indirect effect was mostly channeled positively through growth of business due to contract farming (X_{13}), knowledge on potato contract farming (X_8), commercialization (X_{12}), effective contract farming land size (X_4), training exposure (X_7), and support services (X_6). It may be inferred that other variables remaining constant, extension media contact (X_9) had an influence on the effects on changes of return on investment of potato production through contract farming.

Support services (X_6): Path analysis (Table 6.4) showed that support services (X_6) of the sample potato contract farmers had the 4th highest total indirect effect (0.51) and a positive direct effect of 0.041 on changes of return on investment of potato production through contract farming. The indirect effect was mostly channeled positively through growth of business due to contract farming (X_{13}), extension media contact of potato contract farming (X_9), knowledge on potato contract farming (X_8), commercialization (X_{12}), effective contract farming land size (X_4), and training exposure (X_7). It may be inferred that other variables remaining constant, support services (X_6) had an influence on changes of return on investment of potato production through contract farming.

Effective CF land size (X_4): Path analysis (Table 6.4) showed that Effective CF land size (X_4) of the sample potato contract farmers had the 5th highest total indirect effect (0.30) and a

positive direct effect of 0.089 on changes of return on investment of potato production through contract farming. The indirect effect was mostly channeled positively through growth of business due to contract farming (X_{13}), extension media contact of potato contract farming (X_9), knowledge on potato contract farming (X_8), commercialization (X_{12}), training exposure (X_7), and support services (X_6). It may be inferred that other variables remaining constant, Effective CF land size (X_4) had an influence on changes of return on investment of potato production through contract farming.

Business growth due to contract farming (X_{13}): Path analysis (Table 6.4) showed that business growth due to contract farming 6th highest of the potato contract farming. Business growth due to contract farming (X_{13}) on changes of return on investment of potato production through contract farming affected by business growth due to contract farming had the 6th highest total indirect effect (0.29) and a positive direct effect of 0.635 on changes of return on investment of potato production through contract farming.

The indirect effect was mostly channeled positively through knowledge on contract farming (X_8) and Extension media contact (X_9). The indirect effect of knowledge on changes of return on investment of potato production through contract farming was somewhat positively channeled through growth of business due to contract farming (X_{13}), extension media contact of potato contract farming (X_9), knowledge on potato contract farming (X_8), commercialization (X_{12}), effective contract farming land size (X_4), training exposure (X_7), and support services (X_6). It may be mentioned that other variables remaining constant, Business growth due to contract farming (X_{13}) had a strong influence on changes of return on investment of potato production through contract farming.

Commercialization of potato production (X_{12}): Path analysis (Table 6.4) showed that commercialization of potato production (X_{12}) of the sample potato contract farmers had the 7th highest total indirect effect (0.18) and a positive direct effect of 0.092 on changes of return on investment of potato production through contract farming. The indirect effect was mostly channeled positively through growth of business due to contract farming (X_{13}), extension media contact of potato contract farming (X_9), knowledge on potato contract farming (X_8), effective contract farming land size (X_4), training exposure (X_7), and support services (X_6). It may be inferred that other variables remaining constant, commercialization of potato farming (X_{12}) had an influence on changes of return on investment of potato production through contract farming.

This is a strong indication that the variable knowledge on potato contract farming (X_8), training exposure (X_7), extension media contact of potato contract farming (X_9), support services (X_6), effective contract farming land size (X_4), growth of business due to contract farming (X_{13}) and commercialization (X_{12}) has positive direct and indirect impact on changes of return on investment of potato production through contract farming model in Bangladesh. Therefore, companies, farmers, and other relevant stakeholders to place a greater emphasis on these characteristics of potato contract farmers.

CHAPTER 7

IDENTIFY THE PROBLEMS FACED BY THE FARMERS IN POTATO CONTRACT FARMING ALONG WITH SOLUTION AS PERCEIVED BY THEM

CHAPTER 7

IDENTIFY THE PROBLEMS FACED BY THE FARMERS IN POTATO CONTRACT FARMING ALONG WITH SOLUTION AS PERCEIVED BY THEM

7.1 Problems of Contract Farming Faced by the Farmers in Potato contract farmers

The observed problem faced by the potato contractual farmers in contract farming ranged from 27 to 39 against the possible range of 0-39; the mean was 33.82 with a standard deviation of 2.34 and coefficient of variation of 54.00%. Table 7.1 revealed that two-thirds (78.63%) of the potato contractual farmers were faced with medium problem on the operation of contract farming compared to 7.63 and 13.74% that faced high and low problems in potato contract farming, respectively.

Table 7.1 Distribution of the farmers according to the problem faced by the contractual potato farmers

Level of satisfaction	Number	Percent (%)	Min	Max	Mean	SD	CV
Low problem (< Mean - 1SD i.e. < 31.48)	36	13.74					
Medium problem (Mean ± 1SD i.e. 31.49-36.16)	206	78.63	27	39	33.82	2.34	54%
High problem (> Mean + 1 SD i.e. > 36.16)	20	7.63					
Total	262	100					

There were numerous problems encountered by farmers during potato contract farming practices, but only thirteen of them were considered in this study. Item selection and measurement procedure of problem faced scale were described in Chapter 3 of this dissertation. The Problem Faced Index (PFI) was calculated to compare the difficulty of various selected items. Chapter 3 described the procedure for calculating the PFI for each item. The observed PFI scores for the items ranged from 519 to 743, compared to a possible range of 0-786. Table 7.2 displays the PFI scores and rank order for each item.

According to the descending order of the Problem Faced Index (PFI), Standardize Problem Index (SPI), and Garrett Score, lack of information was found to be the most severe problem faced by contract farmers among all 13 problems encountered during potato contract farming. The farmers found lack of price bargaining, substandard quality of the inputs, and unavailability of prescribed inputs problematic. The substandard quality of inputs could destroy all crop yield. Poor support and extension services were also identified as a medium-level problem. Other issues such as complicated compliance, lack of commitment, tight crop scheduling, delayed payment, and side selling were identified as medium-level problems. According to the respondents, there were a few low-level problems, such as a lack of credit and high input prices. Table 7.2 shows the farmers' problems item by item.

Table7.2 Problems of the potato contract farming in Bangladesh

SL #	Faced problems	Degree of problems			PFI	SPI score (%)	Rank
		High (3)	Medium (2)	Low (1)			
1	Lack of information	223	35	4	743	95	1
2	Lack of price bargaining power	209	44	9	724	92	2
3	Substandard quality of inputs	208	45	9	723	92	3
4	Difficult to collect prescribed inputs	211	35	16	719	91	4
5	Poor support and agricultural extension services	205	46	11	718	91	5
6	Lack of commitment of the contractors	193	38	31	686	87	6
7	Complicated compliances	200	23	39	685	87	7
8	Tight crop scheduling	194	33	35	683	87	8
9	Delay in arranging inputs	180	44	38	666	85	9
10	Delay payment by the contractor	164	67	31	657	84	10
11	Side selling/ purchasing by the contractors	161	62	39	646	82	11
12	Lack of credit for crop production	151	49	62	613	78	12
13	High price of inputs	103	51	108	519	66	13

7.2 Solutions of the Identified Problems Faced by the Potato Contract Farmers

According to field information and data set, there were several ways and means of problem-specific solution suggested by respondents. There was no single solution to solve all of the problems at once; instead, a collection of solutions could be provided as a package based on

location and specific company. Identified and recommended solution from the contractual farmers are given below and in Table 7.3:

- Provision of appropriate information through ICT based tools and apps;
- Appropriate contract farming module development;
- Need-based appropriate training to the farmers;
- Appropriate support services e.g. right inputs, financial linkage, and market support;
- Right inputs at the right time;
- Linkage with agricultural extension service providers;
- Establishment of trustworthy relationship with the contractual farmers and contractors;
- Easy and favorable production compliances;
- On-time payment and follow contractual agreement conditions;
- Stop side selling and side purchasing.

The Solution Index (SI) for each of the item was computed by using the following formula:

$$SI = S_s \times 3 + S_m \times 2 + S_l \times 1 + S_n \times 0$$

Where,

SI = Solution Index

S_s = Number of farmers who answered as best (super) solution of the identified problems

S_m = Number of farmers who answered as moderate solution of the identified problems

S_l = Number of farmers answered as less important solution of the identified problems

S_n = Number of farmers did not answer any or no solution

Table 7.3 Probable solutions of identified problems of potato contract farming

SL #	Faced problems	Probable Solution	Preference of the solution				
			High=3	Medium=2	Low=1,	SI	Rank
1	Lack of information	Apps and mobile application	230	18	14	740	1
		Set market information cell	130	121	11	643	2
		Market visit	30	222	10	544	3
2	Lack of price bargaining power	Contract farming	247	10	5	766	1
		Group sales	38	208	16	546	2
		Direct sales to the large buyer	14	140	108	430	3
3	Substandard quality of inputs	Training to understand good quality inputs	246	5	11	759	1
		Selection of appropriate retailers	28	202	32	520	2

SL #	Faced problems	Probable Solution	Preference of the solution				
			High=3	Medium=2	Low=1,	SI	Rank
		Awareness on good quality inputs	3	138	121	406	3
4	Difficult to collect prescribed inputs	Collect direct from company	243	9	10	757	1
		Good retailers nearby the farm	36	212	14	546	2
		List of retailers	11	131	120	415	3
5	Poor support and agricultural extension services	Linkage with DAE	230	17	15	739	1
		Set-up Knowledge centre	198	54	10	712	2
		Mobile application apps	7	139	116	415	3
		Strengthen extension service by the contractor	10	95	157	377	4
6	Lack of commitment of the contractors	Follow agreement	145	100	17	652	1
		Interactions/meeting with contractor and farmers	176	23	63	637	2
		More communication required	11	140	111	424	3
7	Complicated compliances	Provide Training	242	10	10	756	1
		Manual and standard	47	208	7	564	2
		Categorized the farmers	7	143	112	419	3
8	Tight crop scheduling	Training and sharing crop schedules	251	4	7	768	1
		Flexibility on scheduling as per production	34	216	12	546	2
		Declare before production starts and regular field visits	4	153	105	423	3
9	Delay in arranging inputs	On time delivery of the inputs	239	21	2	761	1
		Link with more inputs retailers	27	195	40	511	2
10	Delay payment by the contractor	On time payment at site	251	9	2	773	1
		Payment through bank within the contracted period	105	142	15	614	2
		Pay advance	9	120	133	400	3
11	Side selling/ purchasing by the contractors	Build trust all of the actors	255	5	2	777	1
		Appropriate cost calculation and pay adequate margin to the price	100	125	37	587	2
		Establish market monitoring cell and revise price time to time as per market demand	43	198	21	546	3
12	Lack of credit for crop production	Linkage with financial institutes for credit	255	6	1	778	1
		Pay advance to the farmers	17	209	36	505	2
		Provide inputs as credit to the farmers	5	110	147	382	3
13	High price of inputs	Direct link with the company	246	16	0	770	1
		Provide inputs to the farmers	167	87	8	683	2
		Credit facilities	100	97	65	559	3

CHAPTER 8

SUMMARY, CONCLUSION AND RECOMMENDATIONS

CHAPTER 8

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

8 Summary, Conclusions, and Recommendations

8.1 Summary

Agriculture is the backbone of the Bangladesh economy, the largest employment sector in the country, and accounts for 13.07% of GDP with a 2.58% growth rate. In Bangladesh, the potato is the third most important crop. The amount of potato produced in 2019 reached a new high of 1.09 crore tones. Only 2% of potatoes are processed into chips and crackers. As a result, companies are forming contractual production agreements in order to manage the supply chain for diverse processed potato products such as chips, french fries, flakes, and others. Contract farming research is limited, as are its implications, sustainability, relationships with farmer characteristics, income on return on investment, and proper policy recommendations. This study attempted to comprehend the characteristics of potato contract farmers, as well as their contribution to changes in the return on investment of potato production through contract farming.

8.1.1 The objective of the research

The overall objective of the study was to assess the extent of changes in Return on Investment (ROI) of potato production through contract farming in Bangladesh. The following specific objectives were formulated for this research:

1. To ascertain the extent of changes in Return on Investment (ROI) of potato production through contract farming
2. To compare the Return on investment (ROI) between contractual and non-contractual potato farming
3. To assess and describe some of the selected characteristics of the potato contract farmers
4. To explore the contribution of the selected characteristics of the farmers to their changes in Return on investment (ROI) of potato production through contract farming
5. To identify the problems faced by the farmers in potato contract farming along with solution as perceived by them

8.1.2 Materials and methods

The study's population comprised of these 820 farmers from three contractors in two upazila namely Mithapukur in Rangpur district and Birampur in Dinajpur district. The sample size was 262 potato contract farmers referred to as the "Study group" according to the statistical formula. Additionally,56 non-contract farmers from Pirganj upazila in Rangpur district were chosen as the "Control group".

Age of the potato contract farmer, education, effective farm size, effective potato contract farming area, potato cultivation experience, support services from contractor, training exposure, knowledge on contract farming, extension media contact, satisfaction on potato contract farming, innovativeness, commercialization, and business growth due to potato contract farming were considered as the independent variable. Changes of return on investment (ROI) of Potato production through contract farming were considered as a focus/dependent variable. SPSS 26, STATA-16, and MS Excel were used for data analysis. The study employed stepwise regression, path analysis, simple t-test, and the Difference in Difference method.

8.1.3 Findings of the research

8.1.3.1 Changes of Return on Investment (ROI) of potato production through contract farming

The research found that the majority of farmers (79.01%) obtained a medium level of change in ROI of potato contract farming, 10.31% obtained a high level of impact of potato contract farming, and 10.69% obtained a low level of change in ROI of potato production through contract farming. The majority of farmers (90%) achieved medium to high level of change of ROI of potato production through contract farming. ROI mean was higher in study group 66.41 and control group was 25.28.

ROI was increased 3.84 times of the potato contract farmers from before contract farming engagement and 2.57 times increased in the non-contract group at the same time, thus the difference in difference (DiD) results showed positive change of 1.27 times higher in contractual farming than non-contractual.

8.1.3.2 Characteristics of the potato contract farmers

Age of the contract farmers: The study found 62.60% of potato contract farmers were middle-aged, compared to 20.61% who were old and 16.79% who were young.

Education of the contract farmers: The large proportion 61.45% of farmers had a secondary level of education, 20.99% had a primary level of education, 9.16% had a higher secondary level of education, and the remaining 8.4% could only sign.

Effective Household Farm Size: The majority of farmers (91.60%) had a medium-sized farm, with 6.11% having a large farm and 2.29% having a small or marginal farm.

Effective land size for potato contract farming: The effective potato contract farming land size ranged from 0.5 to 5.5 ha, with a mean of 1.71 ha and majority of farmers (81.30%) had medium-sized potato farming land, 18.32% had large land size, and 0.38% had small farmland for potato cultivation larger than 0.50 ha. Potato land size, on the other hand, is highly significant and positively associated with return on investment for potato contract farming.

Potato contract farming experience: The majority of potato farmers (60.31%) had medium farming experience, 20.61% had long farming experience, and 19.08% had short farming experience in potato cultivation.

Support services received from contractors: The majority (87.4%) of potato contract farmers received a medium level of support services from the contractor, 11.83% received a high level of support services, and 0.76% received a low level of support services.

Training Exposure: The contract farmers' training exposure score ranged from 2 to 12 days. Two-thirds of the farmers (67.94%) had medium training exposure, 18.32% had high training exposure, and 13.74% had lower training exposure on potato cultivation for contract farming operations. The majority of farmers (86.26%) had medium to high training exposure in potato cultivation, according to the findings. Training on potato cultivation of the contract farmers was positively associated with changes in return on investment of potato production through contract farming.

Knowledge on potato contract farming: The majority (91.22%) of the farmers had medium knowledge, with 5.73% having high knowledge and 3.05% having a low level of knowledge on the potato contract farming system. Knowledge on potato contract farming of the sample farmers was positively associated with changes in return on investment of potato production through contract farming.

Extension media contact: It was found that the majority (80.15%) of the farmers had medium extension contact, with 12.98% having low extension contact and 6.87% having high level of extension media contact. Extension media contact of the farmers was positively associated with changes in return on investment of potato production through contract farming.

Satisfaction on contract farming: More than half (65.65%) of the farmers had shown a medium level of satisfaction on potato contract farming, with 17.56% showing high level of satisfaction, and 16.79% showing a low level of satisfaction. However, the level of contract farming satisfaction of the farmers was positively associated with changes in return on investment of potato production through contract farming.

Innovativeness due to contract farming: The majority (62.60%) of the farmers had medium innovativeness on potato contract farming, with 20.23% showing high innovativeness, and 17.18% showing low level of innovativeness. Innovativeness of the farmers was positively associated with changes in return on investment of potato production through contract farming.

Commercialization of agriculture due to contract farming: The majority (85.88%) of the farmers had a medium level of commercialization on potato contract farming, with 11.07% having low level of commercialization and 3.05% having a high level of commercialization. Commercialization of the farmers was positively associated with changes in return on investment of potato production due to contract farming.

Business growth due to potato contract farming: More than half (58.4%) of the farmers had achieved the medium level of business growth due to potato contract farming, with 25.57% showing a high level of business growth, and 16.03% showing a low level of business growth. Business growth of the farmers was positively associated with changes in return on investment of potato production through contract farming.

8.1.3.3 Contribution of selected characteristics of the potato contract farmers on return on investment of potato production through contract farming

According to stepwise regression analysis, seven variables contributed 94% of changes of ROI of potato production through of potato contract farming. The variables were business growth

due to contract farming, extension media contact, commercialization, effective contract farming land size, training exposure, and support services.

Business growth due to potato contract farming: Business growth due to potato contract farming significantly contributed to changes of ROI and had positive impact on it. Business growth due to potato contract farming had shown the highest contribution of 85% on changes in return on investment of potato production through contract farming.

Extension media contact: The second variable, extension media contact, had significantly changes of return on investment and contributed 5.6% to changes in return on investment of potato production through contract farming.

Knowledge on potato contract farming: The knowledge on potato contract farming contributed 1.6% to changes in return on investment of potato production through contract farming.

Commercialization: Commercialization of potato contract farming contributed 0.5% to changes in return on investment of potato production through contract farming.

Effective contract farming land size: Effective contract farming land size contributed 0.8% to changes in return on investment of potato production through contract farming.

Training exposure: Training exposure contributed 0.3% to changes in return on investment of potato production through contract farming.

Support services: Support services contributed 0.1% to changes in return on investment of potato production through contract farming.

Indirect effect on changes of return on investment (ROI) of potato production through contract farming: Path analysis showed that knowledge on potato contract farming highest indirect contribution (0.64), followed by training exposure (0.58), extension media contact of potato contract farming (0.52), support services (indirect 0.51), effective contract farming land size (indirect 0.30), growth of business due to contract farming (indirect 0.29), and

commercialization (indirect 0.18) respectively has positive direct and indirect impact on changes of return on investment of potato production through contract farming.

Problems faced by the contract farmers and their solutions: Lack of information was found highest ranked problem faced by contract farmers among 13 problems encountered during potato contract farming. The farmers also found lack of price bargaining, substandard quality of the inputs, and unavailability of prescribed inputs problematic. Poor support and extension services were also identified as a medium-level problem. Other issues such as complicated compliance, lack of commitment, tight crop scheduling, delayed payment, and side selling were identified as medium-level problems.

There was no single solution to solve all of the problems at once; instead, a collection of solutions could be provided as a package based on location and specific company, however information through ICT based tools and apps; appropriate contract farming module development; need-based training to the farmers; appropriate support services e.g. right inputs, financial linkage, and market support; linkage with agricultural extension service providers; and on-time payment and follow contractual agreement conditions; recommended by the respondent farmers.

8.2 Conclusion and recommendations:

On the basis of research findings, the conclusions and recommendations of the study drawn as below:

Findings	**Conclusion**	**Recommendation**
The majority -79.01% of the farmers achieved medium level, 10.31% attained high level and 10.69% low level of changes of positive direction of ROI on contract farming ROI was increased 3.84 times of the potato contract farmers from before contract farming engagement and 2.57 times in the control group at the same	Potato contractual farming increased potato farmer's ROI, thus potato contract farming revealed a significant impact on farming communities in-terms of ROI than non-contract farmers	Encourage potato contract farming in Bangladesh Increase farmers' motivation to participate in the potato contract farming

Findings	Conclusion	Recommendation
time, thus the difference in difference (DiD) results showed positive change of 1.27 times		
Potato contract farmers are better to earn greater ROI than control farmers (non-contract farmers). ROI mean was higher in study group 66.41 and control group was 25.28	Achievement of ROI shown much higher in contract farming than the non-contract farmer	Contract farming should be promoted and popularize in Bangladesh
Stepwise multiple regression analysis indicated that seven (7) variables namely business growth due to potato contract farming (85%), extension media contact (5.6%), knowledge on potato contract farming (1.6%), contract farming land size (0.8%), commercialization (0.5%), training exposure (0.3%) and support services (0.1%, together contributed 94.6% to the changes of ROI of potato production through contract farming	These seven (7) factors should get more emphasis in future contract farming operation.	During contract farming these factors should be taken into consideration for contract farming operation.
Business growth due to potato contract farming shown highest (85%) positive contribution to changes of ROI of potato production through contract farming	Higher business growth can increase ROI in potato production	Farmers capacity building on business growth should be strengthened
Extension media contact showed second highest (5.6%) positive contribution to changes of ROI in potato production through contract farming	Effective and appropriate extension media contact can increase ROI in in potato production	Extension media contact should be strengthened further at the farm level both in public and private sectors
Knowledge on potato contract farming had shown third contributory variable (1.6%) to changes of ROI of potato production through contract farming	Knowledge on potato contract farming be able to increase ROI in contractual potato farming	Appropriate farming knowledge and market information should be disseminated through training, demonstration,

Findings	Conclusion	Recommendation
		promotional materials, and documentaries
Effective contract farming land size showed 4th (0.8%) contributory variable to changes of ROI of potato production through contract farming	Potato production land size can increase ROI of potato production. Large land more production more income and gain greater ROI	Group farming system with small farmers can come together to produce potatoes and should be encouraged to maintain the large farm and commercial contract farming
The commercialization of potatoes had a 5th (0.5%) positive contribution to changes of ROI of potato production through contract farming	Commercialization of potatoes be able to increase sales and changes of ROI of potato production	Enhance commercialization of agricultural farming through private sector engagement along with market interventions
Training exposure of the potato contract farmers had shown 6th highest (0.3%) contribution to changes ROI of potato production through contract farming	Training exposure be able to enhance ROI and knowledge of potato farmers and contribute to ROI	Need-based training should be provided to the potato farmers
Support services of the potato contract farmers had shown least (0.1%) contribution to changes ROI of potato production through contract farming 0.1% in predicting the dependent variable ROI	Support services during potato contract farming be able to enhance ROI remarkably	Strengthen support services for potato contract farming
Path analysis revealed that knowledge on potato contract farming of the potato contract farmers had the highest total indirect effect (0.64), followed by Training exposure (0.58), extension media contact (0.52), support services (0.51), effective CF land size (0.30), business growth due to contract farming (0.29) and commercialization (0.18) on changes of return on	All seven independent variable can increase ROI and essential for contract farming operation	During contract farming these factors should be taken into consideration for contract farming operation.

Findings	Conclusion	Recommendation
investment of potato production through contract farming.		
Lack of information ranked highest problem of potato contract farming followed by lack of price bargaining power, substandard quality of inputs , difficult to collect prescribed inputs, poor support and agricultural extension services, lack of commitment of the contractors, complicated compliances, delay in arranging inputs and payments, side selling/ purchasing by the contractors, and high price of inputs respectively	To increase potato contract farming the problems of the farmers should be reduced	Access to market information for farmers through apps, strengthen extension and support services, inputs to the contract farmers, good payment system, provide production manual and training to the contract farmers to be ensured

8.2.1 Future Research

On the basis of scope and limitations of the present study and the observations made by the researcher, the following recommendations have been made for further study:

- This study was conducted in selected three upazillas of two districts in Bangladesh, namely, Rangpur and Dinajpur. It is recommended that such studies should be conducted in other areas of Bangladesh.
- Factors of the farmers were many and varied, but in the present study only 13 factors on contractual potato production were taken into consideration. Obviously, there are other variables which contribute and cause of variations in changes of ROI of contractual potato production. Further research should be conducted involving other variable.
- This study only one crop i.e. potato, but there are many high value crops those can be taken into future research for more analysis.
- A single research work is inadequate to have in-depth understanding of the farmers ‘on changes of return on investment of agricultural production through contract farming in selected areas of Bangladesh. Further studies should be undertaken covering more dimensions of the same issue.

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APPENDIX

Appendix I: Interview Schedule

Department of Agricultural Extension & Information System
Sher-e-Bangla Agricultural University, Dhaka – 1207
English Version of Interview Schedule - Data Collection Instrument

Research Title: Changes of Return on Investment of Potato Production Through Contract Farming

1. Personal information

Name of Respondent:
Husband/ Father's Name:
Mobile phone #
Address : Village: Union:
Upazila: District:

SL No.	
Date	

2. Gender : Male: Female:

3. Age of the respondent

3.1. How old are you? …….**Years**

4. Educational qualification

4.1. Please state your educational level

SL.#	Level of education	Status
I	Illiterate	
Ii	Can sign only	
iii	Having non-formal/adult education which is equivalent to class	
Iv	Passed class	
Score: 0 for illiterate, 0.5 for those who can sign only, and 1 for each year of successful schooling		

5. Effective farm size

5.1 Please state the following information about your effective farm size

SL.#	Type of land	Effective farm area	
		Local unit	Hectare
I	Own cultivated land area		
Ii	Cultivated area leased in		
iii	Area under share cropping (In)		
Iv	Area under share cropping (Out)		
V	Total = $a+b+\frac{1}{2}(c+d)$		

5.2 Effective land size for potato contract farming

5.2	What is the land area under potato contract farming	Local unit:	Hectare:
I	This year		
Ii	Last year		
iii	2^{nd} last year		

6. Potato contract farming experience

6.1 Please mention your potato contract farming experience per following aspects:

SL. #	Types of potato cultivation	Duration of cultivation	Basis of potato contract farming effective score(s) (1 for 1 year engaged in local potato cultivation; 2 for 1 year engaged in HYV/hybrid potato cultivation; 3 for 1 year engaged in processing potato cultivation)	Potato contract farming effective score
1	2	3	4	5 = (3x4)
I	Local variety		x 1	=
Ii	HYV/ Hybrid variety		x 2	=
iii	Processing/ industrial variety		x 3	=
Total				

7. Received support service(s)

7.1 What type(s) and extent of supports you have received for potato contract farming?

SL #	Support services	Extent of support			
		High (3)	Moderate (2)	Low (1)	No support (0)
I	Inputs related information				
Ii	Inputs supports (seed)				
iii	Inputs supports (pesticides)				
Iv	Inputs supports (fertilizers)				
V	Production related technical information				
Vi	Field support services – pest and diseases				
vii	Harvesting technology - Haulm pulling				
viii	Post-harvest technology - sorting				
Ix	Post-harvest technology - grading				
X	Sales and marketing				
Xi	Financial support and linkages				
xii	Land preparation information				
	Others (Specify …….)				
	Total				

8. Training exposure

8.1	Have you received any training related to potato cultivation?	Yes	1	No	2

8.2. If yes, please provide following information regarding potato cultivation training exposure?

SL #	Name of the training course	Duration (days)	Sponsoring organization
I			
Ii			
iii			

9. Knowledge on potato contract farming

9.1. Please mention your level of understanding on contract farming on following issues:

SL #	Questions	Full mark	Obtained score
I	What is contract farming?	2	
Ii	What are the terms and conditions for contract farming?	2	
iii	What is your role in the contract farming?	2	
Iv	What is the difference between contract farming and traditional farming?	2	
V	What is the characteristics of good quality potato seed?	2	
Vi	How do you cut (eye) good quality potato seed for transplantation?	2	
vii	What is the name of two good variety for potato contract farming?	2	
viii	What is the name of two important diseases of potato?	2	
Ix	What is the name of two important insects of potato?	2	
X	What is the appropriate spacing of potato seed to seed and line to line transplantation?	2	
Xi	What is market information?	2	
xii	What is the meaning of pre-fixed price?	2	
xiii	How you apply fertilizer (recommended by contractor)?	2	
xiv	When you do haulm pulling in potato cultivation?	2	
xv	What are the quality parameters (grading standard) of your produces?	2	
xvi	How have you packaged potato to supply contractor?	2	
xvii	What types of records you are maintaining for contract production?	2	
xviii	How do you calculate profit / loss?	2	
xix	What is the benefit of contract farming?	2	
xx	What is the procedure of soil treatment for potato contract farming?	2	
	Total	40	

10. Agricultural Extension and Communication

10.1. Please mention your extent of agricultural extension and communication on contract farming on following aspects:

SL #	Description of communication	Degree of Communication				Obtained Score
		High (3)	Moderate (2)	Low (1)	Not at all (0)	
	Personal Contact	**3**	**2**	**1**	**0**	
i	Consult and meet model farmers per week					
ii	Meet DAE representatives (SAAO) per month					
iii	Communicate with contractor weekly					
iv	Meet with inputs retailers and traders per season (per 3 months)					
v	Banks for credit support per season (per 3 months)					

SL #	Description of communication	Degree of Communication				Obtained Score
		High (3)	Moderate (2)	Low (1)	Not at all (0)	
vi	Agro based NGOs/ Donors for farming purpose per season (3 months)					
vii	Neighbor farmers for farming issues – weekly					
viii	Meet group leaders per month					
	Group Contact					
ix	Attend in group meetings per (per 3 month)					
x	Visit any demonstration plots per month					
xi	Group discussion among CF per month					
	Mass Contact					
xii	Listening agricultural program on Radio per week					
xiii	Watching agricultural program on Television per week					
xiv	Reading agricultural features from printed media (daily newspaper, krishikotha, leaflet, booklet, magazine etc.) monthly					
xv	Visit in agricultural fair per year					
xvi	Use of mobile apps for agricultural purpose per month					
xvii	Social networks (Facebook, LinkedIn etc.,) for agricultural purpose - weekly					

11. Satisfaction on potato contract farming

11.1. Please mention what is your level of satisfaction regarding potato contract farming?

SL #	Level of satisfaction	Level of satisfaction			
		High (3)	Medium (2)	Low (1)	No satisfaction (0)
A	Production level				
i	Contractual terms and conditions - agreement between farmers and contractors				
ii	Availability of inputs				
iii	Legal price of inputs				
iv	Inputs quality and its application methods				
v	Improvement of production technology				
vi	Support services (extension service) for potato production				
vii	Harvest and harvesting methods				
viii	Higher potato yield				

SL #	Level of satisfaction	Level of satisfaction			
		High (3)	Medium (2)	Low (1)	No satisfaction (0)
ix	Helpful to potato based value added products				
x	Received training and technical assistance				
xi	Linkage with good inputs suppliers				
B	Access to market and sales				
i	Potato price fixation				
ii	Price negotiation ability				
iii	Higher legal price of potato				
iv	Modes of sales				
V	Availability and receive market information				
vi	Market information from ICT apps/ mobile				
vii	Reduce market insecurity				
C	Access to Finance				
i	Payment system				
ii	Financing from bank/NGO/Contractor				
iii	Modes of transaction – through bank				
iv	Boost export of potato from Bangladesh				
v	Profit from contract farming				
vi	Import supplementation of processed potato based food items				
D	Social satisfaction				
i	Family level acceptance				
ii	Community level acceptance				
iii	Contract farming is prestigious profession				
iv	Beneficial to start new business, buy new assets				
v	Proud to be a contract farmers				
vi	Local economic development				
vii	Employment generation				
E	Environment satisfaction				
i	Beneficial for environment friendly agriculture				
ii	Provide safe food to the consumer				
	Total				

12. Innovativeness of the potato contract farming

12.1 Please mention your innovativeness regarding potato contract farming

Sl. #	**Name of Innovation**	**Degree of innovation**				
		Used within 1 year of hearing (4)	**Used within >1-2 years of hearing (3)**	**Used within >2-3 years of hearing (2)**	**Used after 3 years of hearing (1)**	**Never Used (0)**
i	Soil and seed treatment					
ii	Crop planning as per buyers requirement					
iii	Improve production technology – appropriate spacing					
iv	Improve harvesting methods – Haulm Pulling					

Sl. #	Name of Innovation	Degree of innovation				
		Used within 1 year of hearing (4)	Used within >1-2 years of hearing (3)	Used within >2-3 years of hearing (2)	Used after 3 years of hearing (1)	Never Used (0)
v	Improve curing and cooling					
vi	Improve sorting system					
vii	Improve grading system					
viii	Improve packaging – buyers friendly					
ix	Improve storage					
x	Use of industrial variety					
	Others					

13. Commercialization of potato contract farming

13.1 Please answer following item regarding potato production, sales and commercialization on potato contract farming

SL #	Items	Kg
i	Total potato production	
ii	How much of your produced potato sold to the contractor and market	
iii	How much consumed by the family and for non-financial use	
iv	Commercialization (ii+iii)/I in percentage	

14. Growth of potato contract farming business

14.1 Please mention your growth of the business due to potato contract farming

SL #	Expansion of the crops or business	At Present (2019)			
		High=3	Medium=2	Low=1	No =0
i	Increased land for potato contract farming last 3 years				
ii	Reduced cost of production due to contract farming				
iii	Increased production and yield				
iv	Increased (easy) market (market access)				
v	Increased Income due to potato contract farming				
vi	Increased net profit				
vii	increased access to get financial supports (loan)				
viii	Increased access to inputs its appropriate use				
ix	Decrease post-harvest loss				
x	Increased farm mechanization				
	Total				

15. Problems of contract farming

15.1. Please mention extent of problems and probable solutions on potato contract farming as per following:

SL #	Probable problems	Degree of problems No (0), Low (1), medium (2), high (3)	Probable Solution	High=3, Medium=2, Low=1, No=0
i	Complicated compliances		Provide Training	
			Manual and standard	
			Categorized the farmers	
			Others (specify…….)	
ii	Lack of information		Apps and mobile application	
			Market visit	
			Set market information cell	
			Others (specify…….)	
iii	Lack of price bargaining power		Contract farming	
			Group sales	
			Direct sales to the large buyer	
			Others (specify…….)	
iv	Poor support and agricultural extension services		Linkage with DAE	
			Set-up Knowledge center	
			Mobile application apps	
			Strengthen extension service by the contractor	
			Others (specify…….)	
v	Difficult to collect prescribed inputs		Collect direct from company	
			Good retailers nearby the farm	
			List of retailers	
			Others (specify…….)	
vi	Substandard quality of inputs		Training to understand good quality inputs	
			Selection of appropriate retailers	
			Awareness on good quality inputs	
			Others (specify…….)	
vii	Delay in arranging inputs		On time delivery of the inputs	
			Link with more inputs retailers	
			Others (specify…….)	
viii	Lack of commitment of the contractors		More interactions/meeting with contractor and farmers	
			Follow agreement	
			More communication required	
			Others (specify…….)	
ix	Tight crop scheduling		Training and sharing crop schedules	
			Flexibility on scheduling as per production	
			Declare before production starts and regular field visits	
			Others (specify…….)	
x	Delay payment by the contractor		On time payment at site	
			Payment through bank within the contracted period	
			Pay advance	
			Others (specify…….)	
xi			Build trust all of the actors	

SL #	Probable problems	Degree of problems No (0), Low (1), medium (2), high (3)	Probable Solution	High=3, Medium=2, Low=1, No=0
	Side selling/ purchasing by the contractors		Establish market monitoring cell and revise price time to time as per market demand	
			Appropriate cost calculation and pay adequate margin to the price	
			Others (specify…….)	
xii	Lack of credit for crop production		Linkage with banks and financial institutes for credit	
			Pay advance to the farmers	
			Provide inputs as credit to the farmers	
			Others (specify…….)	
xiii	High price of inputs		Direct link with the company	
			Provide inputs to the farmers	
			Credit facilities	
			(specify…….)	
xiv	Others (specify)		(specify…….)	
			(specify…….)	
	Total			

16. ROI of potato contract farming

16.1. Please mention cost/investment and income from potato contract farming on following aspects:

SL #	**Items of cost of production** and income	**Before CF (BDT)**	**At present (BDT)**
1	**Investment/Cost**		
i	Land lease value		
ii	Land preparation cost		
iii	Seed and seedling		
iv	Organic fertilizer		
v	Chemical fertilizer		
vi	Pesticide		
vii	Irrigation		
viii	Intercultural operation		
ix	Harvesting		
x	Post-harvest management		
xi	Transport for marketing		
xii	Advisory cost (extension service, training, etc.)		
xiii	Others		
xiv	Total production cost		
2	**Production and Income from potato contract farming**		
xv	Total potato production (Kg)		
xvi	Selling price per unit (Tk./Kg)		
xvii	Total income (total production)		
xviii	Net profit/loss		
xiv	Return on investment		
xv	Changes in return on investment		

Any suggestion:

Thank you for your time and information

Appendix II: Inter-correlation matrix of the selected characteristics on potato contract farming

Correlations														
	X_1	X_2	X_3	(X_4)	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	(ROI) X_{14}
X_1	-													
X_2	-0.105	-												
X_3	-0.083	0.308**	-											
X_4	-0.107	0.260**	0.882**	-										
X_5	-0.070	0.163**	0.271**	0.234**	-									
X_6	0.038	0.327**	0.288**	0.249**	0.370**	-								
X_7	-0.081	0.339**	0.294**	0.270**	0.308**	0.463**	-							
X_8	0.145*	0.394**	0.321**	0.287**	0.258**	0.438**	0.579**	-						
X_9	0.073	0.372**	0.396**	0.320**	0.247**	0.413**	0.490**	0.623**	-					
X_{10}	0.126*	0.397**	0.296**	0.248**	0.401**	0.457**	0.586**	0.803**	0.505**	-				
X_{11}	0.058	0.364**	0.285**	0.252**	0.428**	0.497**	0.625**	0.771**	0.664**	0.698**	-			
X_{12}	0.108	0.011	-0.107	-0.143*	-0.049	0.229**	0.147*	0.223**	0.227**	0.191**	0.213**	-	-	
X_{13}	0.051	0.348**	0.353**	0.297**	0.411**	0.484**	0.560**	0.709**	0.506**	0.715**	0.675**	0.166**	-	
X_{14}	0.055	0.384**	0.428**	0.386**	0.372**	0.553**	0.640**	0.805**	0.671**	0.767**	0.770**	0.273**	0.922**	--
*. Correlation is significant at the 0.05 level (2-tailed).														
**. Correlation is significant at the 0.01 level (2-tailed).														

Legend:

X_1= Age	X_8 = Knowledge on contract farming
X_2= Education	X_9 = Extension media contact
X_3=Effective Farming land size	X_{10} = Satisfaction on contract farming
X_4=Effective contract farming land size	X_{11}=Innovativeness
X_5=CF experience	X_{12} = Commercialization
X_6 = Support Service	X_{13} = Business growth due to potato contract famring
X_7 = Training exposure	

X_{14} = Changes of ROI of potato production through contract farming (dependent variable)

Appendix III: Stepwise regression models

Set-I: with all variables

Variables Entered/Removed[a]			
Model	Variables Entered	Variables Removed	Method
1	13.Business Growth due to CF	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	9.Extension media contact	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	8.Knowledge on CF	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
4	12.Commercialization	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
5	4.Effective CF land size	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
6	7.Training exposure	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
7	6.Support service	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
a. Dependent Variable: 14.ROI_Difference			

Model Summary									
					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.922[a]	.849	.849	6.576455	.849	1464.590	1	260	.000
2	.952[b]	.906	.905	5.216612	.056	154.219	1	259	.000
3	.960[c]	.921	.920	4.776602	.016	50.915	1	258	.000
4	.962[d]	.926	.925	4.622577	.005	18.480	1	257	.000
5	.967[e]	.934	.933	4.378458	.008	30.457	1	256	.000
6	.968[f]	.937	.936	4.292460	.003	11.361	1	255	.001
7	.969[g]	.938	.936	4.262075	.001	4.649	1	254	.032
a. Predictors: (Constant), 13.Business Growth due to CF									
b. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact									
c. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF									
d. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization									
e. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size									
f. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure									
g. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure, 6.Support service									

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	63343.162	1	63343.162	1464.590	.000[b]
	Residual	11244.939	260	43.250		
	Total	74588.101	261			
2	Regression	67539.923	2	33769.962	1240.948	.000[c]
	Residual	7048.178	259	27.213		
	Total	74588.101	261			
3	Regression	68701.593	3	22900.531	1003.708	.000[d]
	Residual	5886.508	258	22.816		
	Total	74588.101	261			
4	Regression	69096.468	4	17274.117	808.402	.000[e]
	Residual	5491.633	257	21.368		
	Total	74588.101	261			

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
5	Regression	69680.351	5	13936.070	726.939	.000[f]
	Residual	4907.749	256	19.171		
	Total	74588.101	261			
6	Regression	69889.672	6	11648.279	632.192	.000[g]
	Residual	4698.428	255	18.425		
	Total	74588.101	261			
7	Regression	69974.120	7	9996.303	550.297	.000[h]
	Residual	4613.981	254	18.165		
	Total	74588.101	261			
a. Dependent Variable: 14.ROI_Difference						
b. Predictors: (Constant), 13.Business Growth due to CF						
c. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact						
d. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF						
e. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization						
f. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size						
g. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure						
h. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure, 6.Support service						

Coefficients[a]										
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	9.350	1.203		7.771	.000	6.981	11.719		
	13.Business Growth due to CF	2.496	.065	.922	38.270	.000	2.368	2.625	1.000	1.000
2	(Constant)	-9.077	1.764		-5.145	.000	-12.551	-5.603		
	13.Business Growth due to CF	2.119	.060	.782	35.340	.000	2.001	2.238	.744	1.344
	9.Extension media contact	.683	.055	.275	12.418	.000	.574	.791	.744	1.344
3	(Constant)	-13.891	1.751		-7.935	.000	-17.338	-10.443		
	13.Business Growth due to CF	1.838	.068	.679	27.186	.000	1.705	1.971	.491	2.037
	9.Extension media contact	.510	.056	.205	9.122	.000	.400	.620	.604	1.656
	8.Knowledge on CF	.493	.069	.196	7.135	.000	.357	.628	.404	2.475
4	(Constant)	-22.813	2.679		-8.515	.000	-28.088	-17.537		
	13.Business Growth due to CF	1.839	.065	.679	28.104	.000	1.710	1.968	.491	2.037
	9.Extension media contact	.483	.054	.194	8.866	.000	.375	.590	.596	1.678
	8.Knowledge on CF	.467	.067	.186	6.962	.000	.335	.599	.401	2.495
	12.Commercialization	.124	.029	.075	4.299	.000	.067	.181	.937	1.067
5	(Constant)	-27.156	2.657		-10.221	.000	-32.388	-21.923		
	13.Business Growth due to CF	1.796	.062	.663	28.768	.000	1.674	1.919	.484	2.068
	9.Extension media contact	.422	.053	.170	8.013	.000	.319	.526	.570	1.753
	8.Knowledge on CF	.449	.064	.179	7.059	.000	.324	.574	.400	2.501
	12.Commercialization	.163	.028	.099	5.777	.000	.108	.219	.878	1.138
	4.Effective CF land size	2.626	.476	.098	5.519	.000	1.689	3.563	.818	1.223
6	(Constant)	-26.689	2.608		-10.232	.000	-31.826	-21.552		
	13.Business Growth due to CF	1.747	.063	.645	27.736	.000	1.623	1.871	.457	2.188
	9.Extension media contact	.394	.052	.159	7.526	.000	.291	.497	.556	1.800
	8.Knowledge on CF	.404	.064	.161	6.327	.000	.278	.529	.382	2.618
	12.Commercialization	.162	.028	.098	5.829	.000	.107	.216	.878	1.139
	4.Effective CF land size	2.509	.468	.093	5.364	.000	1.588	3.430	.813	1.230
	7.Training exposure	.463	.137	.069	3.371	.001	.192	.733	.596	1.677
7	(Constant)	-28.209	2.684		-10.509	.000	-33.495	-22.923		
	13.Business Growth due to CF	1.719	.064	.635	26.940	.000	1.594	1.845	.439	2.279
	9.Extension media contact	.382	.052	.154	7.319	.000	.280	.485	.550	1.819
	8.Knowledge on CF	.403	.063	.161	6.361	.000	.278	.528	.382	2.618

Coefficients[a]									
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
	12.Commercialization	.152	.028	.092	5.445	.000	.097	.207	.855	1.169
	4.Effective CF land size	2.400	.467	.089	5.137	.000	1.480	3.320	.804	1.244
	7.Training exposure	.402	.139	.060	2.893	.004	.129	.676	.572	1.747
	6.Support service	.154	.071	.041	2.156	.032	.013	.294	.673	1.487
a. Dependent Variable: 14.ROI_Difference										

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	1.Age	.008[b]	.331	.741	.021	.997	1.003	.997
	2.Education	.073[b]	2.861	.005	.175	.879	1.138	.879
	3.Effective_Farm_Size	.117[b]	4.750	.000	.283	.875	1.142	.875
	4.Effective CF land size	.124[b]	5.135	.000	.304	.912	1.097	.912
	5.CF_Experience	-.008[b]	-.306	.759	-.019	.831	1.203	.831
	6.Support service	.140[b]	5.348	.000	.315	.766	1.306	.766
	7.Training exposure	.181[b]	6.729	.000	.386	.686	1.458	.686
	8.Knowledge on CF	.305[b]	10.729	.000	.555	.498	2.009	.498
	9.Extension media contact	.275[b]	12.418	.000	.611	.744	1.344	.744
	10.CF_Satisfaction	.220[b]	6.954	.000	.397	.488	2.048	.488
	11.CF_Innovativeness	.272[b]	9.728	.000	.517	.544	1.838	.544
	12.Commercialization	.124[b]	5.347	.000	.315	.973	1.028	.973
2	1.Age	-.005[c]	-.269	.788	-.017	.994	1.006	.742
	2.Education	.012[c]	.565	.573	.035	.827	1.209	.700
	3.Effective_Farm_Size	.053[c]	2.531	.012	.156	.812	1.232	.690
	4.Effective CF land size	.076[c]	3.801	.000	.230	.873	1.145	.713
	5.CF_Experience	-.021[c]	-1.007	.315	-.063	.829	1.206	.657
	6.Support service	.084[c]	3.837	.000	.232	.728	1.374	.653
	7.Training exposure	.107[c]	4.612	.000	.276	.629	1.591	.616
	8.Knowledge on CF	.196[c]	7.135	.000	.406	.404	2.475	.404
	10.CF_Satisfaction	.148[c]	5.558	.000	.327	.461	2.171	.460
	11.CF_Innovativeness	.147[c]	5.122	.000	.304	.404	2.476	.404
	12.Commercialization	.086[c]	4.538	.000	.272	.945	1.058	.723
3	1.Age	-.024[d]	-1.352	.178	-.084	.973	1.028	.395
	2.Education	-.007[d]	-.345	.731	-.022	.812	1.231	.397
	3.Effective_Farm_Size	.055[d]	2.859	.005	.176	.812	1.232	.404
	4.Effective CF land size	.072[d]	3.962	.000	.240	.873	1.146	.404
	5.CF_Experience	-.010[d]	-.521	.603	-.032	.824	1.214	.401
	6.Support service	.074[d]	3.710	.000	.225	.725	1.380	.402
	7.Training exposure	.077[d]	3.468	.001	.211	.600	1.668	.385
	10.CF_Satisfaction	.065[d]	2.075	.039	.128	.312	3.203	.274
	11.CF_Innovativeness	.075[d]	2.466	.014	.152	.325	3.074	.325
	12.Commercialization	.075[d]	4.299	.000	.259	.937	1.067	.401
4	1.Age	-.030[e]	-1.758	.080	-.109	.967	1.034	.393
	2.Education	.002[e]	.110	.912	.007	.803	1.246	.392
	3.Effective_Farm_Size	.078[e]	4.174	.000	.252	.766	1.305	.401
	4.Effective CF land size	.098[e]	5.519	.000	.326	.818	1.223	.400
	5.CF_Experience	.001[e]	.038	.970	.002	.809	1.236	.399
	6.Support service	.064[e]	3.246	.001	.199	.711	1.406	.400
	7.Training exposure	.077[e]	3.589	.000	.219	.600	1.668	.382
	10.CF_Satisfaction	.062[e]	2.051	.041	.127	.312	3.204	.273
	11.CF_Innovativeness	.071[e]	2.429	.016	.150	.325	3.077	.324
5	1.Age	-.019[f]	-1.129	.260	-.071	.950	1.053	.391
	2.Education	-.008[f]	-.471	.638	-.029	.794	1.260	.392
	3.Effective_Farm_Size	-.031[f]	-.872	.384	-.055	.205	4.878	.205
	5.CF_Experience	-.009[f]	-.484	.629	-.030	.802	1.247	.398
	6.Support service	.052[f]	2.753	.006	.170	.701	1.427	.399
	7.Training exposure	.069[f]	3.371	.001	.207	.596	1.677	.382
	10.CF_Satisfaction	.063[f]	2.216	.028	.137	.312	3.205	.272
	11.CF_Innovativeness	.079[f]	2.861	.005	.176	.324	3.084	.322
6	1.Age	-.009[g]	-.534	.594	-.034	.917	1.090	.369
	2.Education	-.014[g]	-.795	.427	-.050	.787	1.271	.377
	3.Effective_Farm_Size	-.029[g]	-.838	.403	-.052	.205	4.880	.205
	5.CF_Experience	-.015[g]	-.861	.390	-.054	.792	1.262	.378
	6.Support service	.041[g]	2.156	.032	.134	.673	1.487	.382

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
	10.CF_Satisfaction	.047[g]	1.652	.100	.103	.301	3.319	.271
	11.CF_Innovativeness	.060[g]	2.108	.036	.131	.304	3.295	.304
7	1.Age	-.010[h]	-.617	.538	-.039	.916	1.092	.369
	2.Education	-.019[h]	-1.095	.275	-.069	.773	1.293	.377
	3.Effective_Farm_Size	-.033[h]	-.953	.342	-.060	.204	4.892	.204
	5.CF_Experience	-.024[h]	-1.362	.174	-.085	.756	1.322	.378
	10.CF_Satisfaction	.042[h]	1.483	.139	.093	.299	3.343	.270
	11.CF_Innovativeness	.053[h]	1.857	.064	.116	.299	3.350	.299

a. Dependent Variable: 14.ROI_Difference

b. Predictors in the Model: (Constant), 13.Business Growth due to CF

c. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact

d. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF

e. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization

f. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size

g. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure

h. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure, 6.Support service

Set II: Significant variables from correlation coefficient

Variables Entered/Removed[a]			
Model	Variables Entered	Variables Removed	Method
1	13.Business Growth due to CF	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	9.Extension media contact	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	8.Knowledge on CF	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
4	12.Commercialization	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
5	4.Effective CF land size	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
6	7.Training exposure	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
7	6.Support service	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
a. Dependent Variable: 14.ROI_Difference			

Model Summary									
					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.922[a]	.849	.849	6.576455	.849	1464.590	1	260	.000
2	.952[b]	.906	.905	5.216612	.056	154.219	1	259	.000
3	.960[c]	.921	.920	4.776602	.016	50.915	1	258	.000
4	.962[d]	.926	.925	4.622577	.005	18.480	1	257	.000
5	.967[e]	.934	.933	4.378458	.008	30.457	1	256	.000
6	.968[f]	.937	.936	4.292460	.003	11.361	1	255	.001
7	.969[g]	.938	.936	4.262075	.001	4.649	1	254	.032
a. Predictors: (Constant), 13.Business Growth due to CF									
b. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact									
c. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF									
d. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization									
e. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size									
f. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure									
g. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure, 6.Support service									

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	63343.162	1	63343.162	1464.590	.000[b]
	Residual	11244.939	260	43.250		
	Total	74588.101	261			
2	Regression	67539.923	2	33769.962	1240.948	.000[c]
	Residual	7048.178	259	27.213		
	Total	74588.101	261			
3	Regression	68701.593	3	22900.531	1003.708	.000[d]
	Residual	5886.508	258	22.816		
	Total	74588.101	261			
4	Regression	69096.468	4	17274.117	808.402	.000[e]
	Residual	5491.633	257	21.368		
	Total	74588.101	261			
5	Regression	69680.351	5	13936.070	726.939	.000[f]
	Residual	4907.749	256	19.171		
	Total	74588.101	261			
6	Regression	69889.672	6	11648.279	632.192	.000[g]
	Residual	4698.428	255	18.425		

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
	Total	74588.101	261			
7	Regression	69974.120	7	9996.303	550.297	.000[h]
	Residual	4613.981	254	18.165		
	Total	74588.101	261			
a. Dependent Variable: 14.ROI_Difference						
b. Predictors: (Constant), 13.Business Growth due to CF						
c. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact						
d. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF						
e. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization						
f. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size						
g. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure						
h. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure, 6.Support service						

Coefficients[a]										
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	9.350	1.203		7.771	.000	6.981	11.719		
	13.Business Growth due to CF	2.496	.065	.922	38.270	.000	2.368	2.625	1.000	1.000
2	(Constant)	-9.077	1.764		-5.145	.000	-12.551	-5.603		
	13.Business Growth due to CF	2.119	.060	.782	35.340	.000	2.001	2.238	.744	1.344
	9.Extension media contact	.683	.055	.275	12.418	.000	.574	.791	.744	1.344
3	(Constant)	-13.891	1.751		-7.935	.000	-17.338	-10.443		
	13.Business Growth due to CF	1.838	.068	.679	27.186	.000	1.705	1.971	.491	2.037
	9.Extension media contact	.510	.056	.205	9.122	.000	.400	.620	.604	1.656
	8.Knowledge on CF	.493	.069	.196	7.135	.000	.357	.628	.404	2.475
4	(Constant)	-22.813	2.679		-8.515	.000	-28.088	-17.537		
	13.Business Growth due to CF	1.839	.065	.679	28.104	.000	1.710	1.968	.491	2.037
	9.Extension media contact	.483	.054	.194	8.866	.000	.375	.590	.596	1.678
	8.Knowledge on CF	.467	.067	.186	6.962	.000	.335	.599	.401	2.495
	12.Commercialization	.124	.029	.075	4.299	.000	.067	.181	.937	1.067
5	(Constant)	-27.156	2.657		-10.22	.000	-32.388	-21.923		
	13.Business Growth due to CF	1.796	.062	.663	28.768	.000	1.674	1.919	.484	2.068
	9.Extension media contact	.422	.053	.170	8.013	.000	.319	.526	.570	1.753
	8.Knowledge on CF	.449	.064	.179	7.059	.000	.324	.574	.400	2.501
	12.Commercialization	.163	.028	.099	5.777	.000	.108	.219	.878	1.138
	4.Effective CF land size	2.626	.476	.098	5.519	.000	1.689	3.563	.818	1.223
6	(Constant)	-26.689	2.608		-10.23	.000	-31.826	-21.552		
	13.Business Growth due to CF	1.747	.063	.645	27.736	.000	1.623	1.871	.457	2.188
	9.Extension media contact	.394	.052	.159	7.526	.000	.291	.497	.556	1.800
	8.Knowledge on CF	.404	.064	.161	6.327	.000	.278	.529	.382	2.618
	12.Commercialization	.162	.028	.098	5.829	.000	.107	.216	.878	1.139
	4.Effective CF land size	2.509	.468	.093	5.364	.000	1.588	3.430	.813	1.230
	7.Training exposure	.463	.137	.069	3.371	.001	.192	.733	.596	1.677
7	(Constant)	-28.209	2.684		-10.51	.000	-33.495	-22.923		

Coefficients[a]									
Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
13.Business Growth due to CF	1.719	.064	.635	26.940	.000	1.594	1.845	.439	2.279
9.Extension media contact	.382	.052	.154	7.319	.000	.280	.485	.550	1.819
8.Knowledge on CF	.403	.063	.161	6.361	.000	.278	.528	.382	2.618
12.Commercialization	.152	.028	.092	5.445	.000	.097	.207	.855	1.169
4.Effective CF land size	2.400	.467	.089	5.137	.000	1.480	3.320	.804	1.244
7.Training exposure	.402	.139	.060	2.893	.004	.129	.676	.572	1.747
6.Support service	.154	.071	.041	2.156	.032	.013	.294	.673	1.487
a. Dependent Variable: 14.ROI_Difference									

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Min
1	2.Education	.073[b]	2.861	.005	.175	.879	1.138	.879
	3.Effective_Farm_Size	.117[b]	4.750	.000	.283	.875	1.142	.875
	4.Effective CF land size	.124[b]	5.135	.000	.304	.912	1.097	.912
	5.CF_Experience	-.008[b]	-.306	.759	-.019	.831	1.203	.831
	6.Support service	.140[b]	5.348	.000	.315	.766	1.306	.766
	7.Training exposure	.181[b]	6.729	.000	.386	.686	1.458	.686
	8.Knowledge on CF	.305[b]	10.729	.000	.555	.498	2.009	.498
	9.Extension media contact	.275[b]	12.418	.000	.611	.744	1.344	.744
	10.CF_Satisfaction	.220[b]	6.954	.000	.397	.488	2.048	.488
	11.CF_Innovativeness	.272[b]	9.728	.000	.517	.544	1.838	.544
	12.Commercialization	.124[b]	5.347	.000	.315	.973	1.028	.973
2	2.Education	.012[c]	.565	.573	.035	.827	1.209	.700
	3.Effective_Farm_Size	.053[c]	2.531	.012	.156	.812	1.232	.690
	4.Effective CF land size	.076[c]	3.801	.000	.230	.873	1.145	.713
	5.CF_Experience	-.021[c]	-1.007	.315	-.063	.829	1.206	.657
	6.Support service	.084[c]	3.837	.000	.232	.728	1.374	.653
	7.Training exposure	.107[c]	4.612	.000	.276	.629	1.591	.616
	8.Knowledge on CF	.196[c]	7.135	.000	.406	.404	2.475	.404
	10.CF_Satisfaction	.148[c]	5.558	.000	.327	.461	2.171	.460
	11.CF_Innovativeness	.147[c]	5.122	.000	.304	.404	2.476	.404
	12.Commercialization	.086[c]	4.538	.000	.272	.945	1.058	.723
3	2.Education	-.007[d]	-.345	.731	-.022	.812	1.231	.397
	3.Effective_Farm_Size	.055[d]	2.859	.005	.176	.812	1.232	.404
	4.Effective CF land size	.072[d]	3.962	.000	.240	.873	1.146	.404
	5.CF_Experience	-.010[d]	-.521	.603	-.032	.824	1.214	.401
	6.Support service	.074[d]	3.710	.000	.225	.725	1.380	.402
	7.Training exposure	.077[d]	3.468	.001	.211	.600	1.668	.385
	10.CF_Satisfaction	.065[d]	2.075	.039	.128	.312	3.203	.274
	11.CF_Innovativeness	.075[d]	2.466	.014	.152	.325	3.074	.325
	12.Commercialization	.075[d]	4.299	.000	.259	.937	1.067	.401
4	2.Education	.002[e]	.110	.912	.007	.803	1.246	.392
	3.Effective_Farm_Size	.078[e]	4.174	.000	.252	.766	1.305	.401
	4.Effective CF land size	.098[e]	5.519	.000	.326	.818	1.223	.400
	5.CF_Experience	.001[e]	.038	.970	.002	.809	1.236	.399
	6.Support service	.064[e]	3.246	.001	.199	.711	1.406	.400
	7.Training exposure	.077[e]	3.589	.000	.219	.600	1.668	.382
	10.CF_Satisfaction	.062[e]	2.051	.041	.127	.312	3.204	.273
	11.CF_Innovativeness	.071[e]	2.429	.016	.150	.325	3.077	.324
5	2.Education	-.008[f]	-.471	.638	-.029	.794	1.260	.392
	3.Effective_Farm_Size	-.031[f]	-.872	.384	-.055	.205	4.878	.205
	5.CF_Experience	-.009[f]	-.484	.629	-.030	.802	1.247	.398
	6.Support service	.052[f]	2.753	.006	.170	.701	1.427	.399
	7.Training exposure	.069[f]	3.371	.001	.207	.596	1.677	.382
	10.CF_Satisfaction	.063[f]	2.216	.028	.137	.312	3.205	.272
	11.CF_Innovativeness	.079[f]	2.861	.005	.176	.324	3.084	.322
6	2.Education	-.014[g]	-.795	.427	-.050	.787	1.271	.377
	3.Effective_Farm_Size	-.029[g]	-.838	.403	-.052	.205	4.880	.205
	5.CF_Experience	-.015[g]	-.861	.390	-.054	.792	1.262	.378
	6.Support service	.041[g]	2.156	.032	.134	.673	1.487	.382
	10.CF_Satisfaction	.047[g]	1.652	.100	.103	.301	3.319	.271
	11.CF_Innovativeness	.060[g]	2.108	.036	.131	.304	3.295	.304
7	2.Education	-.019[h]	-1.095	.275	-.069	.773	1.293	.377
	3.Effective_Farm_Size	-.033[h]	-.953	.342	-.060	.204	4.892	.204
	5.CF_Experience	-.024[h]	-1.362	.174	-.085	.756	1.322	.378
	10.CF_Satisfaction	.042[h]	1.483	.139	.093	.299	3.343	.270
	11.CF_Innovativeness	.053[h]	1.857	.064	.116	.299	3.350	.299

a. Dependent Variable: 14.ROI_Difference

b. Predictors in the Model: (Constant), 13.Business Growth due to CF

c. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact

d. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF

e. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization

f. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size

g. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure

h. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure, 6.Support service

Set- III: Significant variables from regression analysis

Variables Entered/Removed[a]			
Model	Variables Entered	Variables Removed	Method
1	13.Business Growth due to CF	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	9.Extension media contact	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	8.Knowledge on CF	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
4	12.Commercialization	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
5	4.Effective CF land size	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
6	7.Training exposure	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
7	6.Support service	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
a. Dependent Variable: 14.ROI_Difference			

Model Summary									
					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.922[a]	.849	.849	6.576455	.849	1464.590	1	260	.000
2	.952[b]	.906	.905	5.216612	.056	154.219	1	259	.000
3	.960[c]	.921	.920	4.776602	.016	50.915	1	258	.000
4	.962[d]	.926	.925	4.622577	.005	18.480	1	257	.000
5	.967[e]	.934	.933	4.378458	.008	30.457	1	256	.000
6	.968[f]	.937	.936	4.292460	.003	11.361	1	255	.001
7	.969[g]	.938	.936	4.262075	.001	4.649	1	254	.032
a. Predictors: (Constant), 13.Business Growth due to CF									
b. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact									
c. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF									
d. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization									
e. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size									
f. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure									
g. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure, 6.Support service									

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	63343.162	1	63343.162	1464.590	.000[b]
	Residual	11244.939	260	43.250		
	Total	74588.101	261			
2	Regression	67539.923	2	33769.962	1240.948	.000[c]
	Residual	7048.178	259	27.213		
	Total	74588.101	261			
3	Regression	68701.593	3	22900.531	1003.708	.000[d]
	Residual	5886.508	258	22.816		
	Total	74588.101	261			
4	Regression	69096.468	4	17274.117	808.402	.000[e]
	Residual	5491.633	257	21.368		
	Total	74588.101	261			
5	Regression	69680.351	5	13936.070	726.939	.000[f]

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
	Residual	4907.749	256	19.171		
	Total	74588.101	261			
6	Regression	69889.672	6	11648.279	632.192	.000[g]
	Residual	4698.428	255	18.425		
	Total	74588.101	261			
7	Regression	69974.120	7	9996.303	550.297	.000[h]
	Residual	4613.981	254	18.165		
	Total	74588.101	261			
a. Dependent Variable: 14.ROI_Difference						
b. Predictors: (Constant), 13.Business Growth due to CF						
c. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact						
d. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF						
e. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization						
f. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size						
g. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure						
h. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure, 6.Support service						

Coefficients[a]										
		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Collinearity Statistics	
Model		B	Std. Error	Beta	T	Sig.	Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	9.350	1.203		7.771	.000	6.981	11.719		
	13.Business Growth due to CF	2.496	.065	.922	38.270	.000	2.368	2.625	1.000	1.000
2	(Constant)	-9.077	1.764		-5.145	.000	-12.551	-5.603		
	13.Business Growth	2.119	.060	.782	35.340	.000	2.001	2.238	.744	1.344
	9.Extension media contact	.683	.055	.275	12.418	.000	.574	.791	.744	1.344
3	(Constant)	-13.891	1.751		-7.935	.000	-17.338	-10.443		
	13.Business Growth	1.838	.068	.679	27.186	.000	1.705	1.971	.491	2.037
	9.Extension media contact	.510	.056	.205	9.122	.000	.400	.620	.604	1.656
	8.Knowledge on CF	.493	.069	.196	7.135	.000	.357	.628	.404	2.475
4	(Constant)	-22.813	2.679		-8.515	.000	-28.088	-17.537		
	13.Business Growth due to CF	1.839	.065	.679	28.104	.000	1.710	1.968	.491	2.037
	9.Extension media contact	.483	.054	.194	8.866	.000	.375	.590	.596	1.678
	8.Knowledge on CF	.467	.067	.186	6.962	.000	.335	.599	.401	2.495
	12.Commercialization	.124	.029	.075	4.299	.000	.067	.181	.937	1.067
5	(Constant)	-27.156	2.657		-10.22	.000	-32.388	-21.923		
	13.Business Growth due to CF	1.796	.062	.663	28.768	.000	1.674	1.919	.484	2.068
	9.Extension media contact	.422	.053	.170	8.013	.000	.319	.526	.570	1.753
	8.Knowledge on CF	.449	.064	.179	7.059	.000	.324	.574	.400	2.501
	12.Commercialization	.163	.028	.099	5.777	.000	.108	.219	.878	1.138
	4.Effective CF land size	2.626	.476	.098	5.519	.000	1.689	3.563	.818	1.223
6	(Constant)	-26.689	2.608		-10.23	.000	-31.826	-21.552		
	13.Business Growth to CF	1.747	.063	.645	27.736	.000	1.623	1.871	.457	2.188
	9.Extension media contact	.394	.052	.159	7.526	.000	.291	.497	.556	1.800
	8.Knowledge on CF	.404	.064	.161	6.327	.000	.278	.529	.382	2.618
	12.Commercialization	.162	.028	.098	5.829	.000	.107	.216	.878	1.139
	4.Effective CF land size	2.509	.468	.093	5.364	.000	1.588	3.430	.813	1.230
	7.Training exposure	.463	.137	.069	3.371	.001	.192	.733	.596	1.677
7	(Constant)	-28.209	2.684		-10.51	.000	-33.495	-22.923		
	13.Business Growth	1.719	.064	.635	26.940	.000	1.594	1.845	.439	2.279
	9.Extension media contact	.382	.052	.154	7.319	.000	.280	.485	.550	1.819
	8.Knowledge on CF	.403	.063	.161	6.361	.000	.278	.528	.382	2.618
	12.Commercialization	.152	.028	.092	5.445	.000	.097	.207	.855	1.169
	4.Effective CF land size	2.400	.467	.089	5.137	.000	1.480	3.320	.804	1.244
	7.Training exposure	.402	.139	.060	2.893	.004	.129	.676	.572	1.747
	6.Support service	.154	.071	.041	2.156	.032	.013	.294	.673	1.487
a. Dependent Variable: 14.ROI_Difference										

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	4.Effective CF land size	.124[b]	5.135	.000	.304	.912	1.097	.912
	5.CF_Experience	-.008[b]	-.306	.759	-.019	.831	1.203	.831
	6.Support service	.140[b]	5.348	.000	.315	.766	1.306	.766
	7.Training exposure	.181[b]	6.729	.000	.386	.686	1.458	.686
	8.Knowledge on CF	.305[b]	10.729	.000	.555	.498	2.009	.498
	9.Extension media contact	.275[b]	12.418	.000	.611	.744	1.344	.744
	10.CF_Satisfaction	.220[b]	6.954	.000	.397	.488	2.048	.488
	11.CF_Innovativeness	.272[b]	9.728	.000	.517	.544	1.838	.544
	12.Commercialization	.124[b]	5.347	.000	.315	.973	1.028	.973
2	4.Effective CF land size	.076[c]	3.801	.000	.230	.873	1.145	.713
	5.CF_Experience	-.021[c]	-1.007	.315	-.063	.829	1.206	.657
	6.Support service	.084[c]	3.837	.000	.232	.728	1.374	.653
	7.Training exposure	.107[c]	4.612	.000	.276	.629	1.591	.616
	8.Knowledge on CF	.196[c]	7.135	.000	.406	.404	2.475	.404
	10.CF_Satisfaction	.148[c]	5.558	.000	.327	.461	2.171	.460
	11.CF_Innovativeness	.147[c]	5.122	.000	.304	.404	2.476	.404
	12.Commercialization	.086[c]	4.538	.000	.272	.945	1.058	.723
3	4.Effective CF land size	.072[d]	3.962	.000	.240	.873	1.146	.404
	5.CF_Experience	-.010[d]	-.521	.603	-.032	.824	1.214	.401
	6.Support service	.074[d]	3.710	.000	.225	.725	1.380	.402
	7.Training exposure	.077[d]	3.468	.001	.211	.600	1.668	.385
	10.CF_Satisfaction	.065[d]	2.075	.039	.128	.312	3.203	.274
	11.CF_Innovativeness	.075[d]	2.466	.014	.152	.325	3.074	.325
	12.Commercialization	.075[d]	4.299	.000	.259	.937	1.067	.401
4	4.Effective CF land size	.098[e]	5.519	.000	.326	.818	1.223	.400
	5.CF_Experience	.001[e]	.038	.970	.002	.809	1.236	.399
	6.Support service	.064[e]	3.246	.001	.199	.711	1.406	.400
	7.Training exposure	.077[e]	3.589	.000	.219	.600	1.668	.382
	10.CF_Satisfaction	.062[e]	2.051	.041	.127	.312	3.204	.273
	11.CF_Innovativeness	.071[e]	2.429	.016	.150	.325	3.077	.324
5	5.CF_Experience	-.009[f]	-.484	.629	-.030	.802	1.247	.398
	6.Support service	.052[f]	2.753	.006	.170	.701	1.427	.399
	7.Training exposure	.069[f]	3.371	.001	.207	.596	1.677	.382
	10.CF_Satisfaction	.063[f]	2.216	.028	.137	.312	3.205	.272
	11.CF_Innovativeness	.079[f]	2.861	.005	.176	.324	3.084	.322
6	5.CF_Experience	-.015[g]	-.861	.390	-.054	.792	1.262	.378
	6.Support service	.041[g]	2.156	.032	.134	.673	1.487	.382
	10.CF_Satisfaction	.047[g]	1.652	.100	.103	.301	3.319	.271
	11.CF_Innovativeness	.060[g]	2.108	.036	.131	.304	3.295	.304
7	5.CF_Experience	-.024[h]	-1.362	.174	-.085	.756	1.322	.378
	10.CF_Satisfaction	.042[h]	1.483	.139	.093	.299	3.343	.270
	11.CF_Innovativeness	.053[h]	1.857	.064	.116	.299	3.350	.299

a. Dependent Variable: 14.ROI_Difference

b. Predictors in the Model: (Constant), 13.Business Growth due to CF

c. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact

d. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF

e. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization

f. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size

g. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure

h. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure, 6.Support service

Final Set IV: Stepwise multiple regression analysis

Variables Entered/Removed[a]			
Model	Variables Entered	Variables Removed	Method
1	13.Business Growth due to CF	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	9.Extension media contact	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	8.Knowledge on CF	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
4	12.Commercialization	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
5	4.Effective CF land size	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
6	7.Training exposure	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
7	6.Support service	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
a. Dependent Variable: 14.ROI_Difference			

Model Summary									
					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.922[a]	.849	.849	6.576455	.849	1464.590	1	260	.000
2	.952[b]	.906	.905	5.216612	.056	154.219	1	259	.000
3	.960[c]	.921	.920	4.776602	.016	50.915	1	258	.000
4	.962[d]	.926	.925	4.622577	.005	18.480	1	257	.000
5	.967[e]	.934	.933	4.378458	.008	30.457	1	256	.000
6	.968[f]	.937	.936	4.292460	.003	11.361	1	255	.001
7	.969[g]	.938	.936	4.262075	.001	4.649	1	254	.032
a. Predictors: (Constant), 13.Business Growth due to CF									
b. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact									
c. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF									
d. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization									
e. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size									
f. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure									
g. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure, 6.Support service									

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	63343.162	1	63343.162	1464.590	.000[b]
	Residual	11244.939	260	43.250		
	Total	74588.101	261			
2	Regression	67539.923	2	33769.962	1240.948	.000[c]
	Residual	7048.178	259	27.213		
	Total	74588.101	261			
3	Regression	68701.593	3	22900.531	1003.708	.000[d]
	Residual	5886.508	258	22.816		
	Total	74588.101	261			
4	Regression	69096.468	4	17274.117	808.402	.000[e]
	Residual	5491.633	257	21.368		
	Total	74588.101	261			
5	Regression	69680.351	5	13936.070	726.939	.000[f]
	Residual	4907.749	256	19.171		
	Total	74588.101	261			

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
6	Regression	69889.672	6	11648.279	632.192	.000[g]
	Residual	4698.428	255	18.425		
	Total	74588.101	261			
7	Regression	69974.120	7	9996.303	550.297	.000[h]
	Residual	4613.981	254	18.165		
	Total	74588.101	261			
a. Dependent Variable: 14.ROI_Difference						
b. Predictors: (Constant), 13.Business Growth due to CF						
c. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact						
d. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF						
e. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization						
f. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size						
g. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure						
h. Predictors: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure, 6.Support service						

Coefficients[a]										
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	9.350	1.203		7.771	.000	6.981	11.719		
	13.Business Growth due to CF	2.496	.065	.922	38.270	.000	2.368	2.625	1.000	1.000
2	(Constant)	-9.077	1.764		-5.145	.000	-12.551	-5.603		
	13.Business Growth due to CF	2.119	.060	.782	35.340	.000	2.001	2.238	.744	1.344
	9.Extension media contact	.683	.055	.275	12.418	.000	.574	.791	.744	1.344
3	(Constant)	-13.891	1.751		-7.935	.000	-17.338	-10.443		
	13.Business Growth due to CF	1.838	.068	.679	27.186	.000	1.705	1.971	.491	2.037
	9.Extension media contact	.510	.056	.205	9.122	.000	.400	.620	.604	1.656
	8.Knowledge on CF	.493	.069	.196	7.135	.000	.357	.628	.404	2.475
4	(Constant)	-22.813	2.679		-8.515	.000	-28.088	-17.537		
	13.Business Growth due to CF	1.839	.065	.679	28.104	.000	1.710	1.968	.491	2.037
	9.Extension media contact	.483	.054	.194	8.866	.000	.375	.590	.596	1.678
	8.Knowledge on CF	.467	.067	.186	6.962	.000	.335	.599	.401	2.495
	12.Commercialization	.124	.029	.075	4.299	.000	.067	.181	.937	1.067
5	(Constant)	-27.156	2.657		-10.22	.000	-32.388	-21.923		
	13.Business Growth due to CF	1.796	.062	.663	28.768	.000	1.674	1.919	.484	2.068
	9.Extension media contact	.422	.053	.170	8.013	.000	.319	.526	.570	1.753
	8.Knowledge on CF	.449	.064	.179	7.059	.000	.324	.574	.400	2.501
	12.Commercialization	.163	.028	.099	5.777	.000	.108	.219	.878	1.138
	4.Effective CF land size	2.626	.476	.098	5.519	.000	1.689	3.563	.818	1.223
6	(Constant)	-26.689	2.608		-10.23	.000	-31.826	-21.552		
	13.Business Growth due to CF	1.747	.063	.645	27.736	.000	1.623	1.871	.457	2.188
	9.Extension media contact	.394	.052	.159	7.526	.000	.291	.497	.556	1.800
	8.Knowledge on CF	.404	.064	.161	6.327	.000	.278	.529	.382	2.618
	12.Commercialization	.162	.028	.098	5.829	.000	.107	.216	.878	1.139
	4.Effective CF land size	2.509	.468	.093	5.364	.000	1.588	3.430	.813	1.230
	7.Training exposure	.463	.137	.069	3.371	.001	.192	.733	.596	1.677
7	(Constant)	-28.209	2.684		-10.51	.000	-33.495	-22.923		
	13.Business Growth CF	1.719	.064	.635	26.940	.000	1.594	1.845	.439	2.279
	9.Extension media contact	.382	.052	.154	7.319	.000	.280	.485	.550	1.819
	8.Knowledge on CF	.403	.063	.161	6.361	.000	.278	.528	.382	2.618
	12.Commercialization	.152	.028	.092	5.445	.000	.097	.207	.855	1.169
	4.Effective CF land size	2.400	.467	.089	5.137	.000	1.480	3.320	.804	1.244
	7.Training exposure	.402	.139	.060	2.893	.004	.129	.676	.572	1.747
	6.Support service	.154	.071	.041	2.156	.032	.013	.294	.673	1.487
a. Dependent Variable: 14.ROI_Difference										

Excluded Variables[a]								
Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	4.Effective CF land size	.124[b]	5.135	.000	.304	.912	1.097	.912
	6.Support service	.140[b]	5.348	.000	.315	.766	1.306	.766
	7.Training exposure	.181[b]	6.729	.000	.386	.686	1.458	.686
	8.Knowledge on CF	.305[b]	10.729	.000	.555	.498	2.009	.498
	9.Extension media contact	.275[b]	12.418	.000	.611	.744	1.344	.744
	12.Commercialization	.124[b]	5.347	.000	.315	.973	1.028	.973
2	4.Effective CF land size	.076[c]	3.801	.000	.230	.873	1.145	.713
	6.Support service	.084[c]	3.837	.000	.232	.728	1.374	.653
	7.Training exposure	.107[c]	4.612	.000	.276	.629	1.591	.616
	8.Knowledge on CF	.196[c]	7.135	.000	.406	.404	2.475	.404
	12.Commercialization	.086[c]	4.538	.000	.272	.945	1.058	.723
3	4.Effective CF land size	.072[d]	3.962	.000	.240	.873	1.146	.404
	6.Support service	.074[d]	3.710	.000	.225	.725	1.380	.402
	7.Training exposure	.077[d]	3.468	.001	.211	.600	1.668	.385
	12.Commercialization	.075[d]	4.299	.000	.259	.937	1.067	.401
4	4.Effective CF land size	.098[e]	5.519	.000	.326	.818	1.223	.400
	6.Support service	.064[e]	3.246	.001	.199	.711	1.406	.400
	7.Training exposure	.077[e]	3.589	.000	.219	.600	1.668	.382
5	6.Support service	.052[f]	2.753	.006	.170	.701	1.427	.399
	7.Training exposure	.069[f]	3.371	.001	.207	.596	1.677	.382
6	6.Support service	.041[g]	2.156	.032	.134	.673	1.487	.382

a. Dependent Variable: 14.ROI_Difference

b. Predictors in the Model: (Constant), 13.Business Growth due to CF

c. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact

d. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF

e. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization

f. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size

g. Predictors in the Model: (Constant), 13.Business Growth due to CF, 9.Extension media contact, 8.Knowledge on CF, 12.Commercialization, 4.Effective CF land size, 7.Training exposure

Collinearity Diagnostics[a]																
Model	Eigenvalue	Condition Index	Variance Proportions (Constant)	Variance Proportions												
				1.Age	2.Education	3.Effective Farm Size	4.Effective CF Land Size	5.CF Experience	6.CF Support Services	7.Training days	8 Knowledge on CF	9.Agri Ext. Communication	10.CF Satisfaction	11.CF Innovativeness	12. Commercialization	13.CFBus. Growth
1	13.30	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.19	8.39	0.00	0.00	0.00	0.06	0.05	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
3	0.17	8.96	0.00	0.04	0.06	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.05	0.00	0.01	0.03
4	0.11	10.99	0.00	0.00	0.84	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.02
5	0.06	15.06	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.64	0.00	0.00	0.11	0.00	0.00	0.05
6	0.04	18.40	0.00	0.11	0.00	0.00	0.00	0.17	0.01	0.06	0.01	0.00	0.17	0.00	0.00	0.35
7	0.03	20.01	0.00	0.03	0.00	0.00	0.00	0.33	0.01	0.00	0.01	0.02	0.24	0.01	0.00	0.31
8	0.03	20.65	0.00	0.07	0.01	0.00	0.00	0.00	0.01	0.17	0.01	0.07	0.01	0.38	0.00	0.18
9	0.02	25.06	0.01	0.54	0.04	0.00	0.00	0.11	0.11	0.06	0.01	0.01	0.07	0.07	0.13	0.00
10	0.02	28.43	0.02	0.06	0.00	0.01	0.01	0.06	0.80	0.02	0.01	0.04	0.00	0.06	0.04	0.02
11	0.02	28.53	0.00	0.00	0.01	0.59	0.68	0.01	0.00	0.00	0.01	0.15	0.01	0.04	0.00	0.00
12	0.01	34.53	0.00	0.00	0.01	0.29	0.15	0.01	0.04	0.00	0.00	0.66	0.01	0.22	0.19	0.00
13	0.01	40.22	0.02	0.04	0.01	0.03	0.07	0.02	0.02	0.00	0.74	0.04	0.16	0.09	0.22	0.02
14	0.00	57.81	0.94	0.08	0.02	0.01	0.03	0.29	0.00	0.00	0.21	0.00	0.14	0.11	0.42	0.02
a. Dependent Variable: 14.ROI_Difference																