YANGON UNIVERSITY OF ECONOMICS
MASTER OF DEVELOPMENT STUDIES PROGRAMME

A STUDY ON ADOPTING GOOD AGRICULTURAL PRACTICES (GAP) FOR GREEN GRAM PRODUCTION IN AGRICULTURAL TRANSFORMATION

(A Case Study of Three Villages in Tatkone Township)

SOE HLAING
EMDevS – 39 (16th BATCH)

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(A Case Study of Three Villages in Tatkone Township)

A thesis submitted in partial fulfillment of the requirements for the Master of Development Studies (MDevS) Degree

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This is to certify that this thesis entitled "**A Study on Adopting Good Agricultural Practices (GAP) for Green Gram Production in Agricultural Transformation (A Case Study of Three Villages in Tatkone Township)"** submitted as a partial fulfillment of the requirements for the degree of Master of Development Studies has been accepted by the Board of Examiners.

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ABSTRACT

As agriculture plays a crucial role in the economy of Myanmar, sustainable agriculture is a prerequisite for achieving sustainable development objectives. Today, seventy percent of Myanmar's population is engaged in small-scale agriculture. This study examined the awareness of farmers on Good Agricultural Practices (GAP) in terms of Knowledge, Attitude and Practice (KAP) and identified the incentives and disincentives for farmers to adopt Good Agricultural Practices (GAP). For this study, descriptive method is used to examine the awareness of farmers on GAP. The primary data was collected by structured questionnaires for knowledge, attitude and practice on GAP in green gram production. The secondary data were collected from Department of Agriculture. In green gram production of Tatkone Township, average 97 % of farmers have knowledge and average 85% of farmers can use the practices of Food Safety Module of GAP. Average 95% of farmers know knowledge and 74 % of farmers can follow the practices of Environmental Management Module. Average 95% of farmers have knowledge and average 82% of farmers use practices of Produce Quality Module. Average 94% of farmers know knowledge and average 80% of farmers use practices of Worker health, Safety and Welfare Module. All of farmers have positive attitude on all of modules of GAP.

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LIST OF ABBREVIATIONS

ASEAN	Association of Southeast Asian Nations
ASEAN GAP	Association of Southeast Asian Nations Good Agricultural Practices
CSOs	Civil Society Organizations
EU	European Union
FAO	Food and Agriculture Organization
FSC	Food Supply Chain
GAP	Good Agricultural Practices
GDP	Gross Domestic Product
GHP	Good Handling Practices
GMP	Good Manufacturing Practices
HACCP	Hazard Analysis and Critical Control Point
HSCM	Horticultural Supply Chain Management
ICM	Integrated Crop Management
ILO	International Labour Organization
INM	Integrated Nutrient Management
IPM	Integrated Pest Management
IPPC	International Plant Protection Convention
ITC	International Trade Centre
KAP	Knowledge, Attitude and Practice
MRLs	Maximum Residue Limits
NGOs	Non-Government Organizations
SARD	Sustainable Agriculture and Rural Development
UNIDO	United Nations Industrial Development Organization
US	United States
USA	United States of America
WHO	World Health Organization
WTO	World Trade Organization

CHAPTER I
INTRODUCTION

1.1 Rationale of the Study

Growing globalization has an impact on agricultural production and trade, as well as the long-term viability of both conventional and organic agriculture. As a result of the dominating technological and social progress, increasing globalization has been one of the primary developments in recent decades. "The dissolution of the time and space boundaries that restrict human activity throughout the globe, as well as the rising social awareness of these changes," according to this definition of globalization. Growing globalization has ramifications for how agricultural goods are produced and traded, as well as environmental effects for climate, biodiversity, and land resources, among other things (Marie Trydeman Knudsen, Niels Halberg, Jorgen E. Olesen, John Byrne, Venkatesh Iyer and Noah Toly, 2006).

Agricultural development, on the other hand, has led to environmental issues such as global warming, biodiversity loss, and soil degradation. Furthermore, nitrate and pesticide contamination of surface and groundwater is still an issue in most developed nations, and it is likely to become an increasing concern in emerging countries. Organic farming may provide a more sustainable product, but it has also been impacted by globalization. Organic farming is practiced in more than a hundred nations throughout the world, and the number is growing. The European nations have the biggest proportion of land under organic management, although Australia and Argentina, for example, have large expanses under organic care (Marie Trydeman Knudsen, Niels Halberg, Jorgen E. Olesen, John Byrne, Venkatesh Iyer and Noah Toly, 2006).

High-quality, healthful food has grown increasingly vital as GAP has evolved, and consumers are concerned about food production management and demand information through the food chain. GAP is founded on the principles of risk prevention, risk analysis, and sustainable agriculture through Integrated Pest Management (IPM) and Integrated Crop Management (ICM), as well as the use of current technology to improve farming systems. For the protection of consumer health, the GAP is critical. It necessitates guaranteeing food safety across the supply chain, which must be mandatory not only from the table but also upstream (e.g. fertilizers, plant protection) (Fatma Akkaya, Raif Yalcin and Burhan Ozkan, 2006).

Sustainable agriculture is a necessity for attaining Myanmar's sustainable development goals since agriculture is so important to the country's economy. Environmental factors must be included into agricultural policy analysis and planning if agriculture is to be sustainable. Myanmar has a favorable agricultural structure with considerable potential for small-scale and large-scale agricultural growth, with an average farm size of 2.5 ha, second highest in Southeast Asia after Thailand's 3.1 ha. Myanmar has a high land-to-population ratio, with half of its fertile land lying idle. However, macroeconomic volatility, infrastructural limits, marketing and financial challenges, and farmers' lack of access to quality research and extension support have all hampered the sector's growth. The rural sector's overall development has been hampered by relatively poor agricultural performance. In 2015, the agriculture industry contributed 32% of Myanmar's GDP, 17 percent of exports, nearly 50 percent of employment, and 0.45 percent of foreign direct investment for crops and 0.79 percent for livestock and fisheries (Overview of Agriculture Policy in Myanmar, 2016).

Despite its wealth of natural resources and strategic position, Myanmar's agriculture has failed over the last five decades, particularly in terms of productivity, equality, and stability. Low productivity, great inequality, and great volatility define Myanmar's agriculture. Low agricultural productivity translates to poorer worker productivity and land productivity, resulting in lower levels of both. Myanmar's farm profits per worker are half to a third of what they are in neighboring nations. The causes for this differ per commodity, but they are mostly due to long-term chronic underinvestment in agricultural research, inadequate extension support, and restricted financing availability (Overview of Agriculture Policy in Myanmar, 2016).

Rural inequality and poverty are exacerbated by the extremely unequal distribution of land and other economic assets. Annual rural earnings are limited by the seasonality of agricultural work, along with seasonal underemployment and low salaries, with around one-fourth of the rural population living in poverty. With lower earnings and less assets to protect them against seasonal and episodic health and weather shocks, the average rural household only has enough food for roughly 10 months of the year. Food security is provided to landless households for 9.6 months.

Agricultural growth has been recognized as one of the key driving engines of the economy and the foundation for broad-based growth that is needed to enhance the well-being of the majority of Myanmar's population since 1 April 2016, when a democratic people's government took office. Agriculture is expected to improve food security, enhance foreign exchange profits through agricultural exports, and encourage rural development, according to the government (Overview of Agriculture Policy in Myanmar, 2016).

Farmers in Myanmar are increasing agricultural yields by employing chemical fertilizers and insecticides. The Good Agricultural Practices (GAP) Protocol and Guidelines for 15 crops were released by the Ministry of Agriculture, Livestock, and Irrigation. Myanmar's GAP Protocol and Guidelines were launched with the goal of increasing farmer profitability by teaching cultivators on how to produce safe and high-quality goods for the domestic and international markets.

Seventy percent of Myanmar's population is now involved in small-scale farming. Supporting Myanmar's subsistence farmers is vital to the country's economic development. One method the Myanmar government is attempting to enhance the agriculture sector in 2016 is by launching the GAP Protocol and Guidelines (Myanmar launches Good Agricultural Practices, 2017). Myanmar has introduced the Myanmar GAP Protocol, which is divided into four modules: (1) food safety, (2) environmental management, (3) produce quality, and (4) worker health, safety, and welfare. Mango, pepper, maize, avocado, cabbage, groundnut, watermelon, onion, sesame, muskmelon, rice, coffee, tomato, legumes, and pumelo have all been given GAP recognition (Agricultural Sector Development in Myanmar, 2017).

Agrochemicals are now used by the majority of farmers in Myanmar to prevent and manage pests, diseases, and weeds in the field. When farmers apply agrochemicals incorrectly, they endanger humans, beneficial insects, and the environment. The majority of farmers do not follow the pre-harvest interval (PHI) for agrochemicals while harvesting their crops after using them. Chemical residues have now been discovered in various crops, including green gram, and the lingering effects of chemicals in the crops have resulted in a fall in food safety and bad product quality, lowering export quality. As a result, the Myanmar government has implemented GAP for the cultivation of some crops, including green gram.

1.2 Objectives of the Study

The objectives of the study are to examine the awareness of farmers on Good Agricultural Practices (GAP) in terms of Knowledge, Attitude and Practice (KAP) and to identify the incentives and disincentives for farmers to adopt Good Agricultural Practices (GAP).

1.3 Method of Study

For this study, descriptive method is used to examine the awareness of farmers on GAP. Both quantitative and qualitative approaches are used to examine the awareness of farmers on GAP. Random sampling method is used and the structured questionnaire is used as a tool to collect the primary data. This study based on knowledge, attitude and practice (KAP). 150 people of total population are selected as sample size.

The secondary data is also collected from Department of Agriculture which is providing GAP trainings to farmers in green gram production area, Nay Pyi Taw.

1.4 Scope and Limitations of the Study

The study conducted the awareness of farmers on Good Agricultural Practices (GAP) in green gram production in three villages only in Tatkone Township, Nay Pyi Taw. There are 303 farmers who are growing the green gram by using GAP and others are using traditional way. The data are collected from 150 farmers who are adopting GAP in green gram production to assess the awareness of farmers on GAP. The data are also collected from 50% of selected farmers who are growing green gram to assess the disincentives for farmers.

This survey studied awareness of farmers on GAP including Food Safety Module, Environmental Management Module, Produce Quality Module and Worker health, Safety and Welfare Module. This survey also studied incentives and disincentives for farmers who using GAP in green gram production. This survey was not identified cost and benefit for green gram production.

This survey found out the knowledge, attitude and practice about GAP in green gram production, incentives and disincentives for farmers who are using GAP in green gram production. The awareness of farmers on GAP was examined in pre-monsoon green gram production within 2020-2021.

1.5 Organization of the Study

Chapter one is introduction. Chapter two presents literature review. Chapter three presents overview of agriculture and adopting GAP in green gram production in Myanmar. Chapter four presents analysis on the surveying finding of awareness of farmers on GAP and the impact of GAP in green gram yield. Chapter five presents findings and suggestions.

CHAPTER II
LITERATURE REVIEW

2.1 Concept of Good Agricultural Practices

Green gram is a high-quality, easily digestible protein that may be eaten as whole grains, dal, or sprouted in a number of ways. As value addition, split and dehusked, fried in fat, fetch good value as snacks. Green plants are fed to the cattle after the pods have been harvested. The seed husk is also fed to livestock. Green gram is India's most popular crop. Other major producers are Pakistan, Bangladesh, Sri Lanka, Thailand, Laos, Cambodia, Vietnam, Indonesia, Malaysia, and South China. Cultivation is new to Africa, the United States, and Australia. Green gram is one of India's most significant pulse crops. Green gram has been farmed in India from ancient times, according to reports. It is widely grown throughout Asia, particularly in India, Pakistan, Bangladesh, Sri Lanka, and Thailand. India is a significant importer of pulses while producing 3.17 million MT (Grant Thornton, 2016).

As a result, there is a huge possibility to boost productivity while also lowering post-harvest losses. Pulses have high production prices, thus even if they have poor productivity and yield per hectare when compared to other crops, they are profitable. Importantly, India accounts for around 20% of total worldwide pulse output. To prevent losses, Good Agriculture Practices must be implemented during the production and post-harvest stages, as well as in activities like as threshing, winnowing, shipping, processing, and storage. In reality, field consultations reveal that postharvest losses of roughly 2.5 percent are common (as per all-India estimates) (Grant Thornton, 2016).

When observed from outside the agriculture sector, the agricultural transition has been impressively consistent. The share of agriculture in a country's labor force and total output declines in both cross-section and time-series samples as incomes per capita rise (Timme, 1988).

The agricultural revolution appears to proceed through at least four phases, as seen from both historical and present cross-section perspectives. When agricultural production per worker grows, the process begins. This increased production generates a surplus, which can be exploited directly through taxes and factor flows in the second phase, or indirectly through government involvement in rural-urban terms of trade in the third phase. This excess may be used to improve the nonagricultural sector, which is where most dual economy development models concentrate their efforts. Rural factor and product markets must become more connected with those in the rest of the economy for resources to move out of agriculture (Timme, 1988).

A third phase in agricultural development is the gradual integration of the agriculture sector into the macro economy through enhanced infrastructure and market-equilibrium linkages. When this phase is effective, the fourth phase fades into the background; agriculture's function in industrialized economies is similar to that of steel, housing, and insurance. When integration is not successful—and most countries have found it extremely difficult for political reasons—governments face serious resource allocation problems, as well as problems beyond their borders, as a result of high-income countries' widespread attempts to protect their farmers from foreign competition. Managing agricultural protection and its effects on global commodities markets thus remains a priority for agricultural policymakers even after the transformation is "completed." (Timme, 1988).

As a result of the concerns and commitments of a diverse range of stakeholders regarding food production and security, food safety and quality, and agriculture's environmental sustainability, the concept of Good Agricultural Practice (GAP) has evolved in recent years in the context of a rapidly changing and globalizing food economy. These stakeholders include supply-side actors (farmers, farmers' organizations, workers), demand-side actors (retailers, processors, and consumers), and institutions and services (education, research, extension, input supply) that support and connect demand and supply in order to achieve specific goals such as food security, food quality, production efficiency, and livelihoods and long-term and medium-term environmental conservation (FAO, Report of the Expert Consultation on a Good Agricultural Practices (GAP) Approach, November 2003).

A GAP approach utilizes suggestions and existing information to address environmental, economic, and social sustainability for on-farm production and post-production processes, resulting in safe and quality food and non-food agricultural products, according to the definition. Despite the fact that the word "GAP" is regarded conceptually challenging because to the wide range of regulations, rules, and definitions used in the agriculture sector, the participants were able to agree on a working definition of a GAP strategy. There was consensus on a description of the approach that reflected the three pillars of sustainability (economically feasible, ecologically sound, and socially acceptable), which include food safety and quality; related to obligatory and/or voluntary standards, with an emphasis on primary production, and taking into consideration incentive and institutional context. As a result, the GAP method serves as a means to a goal rather than a goal in and of itself. It's a means of working with critical stakeholders in a comprehensive fashion that encourages creativity and choice rather than prescriptive answers (FAO, Report of the Expert Consultation on a Good Agricultural Practices (GAP) Approach, November 2003).

Such production guidelines spawned the concept of Good Agricultural Practices, which evolved and expanded on them. Consumers, as well as the food business and development community, are becoming increasingly concerned about the safety of food, which increasingly originates from processing and store chains. They are also becoming increasingly concerned that goods are produced in a manner that is compatible with the environment and social values (e.g., at the very least, farm laborers' basic necessities are satisfied, and international accords on child labor are upheld, among other things, etc.). In many industrialized countries, these transformations in agricultural values have resulted in the development of a wide range of social, environmental, and quality standards, codes of practice, and certification programs in agriculture and the food sector over the last two decades. Food safety and quality rules, as well as voluntary organic agriculture standards and sustainability evaluation programs, have been established by governments, particularly in wealthy countries. Governments, NGOs, CSOs, producers associations, and the food industry have all issued ‘GAP' norms, standards, and laws, claiming to codify sustainable agriculture at the farm level (Anne-Sophie Poisot, Andrew Speedy and Eric Kueneman, 2004).

Some of these rules, but not all, utilize the phrase "Good Agricultural Practices" (GAP) specifically. The underlying premise in all of these standards is that the standard codifies some type of good practice. However, there is little agreement among these rules as to what constitutes a "good" practice. The term "good agricultural practices" covers a wide range of topics, from pesticide usage monitoring to more comprehensive aspects of primary production and post-production systems, such as environmental impact assessment and labor conditions. The majority of agricultural rules and standards are process standards (conditions for how products are manufactured) rather than product standards (specifications and criteria for the final characteristics of products). The scope of a GAP scheme reflects its intended aims, which might range from assuring food safety and quality while allowing traceability to product diversification (in order to capture new market niches by reacting to consumer expectations for sustainable agriculture), or establishing new possibilities and more equitable circumstances for small farmers in developing nations; or reducing agriculture's negative environmental externalities (Anne-Sophie Poisot, Andrew Speedy and Eric Kueneman, 2004).

Good Manufacturing Practices (GMPs) for processed items, such as processed food, pharmaceuticals, clothing, and practically everything else we buy, have also been established and are now a standard part of corporate protocols and national and international government policy regulations, WHO, WTO, ILO, UNIDO, and, to a lesser extent, FAO (Codex, International Plant Protection Convention (IPPC)) provided support. However, in order to ensure that manufactured products are safe and meet other criteria, agricultural products used as raw materials should logically be produced in accordance with GMP standards. This has led to the creation of 'farm to table' initiatives that use GAP as a starting point for assuring food safety and quality across the food chain. Governments and civic society, including the food and allied industries, are increasingly recognizing GAP procedures for farm decision-making as a critical prerequisite to food safety from farm to fork (Anne-Sophie Poisot, Andrew Speedy and Eric Kueneman, 2004).

From the standpoint of microbiological and chemical safety, the GAP process encompasses actions, technologies, and systems that are accepted as most effective for optimal soil and water management, as well as crop and livestock production, with the added dimensions of environmental, economic, and social sustainability. The specifics of a GAP protocol for a commodity in a given production environment cannot be generalized and prescriptive from a central information source like the FAO, but must be tailored locally (taking into account local conditions and market requirements, if any) while remaining based on general underlying principles or norms. The FAO and WHO's sanitary and phytosanitary regulatory instruments deal with food contamination limitations from agricultural practices, but they don't provide location-specific guidance on how to ensure this on the farm. They also concentrate on the food safety aspects of the product, rather than the environmental or social conditions of production. One of the strong reasons for adopting GAP methods to address these and other public concerns about agricultural production may be found here (Anne-Sophie Poisot, Andrew Speedy and Eric Kueneman, 2004).

The Expert Consultation definition clearly outlines GAP within the context of Sustainable Agriculture and Rural Development (SARD) as defined in Agenda 21 of the Rio Summit. Some individuals are still confused about how the GAP approach relates to SARD. While both GAP and SARD use the same three pillars (economic, environmental, and social), SARD is a much broader concept that encompasses not only agricultural production difficulties (GAP), but also rural infrastructure, rural education, and much more. However, operationalizing GAP will help SARD (Anne-Sophie Poisot, Andrew Speedy and Eric Kueneman, 2004).

GAP refers to the farm-level portion of the chain or continuum, which comprises Good Handling Practices (GHP), Good Manufacturing Practices (GMP), Hazard Analysis and Critical Control Points (HACCP), and quality control standards, among others. Indeed, one of the most essential criteria for defining practices as GAP is that they should result in safe and healthy food while also taking into account the food safety and quality standards needs in a specific market context and legal framework. However, GAP's concentration and contribution to this is clearly at the production stage (Anne-Sophie Poisot, Andrew Speedy and Eric Kueneman, 2004).

Good agricultural practice is defined by the Food and Agricultural Organization of the United Nations (FAO) as a set of principles that can be applied to on-farm production and post-production processes to produce safe and healthy food and non-food agricultural products while also considering economic, social, and environmental sustainability. GAPs can be used in a variety of farming systems and at various scales. They are implemented through sustainable agriculture methods, which include producing enough food (food security), keeping the food safe (food safety), and ensuring that the food is nutritious (food quality) (Good Agricultural Practice, 2012).

GAPs related to soil erosion by wind and water, hedging and ditching, and fertilizer application at the right time and in the right doses (i.e., when the plant needs the fertilizer), to reduce run-off, manure application, grazing, crop rotation, lowering soil compaction issues (by avoiding the use of heavy mechanical devices), and maintaining soil structure by minimizing heavy tillage methods are all recommended (Good Agricultural Practice, 2012).

Water GAPs include following an irrigation schedule while monitoring plant needs and soil water reserve status to avoid water loss through drainage, preventing soil salinization by limiting water input to needs, and preventing soil salinization by limiting water input to needs, and reusing water where possible, avoiding crops with high water demands in low-availability areas, preventing drainage and fertilizer run-off, and preserving permanent soil cover water table by reducing heavy production of water, restoring or conserving wetlands, providing appropriate water sites for cattle, gathering water in situ by digging catch pits, constructing bunds across slopes (Good Agricultural Practice, 2012).

Because of growing concerns about food quality and safety around the world, GAP rules, programs, and standards exist. Their goals range from meeting trade and government regulatory standards, particularly in the areas of food safety and quality, to meeting the more specific needs of niche or specialty markets. Their goals range from ensuring the safety and quality of produce in the food chain to capturing new market advantages by modifying supply chain governance, improving natural resource use, worker health, and working conditions, and opening new markets for farmers and exporters in developing countries (FAO, Food safety and good practice certification, 2003).

GAP codes, standards, and regulations have a number of advantages, including improved food quality and safety, easier market access, and lower non-compliance risks with approved pesticides, MRLs, and other contamination dangers (FAO, Food safety and good practice certification, 2003). The following are some of the advantages of good agricultural practices:

(1) Pathogen contamination may be avoided by following appropriate agricultural practices throughout crop production, harvesting, sorting, packing, and storage.
(2) Producers and marketers will gain a competitive advantage by demonstrating the quality and safety of their products in more competitive marketplaces.
(3) Retailers will have confidence in the quality and safety of the items they stock.
(4) Consumers may purchase certified items without fear of environmental harm or residual issues in the manufacturing process.
(5) The usage of natural resources in a sustainable manner will be considered (Fatma Akkaya, Raif Yalcin and Burhan Ozkan, 2006).

Increased production expenses, particularly record keeping, residue testing, and certification, as well as insufficient access to information and support services, are the key problems associated with GAP implementation (FAO, Food safety and good practice certification, 2003).

2.2 ASEAN GAP

ASEAN GAP is a standard for good agricultural practices in the cultivation, harvesting, and post-harvest management of fresh fruits and vegetables in the ASEAN area, established by the ASEAN Secretariat (including member nation representatives) and released in 2006. The goal of ASEAN GAP is to improve the harmonization of national GAP programs throughout the ASEAN area, improve fruit and vegetable safety for consumers, ensure natural resource sustainability, and promote regional and international fruit and vegetable commerce (FAO, Food safety and good practice certification, 2003).

ASEAN GAP is a quality assurance system for ASEAN fruits and vegetables created by the Association of Southeast Asian Nations (ASEAN). ASEAN GAP is a voluntary GAP standard that is used in the ASEAN region to manage risks in the production, harvesting, and post-harvesting of fresh fruits and vegetables (Chan, 2016). ASEAN GAP is a standard for good agricultural practice in the ASEAN area when it comes to the cultivation, harvesting, and postharvest management of fresh fruits and vegetables. The ASEAN GAP practices are intended at preventing or reducing the possibility of hazards arising. ASEAN GAP covers four hazards: (1) food safety, (2) environmental management, (3) worker health, safety, and welfare, and (4) produce quality.

As commerce grows more open, global trade in fresh fruits and vegetables is growing. Changes in consumer lifestyles in the ASEAN region and throughout the globe are increasing demand for assurance that fruits and vegetables are safe to eat and of good quality, and that they are grown and handled in a way that does not hurt the environment or workers' health, safety, or welfare. These changes are having an influence on retailers' compliance with GAP programs, as well as governments' establishment of legislative standards for food safety, environmental protection, and worker health, safety, and welfare (Good Agricultural Practices for Production of Fresh Fruit and Vegetables in the ASEAN region, 2006).

The ASEAN GAP was created to improve GAP program uniformity among ASEAN member nations. It includes fresh fruit and vegetable cultivation, harvesting, and postharvest handling on farms, as well as postharvest handling at areas where produce is packaged for sale (Good Agricultural Practices for Production of Fresh Fruit and Vegetables in ASEAN countries- Food Safety Module, 2006). Since ASEAN GAP aims to improve product standardization and promote trade, accredited farmers have a lot of opportunity to expand their exports of fresh fruits and vegetables to other ASEAN nations. Because the ASEAN GAP contains implementation instructions, training materials, and a code of recommended practices, it may be used as a benchmark in building national GAPs by ASEAN's less developed nations. To achieve harmonization, member nations can compare their country GAP programs to ASEAN GAP (FAO, Food safety and good practice certification, 2003).

The goal of ASEAN GAP's food safety module is to reduce the detrimental impacts of manufacturing and post-production activities on the product's safety. Any chemical, biological, or physical ingredient or attribute that might cause fresh fruits and vegetables to become an unacceptable health risk for consumers is considered a food safety hazard. Controlling food safety threats throughout fresh produce cultivation, harvesting, and postharvest processing (trimming, grading, packaging, shipping, and so on) is critical for protecting consumer health and gaining access to markets in the ASEAN area and beyond.

Food safety risks may be divided into three categories: Chemical, biological, and physical are the three categories. Fresh fruits and vegetables can be polluted directly by the dangers or indirectly by coming into touch with polluted soil, water, people, equipment, materials, fertilizers, and soil additives, among other things (Good Agricultural Practices for Production of Fresh Fruit and Vegetables in ASEAN countries- Food Safety Module, 2006).

This module of the environmental management module deals with Good Agricultural Operations (GAP) to control environmental risks during production and post-production practices. Environmental hazards are the negative effects that fruit and vegetable cultivation, harvesting, and postharvest processing have on the environment both on and off the farm. While there are a number of common risks connected with farms and packing sheds, each one is unique. When dealing with possible environmental dangers, each property's unique conditions must be taken into account.

The steps to controlling environmental hazards are (1) Identify the hazards - What can happen to the environment both on and off the site if something goes wrong? (2) Evaluate the risk - What are the chances of the danger occurring and what will happen if it does? (3) Control the hazard – What are the best farming methods for preventing or reducing the danger of major hazards? (4) Review and monitor hazards—Are good agricultural practices operating, and have there been any changes that have introduced new hazards? (Good Agricultural Practices for Production of Fresh Fruit and Vegetables in ASEAN countries- Environmental Management Module, 2007).

Any individual who works on the farm, including adult family members, permanent workers, temporary/ casual/ sub-contracted laborers, is a worker in the workers' health, safety, and welfare module. Because farming includes multiple jobs, employees are frequently exposed to a variety of risks. This module considers the function of farm employees and emphasizes the importance of their health because it has a direct impact on the farms' output and earnings. Because farming entails a wide range of jobs, many of which include the use of machinery, persons who work and live on the farm face a variety of risks. Thousands of agricultural workers are hurt and some are killed every year in farming accidents. Farm accidents are tragic since the casualties are frequently family members who work on the farm, and in some cases, children who use the workplace as a playground. Injury and disease are costly to everyone on the farm's health and well-being, and fatalities bring sadness and misery. Time off work, missed output and revenue, and rising insurance costs are all factors to consider. Everyone on the farm has a role to play in lowering the risk of work-related injuries and illnesses.

Employers must assess and execute excellent agricultural practices, as well as assess and implement health and safety hazards to workers and others such as visitors and contractors. (2) Ensuring a secure working environment (3) Establishing safe work processes, (4) maintaining safe work environments, machinery, and equipment, and (5) ensuring the safe use, handling, storage, and transportation of hazardous chemicals. (6) Provision of necessary worker information, training, teaching, and supervision, (7) Provision of suitable worker welfare facilities (Good Agricultural Practices for Production of Fresh Fruit and Vegetables in ASEAN countries- Worker health, Safety and Welfare Module, 2006).

This module of the produce quality module is to address produce quality by minimizing adverse consequences of production. A quality plan for the crop developed identifies practices that are crucial to regulating produce quality through cultivation, harvesting, and post-harvest management. The type of produce, as well as how it is produced, harvested, handled, packed, and transported, all influence the good agricultural practices necessary to manage food quality hazards. Each farmer or employer must define and document the procedures that are essential to quality management in a quality plan. A quality plan (Process steps, Quality hazards, Causes of quality loss, GAP), planting material, fertilizer and soil additives, water, chemicals, harvesting and handling produce, traceability and recall system, training, documents and records, and review of practices are the ten elements that make up this module (Good Agricultural Practices for Production of Fresh Fruit and Vegetables in ASEAN countries- Produce Quality Module, 2007).

2.3 Incentives and Disincentives for Farmers to Adopt GAP

Farmers are given different incentives to adopt GAPs based on the GAP program's aim and the market failure it solves. Economic incentives, regulatory/legal incentives, and human capital incentives are the three types of incentives available.
Economic disincentives, institutional infrastructure limits, and human capital limits are all barriers to farmers adopting GAPs.

Individual farmers' economic motivations to use GAPs are roughly defined as an increase or stabilization of revenue and a decrease in costs. Farm households may have several aims, such as producing food for sale and for home use, reducing farm labor, protecting farm assets for future generations, and so on. GAPs may permit an increase in revenue from market production, but they may also boost the return to the family farm by increasing the amount of food available for home use. The farmer's decision is influenced by revenue net of costs. While GAPs may boost gross farm revenue, they may also raise expenditures, resulting in an increase or drop in net income (Hobbs, 2003).

GAPs that are market-driven, focusing on commercial production of food with traits desired by customers, may enhance gross farm revenue through higher pricing. This includes programs that increase food safety or information flow through the supply chain by giving quality assurance assurances for hidden (experience, credibility) product qualities such as ecologically friendly agriculture techniques. Consumers may be ready to pay a premium for these assurances, and a GAP program offers the institutional framework through which premiums can be paid back to agricultural farmers if the necessary institutions do not presently exist in the nation. Some programs have sought to link GAP criteria linked to agricultural environmental impacts to 'fair-trade' measures that guarantee farmers in poorer nations a base price covering production costs. Price rewards are anticipated to be a powerful motivator for commercial farmers to adopt GAPs. Although price premiums provide a clear and concrete revenue-based incentive for companies to implement GAP, price is simply one component of revenue (Hobbs, 2003).

Production practices that improve or maintain soil fertility can assist to stable income over time and between farm proprietors. Improvements in post-harvest storage and handling procedures minimize crop losses while increasing the amount of produce accessible for family use and market. In the case of on-farm storage, this immediately contributes to farm revenue. Improved agricultural methods that minimize storage costs, waste, or result in a more effective use of labor or other farm inputs can all lower average costs. Farmers have a strong economic incentive to use measures that minimize their average production costs. Aside from the immediate benefits on short-run profitability through revenue enhancement or cost reduction, farm owner-operators have an incentive to implement GAPs if they contribute to long-run increases in the farm's asset values (Hobbs, 2003).

Farmers have an incentive to use GAPs, either collectively or individually, to protect themselves against market externality impacts caused by other poorly managed farms. In the case of a food safety issue in the industry as a whole, adherence to a recognized GAP program may shield the farmer against a loss of customer or buyer trust caused by negligent or bad management practices by other farm enterprises or supply chains. The power of this incentive is strongly reliant on the marketing system's capacity to separate GAP from non-GAP produce. Blending GAP and non-GAP product removes the monetary incentive for farmers to adopt GAP in the absence of sufficient transportation and storage infrastructure (Hobbs, 2003).

GAPs can be used by farmers to create environmental advantages or to minimize environmental costs. Some of them provide direct private advantages to farmers, such as improved soil quality. Similarly, GAPs that enhance agricultural laborers' working conditions may generate private benefits to farmers in the form of higher labor productivity and decreased waste. Property rights distribution and protection are critical in deciding whether resources are distributed in response to economic signals or as a consequence of skewed bureaucratic incentives, corruption, or bribery (Hobbs, 2003).

Insecure property rights are a major impediment to fresh investment and economic progress. In theory, governmental action can be taken to change property rights in the face of a market failure, such as a manufacturing method that causes environmental harm. Compelling polluters to compensate for pollution created, or requiring users of scarce resources (e.g., water) to pay the true societal cost of that resource rather than utilizing it for free, might provide farmers with an economic incentive to adopt GAP. Government rules concerning food safety, environmental protection, or human health protection, among other things, increase the motivation for farmers (or downstream processors and merchants) to perform due diligence. GAPs allow farms to broaden their knowledge and skill set (core competences) by gaining access to codifiable knowledge – that is, knowledge that can be described in production protocols. They may also allow access to tacit information that cannot be described in simple protocols but is gained via experience or shared among supply chain participants. Access to tacit information is more likely in supply chain-driven GAPs if the interaction between farmers and downstream purchasers is interactive and includes feedback systems on the results of effective production and management practices (Hobbs, 2003).

Economic disincentives, institutional infrastructure limitations, and human capital restrictions are among the disincentives or restrictions that farmers face while implementing GAPs. The most obvious economic impediment is cost. GAP programs may force farmers to adopt new production practices, which may raise variable production costs, decrease output, or need significant capital investments. Greater variable costs include greater labor needs or labor training to enhance harvesting skills, increased record-keeping needs, abandoning cheaper inputs in favor of harder to get and/or more expensive but more ecologically friendly inputs, and so on. Reduced yields can be caused by less intense use of agricultural pesticides or the application of soil and water conservation practices. Reduced yield raises average production costs, provided all other input costs stay constant. New capital expenditures raise fixed costs and might include upgrades to harvesting and storage equipment, energy and waste management, or expenditures to improve farm worker safety (Hobbs, 2003).

GAP development must take into account the possible influence on farm-level expenses as well as the extent to which the suggested agricultural methods are compatible with local growing conditions, knowledge, and resource bases. End-product testing as a technique of evaluating quality and safety must also be included as a cost in the manufacturing process. Compliance expenses are incurred at several stages across the supply chain. While farmers suffer expenses in modifying and documenting agricultural techniques, first-stage handlers, processors, and distributors pay compliance expenses in updating processing facilities and investing in testing and monitoring equipment for input quality (Hobbs, 2003).

The farmer is vulnerable to the buyer seeking to renegotiate the terms of the agreement by providing a cheaper price or modifying the delivery terms after the farmer has made an unrecoverable investment (a sunk investment). Adoption of all sorts of GAP programs might be hampered by a lack of suitable infrastructure to support them. GAPs offer a trade-off between quality and safety assurances and increased transaction costs since the responsibility of monitoring and quality verification back to the supplier nation raises transaction costs and may limit farmers' capacity to adopt these specific production techniques (Hobbs, 2003).

Farmer adoption of GAPs is frequently hampered by human capital constraints, i.e. restrictions on the farmer's capacity to execute the prescribed production and management procedures while also maintaining the proper degree of documentation. This will be especially essential in developing nations where illiteracy rates are high. The GAP system necessitates paperwork that allows for the traceability of farm goods (e.g., sales records), records of chemical and fertilizer inputs, and so on. These records are tools for lowering transaction costs and facilitating commerce over time and distance. Record keeping is also an important aspect of sound management practice since it helps a farm organization to assess its current situation and plan future production decisions (Hobbs, 2003).

Significant extension initiatives are necessary in developing nations with high rates of illiteracy to support the adoption and maintenance of GAPs among poorly educated farmers. Without these processes, GAPs may result in market exclusion for farmers who are poorly educated or illiterate. Record and documentation requirements can also be costly in terms of the opportunity cost of a farmer's work - that is, the time spent compiling and keeping records may be spent more productively on other tasks. This can be an issue if numerous GAP systems emerge and farmers are required to store duplicate records for different crops or to qualify for different GAP programs. This is significant for GAPs programs in both developed and poor nations (Hobbs, 2003).

Many small and rural farmers in Asia's emerging countries lack the managerial skills and production techniques needed to adopt and improve GAP procedures. These farmers also have limited financial resources and cannot pay the expenditures of GAP compliance. Individual development agencies in these nations have already launched a slew of initiatives to remedy these shortfalls. These limits, however, continue to plague small and rural farmers (Chan, 2016).

According to current thinking, the lack of interest in adopting GAP in these developing nations may be attributed to the fact that small and rural farmers in these nations frequently do not engage directly in the market system. It is also considered that the presence of several multi-tiered marketing middlemen has reduced the incentive of small and rural farmers to implement GAP production methods. However, as supermarket growth in Asia continues, with more direct procurement from farms, small and rural farmers will have more opportunity to actively engage in the mainstream market system. Supermarkets have also suggested that reducing marketing intermediaries will lower distribution costs, with the savings going back to farmers. Farmers gain from increased returns on farm gate pricing, and connecting them to the market encourages them to implement GAP programs (Chan, 2016).

2.4 Promoting GAP and Using GAP as a management tool

Many farmers and agricultural practitioners throughout the world struggle to grasp the GAP criteria established by national authorities, international organizations, or merchants. Their initial perception of GAP standards or GAP schemes is simply that they are prohibiting many of their agriculture operations. Furthermore, many farmers who utilize traditional agricultural methods believe that GAP is an insult to their beliefs. Crop cultivation, on the other hand, has become a scientific process in which every element of plant development can be scientifically described, thanks to the incorporation of science into agricultural methods. Scientifically improved crop cultivation approaches outperform conventional crop cultivation approaches in terms of production, and they are critical for feeding the world's growing population. Modern scientific food production procedures have now become the standard method of farming (Chan, 2016).

The majority of farmers today employ sophisticated chemicals in all aspects of their everyday practices, including crop production, crop protection, plant development, post-harvest treatment, and storage life, to boost yield productivity and quality and to protect their crops from pests and diseases. However, improper application of these compounds can result in the production of hazardous waste and contamination of crop products with harmful residue. This also disrupts the farm's and the surrounding environment's biological balance of flora and wildlife. Poor agricultural practices have a detrimental impact on food production, farmers' livelihoods, and consumers. GAP assists all players in the food production chain in understanding the importance of food safety, the need for a sustainable food production system, and the need to avoid waste. GAP does not suggest agricultural productivity-increasing strategies. It does, however, assist farmers in producing lucrative and sustainable crops, resulting in advantages that directly benefit them (Chan, 2016).

GAP is a term used to describe excellent agricultural practices. Farmers become specialists in agricultural activities via hands-on experience in the fields, while agricultural technicians are educated in the academic and scientific aspects of the agricultural industry. Some farmers and agricultural professionals who read this paper may object to the investigation and questioning of their farming practices due to their expertise and expertise. The primary guiding principle of GAP is to develop a safe and sustainable food production system for producers and consumers. This secure manufacturing method is required to safeguard customers' entitlement to clean, nutritious, and inexpensive food. Furthermore, it is critical for food production to protect the health, cleanliness, and welfare of producers and agricultural employees. During input applications, they must not be exposed to threats and risks. Farmers are particularly concerned with raising excellent crops that will allow them to sell high-quality products at a profit. However, the market's power is significantly skewed in favor of consumers (Chan, 2016).

Consumers increasingly want and expect GAP criteria to be implemented for market access for a wide range of food crops. Crops from farms that do not meet GAP requirements must be traded in lower market locations, which means they must be sold at cheaper prices. Farmers, particularly small and rural farmers in Asia, have an urgent need to comprehend the workings of GAP under these situations. They must learn how to capitalize on possibilities while avoiding the disadvantages of being locked in a food market system in which their crop products are marginalized in the food supply chain (FSC) (Chan, 2016).

2.5 Consumer Demand as a Driver of GAP Promotion

GAP is an unique approach to agricultural productivity. As a result, GAP principles and applications have been perplexing for traditional horticulture practitioners. One part of this is that farmers will have to focus more than ever before on documenting agricultural producing operations. Farmers are typically self-sufficient and provide for their local community while respecting the natural environment. Under such circumstances, they merely need to consider growing the produce and selling it at the farm gate. Farmers must now balance customer expectations, supermarketization, post-harvest handling and treatment, and logistics management, thanks to the development of modern Horticultural Supply Chain Management (HSCM). Farmers now have the combined obligation of being responsible buyers and sellers as supply chain stakeholders. Farmers are increasingly aware that whatever action they take on their farms will have an influence on the sector. Plant Protection Products (PPP), including insecticides, appear to be required in current horticultural production. Many customers, however, question whether farmers understand the proper application procedures for employing PPP. Because the market is based on consumer demand, consumer decisions now have a big influence on what farmers grow, when they produce, and how they grow (Chan, 2016).

Consumers used to eat to survive, and the amount of food available on the market was never enough. Growers were guaranteed that they would be able to sell their whole crop at any moment. During the supply drive, markets were relatively near to manufacturing centers. Imported food was more costly, more difficult to get, and of worse quality. Harvested food crops may now move quicker, better, and cheaper from the furthest reaches of the planet into the affluent markets of Europe, the United States, and Japan, thanks to advancements in transportation, cold chain systems, and post-harvest handling technologies (Chan, 2016).

Consumers are no longer simply concerned with satiating their hunger, and they have a wide range of food options at their disposal. Consumers in affluent and developed economies have a wide range of food options accessible at all times of the year due to their high purchasing power. Food production has evolved into a demand-pull function. Consumers increasingly decide the quality standards for how food goods are sold. Consumers are more concerned with whether impoverished farmers in developing nations can supply product into these marketplaces at the greatest rates while meeting these quality criteria than with pricing (Chan, 2016).

Consumers have a right to safe food under this contemporary system. The novel component of this conceptual approach to agriculture is every farmer's moral and legal commitment to produce hygienic food that is guaranteed to be safe and clean. Consumer expectations in the market system require farmers to produce products that meet GAP criteria (Chan, 2016).

2.6 Review on Previous Studies

Jill E. Hobbs, (October 2003), “Incentives for the Adoption of Good Agricultural Practices (GAPs),”. The descriptive technique was adopted in this investigation. According to the findings of this study, the (dis)incentive for adoption is significant in some instances independent of the kind of system, such as stabilized yield (revenue) or increased variable expenses. Other incentives are more applicable to certain types of programs; for example, (asset) specific investments related to a single customer are a significant deterrent for commercial supply chain GAPs but less so for GAP systems established by international organizations. In general, the economic incentives for private supply chain systems are higher, although many of the economic disincentives (higher costs) apply to all types of GAP systems. GAPs programs that are both sustainable and accessible require proper institutional infrastructure, such as third-party monitoring, quality verification methods, and changes in transportation and storage facilities to avoid co-mingling with non-GAP food. Participation of farmer groups or co-operatives can help to balance farmers' negotiating power in relation to major purchasers or supermarkets urging suppliers to adopt GAPs.

The descriptive approach was utilized for this study in FAO's (November 2003) thesis of "Report of the Expert Consultation on a Good Agricultural Practices (GAP) Approach." The Consultation stressed the need of a GAP approach in primary agriculture, particularly for small-scale farmers in developing countries. There are incentives that may be constructed or seized on to encourage producers to adopt excellent practices. These may include: financial assistance, longer-term access to finance (on better terms), improvements in income and infrastructure, improvements in yield with less waste and inputs and higher biodiversity, higher market access and positioning, and a reduction in uncertainty (e.g. contract farming), enhanced labor health and quality, benefits in social connections and image, farmer capacity building.

Producers confront several disincentives to adopt excellent practices connected with existing agricultural systems, laws, and standards. Lack of specific product and or fickle markets, existing protocols designed for developed countries, confusion over multiple schemes, codes and guidelines, as well as conflict between domestic and international schemes, associated compliance costs such as inputs and record keeping, traceability, and a lack of analysis of the costs and benefits of GAP adoption were identified as some of these issues. Increases in output and revenue are major motivators for farmers. For growers, the absence of stable markets, record keeping, and traceability are significant deterrents.

Anne-Sophie Poisot with Andrew Speedy and Eric Kueneman, (October 2004), The descriptive technique was employed for this study, which was based on the thesis "Good Agricultural Practices- a Working Concept." Economic benefits such as increased or stabilized revenue are among the incentives for farmers to adopt GAPs, lowering average costs, improving market access, increasing capital valuation of farm assets, and reducing vulnerability to other farmers' bad agricultural practices; regulatory or legal incentives, such as changes in ownership rights and subsidies; and human capital incentives, such as access to new skills, are also available. Economic disincentives for farmers to adopt GAPs include higher production costs, investments in assets that are particular to one buyer or cannot be recovered if the buyer-seller relationship fails, and so on, institutional constraints include a lack of quality monitoring infrastructure, weak or corrupt public institutions in charge of overseeing GAPs, and human capital constraints like literacy limits on documentation capabilities, labor or management time constraints, and a lack of public extension, among others. Adopting GAP has a lot of benefits, including increased income, subsidies, and access to new skills. Increased product production costs and the breakdown of buyer-seller relationships as a result of specialized asset investments in one buyer are two separate disincentives to using GAP in agricultural production.

Fatma Akkaya, Raif Yalcin and Burhan Ozkan, (2006), the thesis of “Good Agricultural Practices (GAP) and Its Implementation in Turkey”. The primary grounds for increasing excellent agricultural practices in Turkey include Turkey's expertise in the sectors of IPM and ICM, the nation's considerable natural resources biodiversity, and the use of wide agricultural methods in many regions of the nation. Furthermore, Turkish fresh fruit and vegetable exporting enterprises have extensive expertise with health and environmental issues, and they are able to meet client requests by providing goods that meet both statutory and commercial standards. However, there are also significant barriers to the widespread use of GAP systems in Turkey. These include the following: a highly fragmented structure of production regions and small farm sizes (5 ha on average), a lack of record-keeping by producers, and a lack of number and scale of producers' organizations.

Marie Trydeman Knudsen, Niels Halberg, Jorgen E. Olesen, John Byrne, Venkatesh Iyer and Noah Toly, (2006), the thesis of “ Global trends in agriculture and food systems". Increased globalization and agricultural output have mostly benefitted industrialized nations and select emerging nations, such as China, that are integrated into global markets, according to this study, which utilized a descriptive technique. Food security has improved in such countries, and a wider range of foods is now available. The progress masks an increasing mismatch between agricultural systems and populations, with limited increases in food security and output in emerging nations in Africa, in particular. The great majority of rural families in developing nations lack the ecological and financial resources to transition to intensive modern farming techniques while also being integrated into global markets. At the same time, intensive agriculture, particularly in industrialized nations, has led to environmental issues such as nitrate and pesticide contamination of surface and groundwater, global warming, biodiversity loss, and soil degradation.

Khin Thu Thu, (May 2012), the thesis of "An Analysis on Adopting Good Agricultural Practices in Mango Production of Sagaing Region", to assess the benefits and restrictions of farmers, a simple random sample approach was utilized, along with both quantitative and qualitative questionnaires. In the Sagaing Region's mango production, an average of 50% of farmers can successfully use GAP from the Food Safety Module, 39% of farmers can use GAP perfectly from the Environmental Management Module, 62% of farmers can use GAP systematically from the Produce Quality Module, and 38% of farmers can follow GAP perfectly from the Worker Health, Safety, and Welfare module. Farmers have challenges in implementing GAP, such as manpower and equipment shortages, financial issues, market access, and transportation. The majority of mango producers, according to this survey, did not strictly adhere to the GAP guidelines for mango production.

Uday Pandit, M S Nain, Rashmi Singh, Shiv Kumar and V P Chahal, (July 2016), Thesis of "Adoption of Good Agricultural Practices (GAPs) in Basmati (Scented) rice: A study of prospects and retrospect". The respondents' awareness was assessed by their replies to a set of items relating to the conceptual and implication domains of knowing about GAP criteria on a three-point continuum of totally aware, aware, and not aware at all, with corresponding weightage of three, two, and one, respectively. The low level of awareness and adoption of GAPs in premium quality basmati rice was discovered to be very low, directing policy initiatives toward economic incentives such as increasing and stabilizing revenue, lowering average costs, improved market access, reduced vulnerability to market risks, and poor agricultural practices of other farmers.

Human capital readiness and access to new skills, institutional infrastructures such as buyer-seller relationships, quality monitoring infrastructure, backward and forward institutional linkage, linkage with certification agencies, credit facilities, and extension intervention in disseminating GAP information are all factors to consider. The primary concerns for making the dream of GAP adoption in basmati rice into reality are effective education of farmers and consumers on food safety, sustainable and ecofriendly technology to tackle insect problems in basmati rice, as well as labor saving technologies. The advantages of adopting GAPs are well understood by potential adopters, but awareness, as well as infrastructural and technological issues, must be addressed in a systematic manner through policy interventions in order to establish and maintain our position in the international basmati rice market.

CHAPTER III
ADOPTING GAP IN GREEN GRAM PRODUCTION IN MYANMAR

3.1 Role of Agriculture in Myanmar

Agriculture has been critically important in reducing poverty in Myanmar, and further progress in agriculture will remain important as Myanmar's economy continues to evolve. Economic structural change is underway in Myanmar, even as primary agriculture (which also includes fisheries and forestry) provides either a primary or secondary livelihood for nearly 70% of the population and accounts for nearly 30% of national gross domestic product (GDP) and merchandise exports. The fuller agrifood system accounts for some 42% of GDP when forward and background linkages to primary agriculture are considered. Agricultural growth has helped significantly to reduce poverty; progress in agriculture was directly responsible for 46% of the poverty reduction achieved between 2005 and 2015. Myanmar has been able to focus on a far broader set of development concerns as a result of this success, while also attempting to strengthen agriculture's economic benefits (Word Bank Agriculture Global Practice, 2019).

For many years, the lack of accurate, current data at the sectoral, subsectoral, and microeconomic levels has hampered knowledge of Myanmar's agricultural dynamics and performance, but improved data is now accessible. A lack of data constrained policy making as well as the effective prioritization of programs and public spending, but recently a variety of studies started to fill important gaps. The Myanmar Agricultural Survey (MAS), which took place in 2013-14, is one example. Results of the MAS were available two years later and provided valuable insights on crop profitability, productivity, farm practices, and the underlying state of farm household economics (Word Bank Agriculture Global Practice, 2019).

In the years since the MAS was undertaken, Myanmar's economy, public expenditures, demography, and integration into global and regional markets for agrifood products have all seen substantial changes, all of which have ramifications for policy and public initiatives. Agricultural production patterns and performance, as well as the structure and performance of agricultural value chains in respect to local and global market possibilities, are likely to change as a result of such developments. A new agricultural economics survey was conducted to better understand these shifts and draw implications for future policy and public initiatives. This is focused on results for the 2017-18 crop year, covered 1,728 farm households involved with paddy, pulse or bean production in Ayeyarwady, Bago, and Sagaing Regions and Shan State. Parallel to the farm survey, interviews and the gathering of other data aided in the better understanding of Myanmar's rice and pulse or bean value chains' growing structure and underlying strengths, weaknesses, opportunities, and dangers (Word Bank Agriculture Global Practice, 2019).

Rice, pulses, and beans remain staples of Myanmar's agriculture, despite the country's diversification over the last decade. Diversification of agriculture has happened through fisheries and increasing production of cattle, fruit, and numerous industrial crops (namely rubber and sugar). During 2015-16, however, rice still accounted for 35% of agricultural output and pulses or beans accounted for another 17%. Together, these three crops constituted just over 67% of gross crop output in 2016, only slightly lower than their 72% share a decade earlier. Rice, pulses, and beans occupy about 75% of the cultivated area in Myanmar and deliver most of Myanmar's earnings from agricultural exports (the share varies from year to year depending upon market circumstances). In recent years, the country has ranked as the world's sixth-largest rice exporter and second-largest pulse exporter by volume (Word Bank Agriculture Global Practice, 2019).

Myanmar is the world's third-largest producer of pulses after India and Canada. Farmers produce 18 kinds of pulses, of which the most important are black gram, green gram, pigeon pea, and chickpea. About two-thirds of pulse production takes place during the dry season (in rotation with monsoon-season paddy) and is concentrated in the regions of Sagaing (25%), Bago (21%), Magway (18%), and Ayeyarwady (14%). The area allocated to pulse and bean production has increased over the years, reaching 4.7 million hectares in 2016-17. These crops covered 36% of arable land in Myanmar in 2016-17, up from less than 7% in the early 1980s. Total production was 6.2 million tons in 2016-17, having increased by 2.4% per annum over the previous 10 years (Word Bank Agriculture Global Practice, 2019).

Myanmar is also a major exporter of pulses, with the Association of Southeast Asian Nations' greatest exporting country (ASEAN). Myanmar has maintained its position among the top four exporters of legume-based products over the last 10 years. Farmers grow pulses mostly for sale, so they are an important source of farm income. India receives the majority of legume exports, particularly black gram. India's demand drives practically all domestic wholesale black gram pricing. China, the United Arab Emirates, Thailand, Bangladesh, and European countries are among the other markets for pulses and beans. Myanmar exported over 1.4 million tons of pulses and beans for US$1.40 billion in 2016. Black gram constituted close to 40% of the total export volume and nearly half of the export value. Green gram accounted for one-third of the total export volume and one-fifth of the export value during that period. With growing global demand for plant-based protein, Myanmar’s gain from exports is expected to increase (Word Bank Agriculture Global Practice, 2019).

Following India's limitations on imports of black gram, chickpeas, and other commodities in 2017, the pulse subsector encountered serious challenges in 2017. As a result, domestic prices in Myanmar dropped very sharply and unsold stocks accumulated. Farmers had difficulty marketing their pulse and bean crops and ultimately experienced either losses or very low net margins during the 2017-18 production season. Producers’ net margins per hectare were positive only for green gram growers, negligible for chickpea growers, and negative for black gram growers, who incurred a net loss of $75 per hectare. Some oilseeds, such as winter peanut, suffered even greater net losses. Except for laborers who produced green gram, all labor returns were below the prevailing wage rate, posing a threat to livelihoods (Word Bank Agriculture Global Practice, 2019).

While trade limitations exposed the pulse subsector's vulnerability to a large reliance on a single market for specific products, the subsector also confronts other issues, particularly in terms of farm production. Green gram yields increased by about 8% between 2014 and 2018, whereas black gram yields fell by 7% and chickpea yields by 4%. The yield problem is partly the result of low availability and use of improved seed. During the 2014/15 production season, less than 0.5% of the black and green gram area was sown to high-yielding varieties of these crops. Farmers are still using extremely basic conventional producing methods. There has been very little mechanization. Very few farmers clean or sort their produce before selling it, so they receive discounted prices from traders (Word Bank Agriculture Global Practice, 2019).

3.2 The Requirements of GAP in Green Gram Production

Chemical and biological toxicity must be eliminated from the soil. The cultivated area must be clear of hospital structures, livestock, and municipal garbage. Water from cattle, hospitals, and factories, as well as municipal runoff, must be avoided. Seeds of good quality, free of pests and diseases, and suitable to soil should be chosen. Seeds are received from a certain place, and the quantity, date, and supplier are all recorded. To reduce the usage of chemicals, integrated pest management (IPM) is used. Plant extract pesticides and microbiological pesticides should be employed. If agrochemicals are required to control pests and illnesses, the registered goods should be utilized. Pesticide pre-harvest intervals (PHI) must be followed. Farmers must be aware of the various pesticide applications. Pesticide purchases, storage, use, and disposal must all be done in a methodical and documented manner. To reduce crop toxicity, fuel, lubricants, and other chemicals (not used in agriculture) should be used, stored, and discharged as little as possible. Cleaning is required for machines, tools, and packing materials. It is necessary to clean the packaging and storage areas. For the least amount of product damage, appropriate chemicals are used to clean the storage area. During the storage phase, specific insecticides with prescribed dosages are used to control storage pests. The directions must be followed to prevent storage pests during the storage period for foreign nations that will import the products and to ensure that each country's standards are met if the items are exported to other nations. The transportation machines are inspected for hazardous substances, pests, and diseases caused by other products. Farmers should receive basic integrated pest management training (IPM).

To improve the physical and chemical features of the soil, three to five tons of natural fertilizer (humus) and green manure should be added annually. The addition of natural fertilizer (humus) and green manure to the soil improves its physical characteristics. If the leftovers of plants are utilized to make compost, disease-free plants should be used. Crop cultivation is documented in terms of land use. Contamination of soil and water should be avoided during fertilizer mixing and storage, as well as the decomposition of organic matter. The region where fertilizer or soil additions are delivered, as well as the amount, date, and seller, must all be documented.

Soil pH is 6.5 to 7.5 to grow green gram. The water is tested in laboratory which is suitable for green gram cultivation. Seed rate of one acre should be 4-6 pyi in raining season and 6-8 pyi in winter season. Plant spacing (18 inch x 4 inch) and plant population (85000) of green gram should be used per acre in raining season, plant spacing (12 inch x 4 inch) and plant population (130000 plants) should be in used per acre in winter season. Bean after bean cultivation must be avoided. Twenty pyi of fertilizer containing five percent of sulphur nutrient in green gram growing time and foliar fertilizer can be used. 75 to 85 percent of ripening pods should be harvested. Late harvesting and pre-harvesting before ripening time should be avoided in green gram production. Winnowing and drying process of green gram seeds should be done on concrete floor and ground sheet. Agrochemical and other dangerous chemical bags are avoided for packaging and storing green gram. Green gram should be stored systematically by using super bags, airtight bags and bucket made with iron. Green gram bags were transported and stored in warehouse separately form chemical, biological and physical toxic products. Buildings are constructed away from humus storage area, livestock area and animal feed storage area. Bamboo floor or floor board are used to prevent the green gram bags from direct contact to floor or wall of warehouse. Warehouse is prepared in good aeration and to prevent mouse, birds and other pests. Insect pests are being prevented around the storage area. The records concerning GAP are stored at least two years. The current production procedure is recorded in designated form. The distinct logo and registered logo on green gram packaging were made to recheck the production site. Transported places, amount and date of transportation for green gram are recorded. Technical team concludes either farmers correctly use GAP or they did not use GAP in farm at least one time per production season. Conclusion and operating procedures are recorded.

The rules of pesticide application are written and announced for worker' safety. The instructions for hygiene are distributed among the workers. The cast-off waste and lavatorial water must be abandoned carefully. Worker's health and social welfare are performed. Organization for social welfare and bookish meeting should be performed.

3.3 Pulses and Bean Production in Myanmar

Among the ASEAN countries, Myanmar is the leading pulse and bean producer, with 6.2 million tons of production on 11.52 million acres in 2016-17 and an average yield of 543 kg per acre. About 18 types of pulses are produced in Myanmar, led by black gram and followed by green gram, pigeon pea, and chickpeas, and including a number of "other pulses." In the ten years between 2008 and 2017, pulse and bean production climbed by 2.4 percent per year, owing primarily to increasing yields rather than an increase in the area planted to these crops, which remained stable. During the dry season, around two-thirds of pulses are produced, mostly in Sagaing (25 percent), Bago (21 percent), Magway (18 percent), and Ayeyarwady (14 percent). If the risk of flooding is low, farmers can plant pulses during the monsoon season (Word Bank Agriculture Global Practice, 2019).

During three years growing season of pulses and beans, Sagaing is the largest area of pulses and beans cultivation and it was 25 percent of total cultivated area of Myanmar in 2019. Bago is the second lagest area of pulses production and 19 percent of total cultivated area in 2019. In 2017, Magway is the third largest cultivated area and 16 percent of total cultivation in Myanmar. In 2018 and 2019 crop growing season, Mandalay is the third lagest area of pulses production. It was 12 percent of total pulses and bean cultivation area in Myanmar (Table: 3.1). Farmers grow pulses mostly during rainy and winter season in Myanmar.

Table (3.1) Pulses and Bean Production in Myanmar

State/Region	2017-2018				2018-2019				2019-2020			
	Cultivated Area (acre)	Harvested Area (acre)	Yield/ Acre (ton)	Total Yield (ton)	Cultivated Area (acre)	Harvested Area (acre)	Yield/ Acre (ton)	Total Yield (ton)	Cultivated Area (acre)	Harvested Area (acre)	Yield/ Acre (ton)	Total Yield (ton)
Ayeyarwady	1665835	1665830	0.54	897327	1608186	1608130	0.55	879111	1611107	1611107	0.56	895775
Bago	2038748	2038737	0.65	1314985	2013341	2013030	0.65	1309812	2028187	2028080	0.66	1333125
Chin	21664	21662	0.33	7141	18855	18855	0.30	5594	17572	17572	0.30	5231
Kachin	60871	60871	0.56	33905	61328	61328	0.56	34405	75157	75154	0.57	43088
Kayar	32937	32937	0.40	13043	32197	32167	0.40	12792	30307	30300	0.39	11948
Kayin	153861	153861	0.54	82367	164677	164677	0.54	88926	165151	165151	0.54	89787
Magway	1789346	1785307	0.47	838499	1203608	1194822	0.41	495453	1124853	1121638	0.40	444169
Mandalay	1458246	1457433	0.42	610179	1316571	1316512	0.40	530554	1320952	1320033	0.39	511733
Mon	56914	56914	0.53	30354	57326	57326	0.54	30880	60148	60148	0.51	30555
Nay Pyi Taw	149341	149271	0.51	76128	145500	145500	0.52	76194	149525	149525	0.53	78650
Rakhine	67175	67175	0.47	31281	62504	62504	0.47	29481	61512	61512	0.46	28480
Sagaing	2639666	2632624	0.60	1566411	2534343	2531098	0.60	1506847	2529767	2529718	0.58	1454588
Shan	414288	414137	0.53	219217	402922	402523	0.53	211995	395318	395316	0.53	207673
Tanintharyi	1065	1065	0.30	324	745	745	0.30	220	702	702	0.24	168
Yangon	419532	419532	0.48	199278	411804	411804	0.48	197117	411374	411354	0.48	197998
Total	**10969489**	**10957356**	**0.54**	**5920625**	**10033907**	**10021021**	**0.54**	**5408011**	**9981632**	**9977310**	**0.53**	**5334535**

Source: Data from DOA (2017-2020)

Beans and pulses have a lower production cost and higher return in comparison to paddy. Between 2012 and 2017, bean and pulse production climbed by 3–4% year, with many farmers switching to bean and pulse cultivation in June–July 2016, owing to rising demand from India and China, as well as new markets in Japan, Korea, the EU, and the US. Beans and pulses account for 28% of total sown land and 64% of value-added crops. Black gram, green gram and pigeon peas make up 80% of the beans and pulses exported (EuroCham Myanmar, 2019).

3.4 Green Gram Production in Myanmar

Green gram is one of Myanmar's most important crops. During the rainy and winter seasons, most farmers in upland Myanmar produce green gram. The farmers grow green gram during the winter season in lower Myanmar area. Magway is the largest area of green gram production and 23 percent of green gram cultivation area in Myanmar, 2017. Bago and Sagaing regions are the second and third largest producting area of green gram. 22.6 percent of total cultivated area was in Bago region and 18 percent of cultivated area was in Sagaing region. Bago is the largest production area of green gram in 2018 and 2019. Green gram was mostly grown during winter season in this region. Green gram cultivated area and yield were shown in table (3.2). As a whole, the total cultivated area and yield per acre decreased from 2017-2018 to 2019-2020 due to the declination of cultivated area (38 percent) in Magway.

Table (3.2) Green Gram Production in Myanmar

State/Region	2017-2018				2018-2019				2019-2020			
	Cultivated Area (acre)	Harvested Area (acre)	Yield/ Acre (ton)	Total Yield (ton)	Cultivated Area (acre)	Harvested Area (acre)	Yield/ Acre (ton)	Total Yield (ton)	Cultivated Area (acre)	Harvested Area (acre)	Yield/ Acre (ton)	Total Yield (ton)
Ayeyarwady	238469	238464	0.56	133619	270971	270971	0.55	148853	268415	268415	0.56	150939
Bago	693980	693974	0.65	454090	678948	678948	0.67	453764	729336	729317	0.68	494477
Chin	338	338	0.39	132	1101	1101	0.24	265	1096	1096	0.24	264
Kachin	2113	2113	0.40	837	1938	1938	0.40	784	3152	3152	0.39	1223
Kayar	1039	1039	0.44	459	849	849	0.44	374	848	848	0.44	376
Kayin	65453	65453	0.60	39206	68260	68260	0.60	41229	68409	68409	0.60	41319
Magway	704099	700346	0.47	325894	514482	509460	0.37	189859	439970	436915	0.35	151173
Mandalay	314243	313579	0.39	121355	297425	297389	0.37	110926	285091	284196	0.38	108279
Mon	35794	35794	0.54	19472	37801	37801	0.55	20627	38126	38126	0.51	19355
Nay Pyi Taw	73028	73028	0.46	33325	70846	70846	0.49	34573	70918	70918	0.48	33852
Rakhine	2560	2560	0.41	1055	2576	2576	0.42	1074	2145	2145	0.42	892
Sagaing	562364	560576	0.54	305327	577121	573959	0.54	311660	595760	595751	0.54	324089
Shan	4662	4662	0.51	2395	5290	5290	0.50	2656	9238	9238	0.52	4779
Tanintharyi	49	49	0.36	18	23	23	0.34	8	20	20	0.16	3
Yangon	367060	367060	0.47	173130	360097	360097	0.47	170806	359239	359219	0.48	171228
Total	**3065251**	**3059035**	**0.53**	**1610072**	**2887728**	**2879508**	**0.52**	**1487746**	**2871763**	**2867765**	**0.52**	**1502709**

Source: Data from DOA (2017-2020)

3.5 Adopting GAP in Green Gram Production in Myanmar

In Myanmar, GAP was applied in green gram production during the 2017-18 growing season. Because the Department of Agriculture did not compute the area of the implementation period after GAP was completed, the total cultivated area of green gram using GAP in 2018 is not greater than the cultivated area in 2017. Farmers wanted to grow green gram with GAP and they knew good quality, higher price of GAP products, therefore the production area of green gram with GAP rose year after year during implementation in the Nay Pyi Taw area. In 2017, 2018, and 2019, the total cultivated area of green gram with GAP in the Nay Pyi Taw area was 0.14 percent (65 acres), 25 percent (591 acres), and 20 percent (920 acres). The table shows the cultivated area, harvested area, and green gram yield of GAP in Myanmar (Table: 3.3).

Table (3.3) Green Gram Production During Implemented Period of GAP in Myanmar

State/Region	2017-2018				2018-2019				2019-2020			
	Cultivated Area (acre)	Harvested Area (acre)	Yield/ Acre (ton)	Total Yield (ton)	Cultivated Area (acre)	Harvested Area (acre)	Yield/ Acre (ton)	Total Yield (ton)	Cultivated Area (acre)	Harvested Area (acre)	Yield/ Acre (ton)	Total Yield (ton)
Ayeyarwady	150	150	0.55	83	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bago	320	320	0.65	207	30	30	0.57	17	N/A	N/A	N/A	N/A
Kayar	10	10	0.51	5	N/A	N/A	N/A	N/A	1	1	0.50	1
Kayin	5	5	0.59	3	20	20	0.62	12	441	441	0.59	260
Magway	230	230	0.49	114	30	30	0.63	19	1133	1133	0.47	531
Mandalay	100	95	0.54	51	335	335	0.60	202	655	655	0.56	368
Mon	N/A	N/A	N/A	N/A	5	5	0.57	3	220	220	0.52	115
Nay Pyi Taw	65	65	0.51	33	591	591	0.60	356	920	920	0.59	546
Others	43808	43808	0.51	22211	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Rakhine	N/A	N/A	N/A	N/A	10	5	0.42	2	N/A	N/A	N/A	N/A
Sagaing	160	160	0.65	104	230	230	0.62	143	N/A	N/A	N/A	N/A
Shan	10	10	0.40	4	40	40	0.65	26	N/A	N/A	N/A	N/A
Yangon	1845	1845	0.53	983	1065	1065	0.52	556	1205	1205	0.57	683
Total	**46703**	**46698**	**0.51**	**23800**	**2356**	**2351**	**0.57**	**1335**	**4575**	**4575**	**0.55**	**2504**

Source: Data from DOA (2017-2020)

3.6 Adopting GAP in Green Gram Production in Tatkone

During the three-year implementation period from 2017 to 2019, the cultivated area of green gram with GAP in Tatkone township was 18 percent (12 acres), 85 percent (500 acres), and 76 percent (700 acres) of green gram with GAP in Nay Pyi Taw region, respectively. Green gram growing area in Nay Pyi Taw Union Territory during the pre-monsoon cultivated season in 2020 was 720 acres, with farmers planting green gram with GAP. Farmers in the survey region (Kyar Thay Eai, Ma Gyi Gone, and Shauk Kone village) farmed green gram with GAP, with a total cultivated area of 700 acres during the pre-monsoon cultivated season in 2020. After the GAP implementation term has ended, this land is no longer included in the Department of Agriculture's agricultural area. Table (3.4) shows the production and yield of green gram with GAP in Tatkone township.

Table (3.4) Green Gram Production during implemented period of GAP in Tatkone

Villages	2017-2018				2018-2019				2019-2020			
	Cultivated Area (acre)	Harvested Area (acre)	Yield/ Acre (ton)	Total Yield (ton)	Cultivated Area (acre)	Harvested Area (acre)	Yield/ Acre (ton)	Total Yield (ton)	Cultivated Area (acre)	Harvested Area (acre)	Yield/ Acre (ton)	Total Yield (ton)
Kyar Thay Eai	N/A	N/A	N/A	N/A	29	29	0.60	17	100	100	0.61	61
Ma Gyi Gone	2	2	0.55	1	222.75	222.75	0.60	134	240	240	0.61	146
Oak Shit Kone	10	10	0.52	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shauk Kone	N/A	N/A	N/A	N/A	248.25	248.25	0.65	161	360	360	0.66	237
Total	**12**	**12**	**0.53**	**6**	**500**	**500**	**0.62**	**312**	**700**	**700**	**0.63**	**444**

Source: Data from DOA (2017-2020)

CHAPTER IV
SURVEY ANALYSIS

4.1 Survey Profile

Tatkone Township is located in Nay Pyi Taw Union Territory. Tatkone's latitude and longitude is 20° 7' N and 96° 13' E .The Township covers an area of 695.9 square miles. Tatkone has a population of 217,093 people. The majority of the people in the Township live in rural areas with only (19.2%) living in urban areas. The neighbors of Tatkone Township are Pinlaung Township in Shan State, in the east, Natmauk Township and Myothit Township in Magway Region, in the west, Ottarathiri Township, Pobbathiri Township and Zeyathiri Township in the south and Yamethin Township in the north.

The survey area was selected in green gram cultivated area in Tatkone Township, Nay Pyi Taw. In pre-monsoon green gram production area, total green gram cultivation area is 720 acres. There are three villages in which the farmers cultivated green gram by using GAP and total cultivated area of green gram by using GAP is 700 acres.

4.2 Survey Design

In this study, the questionnaires were prepared for farmers who use GAP and farmers who do not use GAP for green gram production in three villages. Data were collected by using Myanmar GAP guidelines for green gram production as questionnaires depending in Food Safety Module, Environmental Management Module, Produce Quality Module and Worker health, Safety and Welfare Module. Data were collected to examine the awareness of farmers on GAP in green gram production. The data were also collected to to examine the incentives and disincentives for farmers to adopt GAP.

4.2.1 Sample Design

For this study, simple random sampling method was used in selecting respondents to collect the data from the survey questionnaire in primary data collection. Based on the survey questionnaire, 150 farmers were selected to know the knowledge, and attitude and practice of GAP and 75 farmers were selected to find out the disincentives of farmers who do not use GAP in green gram production.

4.2.2 Questionnaire Design

The questionnaires were prepared for the data collection to know the awareness of farmers on adopting GAP and to identify the incentives and disincentives for farmers to adopt GAP in green gram production. The first part includes demographic information. The second part includes green gram cultivated area of farmers. The third part includes questionnaires for knowledge, attitude and practices of four modules (Food Safety Module, Environmental Management Module, Produce Quality Module and Worker health, Safety and Welfare Module). The fourth part includes questionnaire to identify incentives and disincentives for farmers to adopt the GAP. The questionnaires are attached in appendix.

4.3 Survey Data Analysis and Survey Results

The knowledge, attitude and practice status of the respondents on adopting GAP in green gram production, incentives and disincentives for farmers to adopt GAP were assessed by face to face interview with farmers. In this study, a total of 150 individuals took part.

4.3.1 Demographic Characteristics of Respondents

The specific characteristics of farmers were described in the following table (4.1).

Table (4.1) Demographic Characteristics of Respondents

Variables	Measuring Group	Respondents	Percentage
Gender	Male	54	36.0
	Female	96	64.0
	Total	150	100
Age Group (Years)	< 30	5	3.3
	30-39	16	10.6
	40-49	37	24.7
	50-59	54	36.0
	60-69	30	20.0
	70-79	7	4.7
	80-89	1	0.7
	Total	150	100

Source: Survey data (2020)

The majority of the respondents were 50-59 years age group (36.0%) and it was followed by 40-49 years age group (24.7%), 60-69 years age group (20.0%), 30-39 years age group (10.6%), 70-79 years age group (4.7%), under 30 years group (3.3%) and 80-89 years age group (0.7) respectively. The minimum and maximum ages of respondents were 23 and 80 years. In this survey, 150 respondents who are growing green gram by using GAP. There are farmers who are not only male but also female working for crop production in farm level.

4.3.2 Green Gram Cultivated Area and Yield of GAP

Green gram cultivated area of farmers adopting GAP was described in the following table (4.2).

Table (4.2) Frequency Distribution of Cultivated Area

Cultivated Area Group (acre)	Frequency	Percentage
<5	120	80.0
5-9	26	17.3
10-14	4	2.7
Total	**150**	**100**

Source: Survey data (2020)

Most of the respondent cultivated green gram under 5 acres (80.0%) and it was followed by 5-9 acres (17.3%), 10-14 acres (2.7%). Therefore, a gradual decrescendo number of cultivated area groups increment were observed among the respondents. The minimum and maximum cultivated areas were 0.5 and 12 acres.

Increase in green gram yield per acre by GAP was described in the following table (4.3).

Table (4.3) Frequency Distribution of Increase in Green Gram Yield per Acre

Increase in Yield (Basket)	Frequency	Percentage
<3	20	13.3
4-6	75	50.0
7-9	14	9.3
10-13	29	19.3
14-16	12	8.0
Total	**150**	**100**

Source: Survey data (2020)

Most of the respondent received increase in yield green 4-6 baskets (50.0%) and it was followed by 10-13 baskets (19.3%), under 3 acres (13.3 %), 7-9 baskets (9.3%) and 14-15 baskets (8.0%). The minimum and maximum yields were 1 and 16 basket.

4.3.2 (a) Knowledge, Attitude and Practice Status of Respondents on Food Safety Module

The knowledge, attitude and practice status of farmers on Food Safety Module were assessed by using knowledge, attitude and practice questionnaire shown in Appendix. The questionnaire included 19 in each knowledge, attitude and practice assessment questions. The area specific knowledge, attitude and practice status of farmers were shown in the following:

(i) Knowledge Status of Respondents on Food Safety Module

The area specific knowledge status of farmers on Food Safety Module was shown in the table (4.4).

Table (4.4) Knowledge Status of Respondents on Food Safety Module (n=150)

No.	Particular	No. of Respondent	Percentage
1	The soil must be free from the chemical and biological toxicity.	145	96.7
2	Cultivated area must be free from the places built for hospital, livestock and rubbish from municipal.	144	96
3	The water from the livestock, hospitals, factories and cast-off water from municipal area must be avoided.	141	94
4	Good quality seeds that are free from pests and diseases and adaptable to soil should be selected.	150	100
5	The region from which seeds are received, quantity, date and seller are recorded.	129	86
6	Integrated pest management (IPM) is used to decrease the use of chemicals.	145	96.7
7	The microbial pesticides and plant extract pesticides should be used.	148	98.7
8	The registered products should be used to control the pests and diseases if it is necessary to use the agrochemicals.	150	100

Table (4.4) Knowledge Status of Respondents on Food Safety Module (n=150) (Continued)

No.	Particular	No. of Respondent	Percentage
9	Pre-harvest interval (PHI) of pesticides must be obeyed.	149	99.3
10	The farmers need to understand the ways of use of pesticide.	150	100
11	Pesticide buying, storage, usage and disposal must be done systematically and recorded.	143	95.3
12	Fuel, lubricant and another chemicals (which are not used for agriculture) should be used, stored and discarded to decrease the lowest toxicity to crops	142	94.7
13	Machines, tools and packaging materials must be cleaned.	150	100
14	The places for packaging and storage must be cleaned.	150	100
15	Suitable chemicals are selected to clean the storage area for the lowest damage to products.	150	100
16	Designated pesticides with designated dosage are used to control the storage pests during the storage period.	146	97.3
17	The instructions must be obeyed to prevent the storage pests during storage period for foreign countries which will import the products to get standardization of each country if there is export to foreign countries.	141	94
18	The machines used for transportation are checked to be free from toxic chemicals and pests and diseases of other products.	141	94
19	The farmers should attend basic training of integrated pest management (IPM).	142	94.7

Source: Survey data (2020)

Regarding the knowledge status of farmers on Food Safety Module, 100% (n=150) of farmers knew to select good quality seeds that are free from pests and diseases and adaptable to soil, to choose the registered products to control the pests and diseases, to use the pesticides systematically and to clean the places for packaging and storage, to choose the chemicals to clean the storage area that should be the lowest damage to products. They also knew to clean the machines, tools and packaging materials used in farm.

94% (n=141) of farmers used the water that are free from the livestock, hospitals, factories and avoided to use cast-off water from municipal area. They obey the instruction to control the storage pests for foreign countries which will import the products and they also checked the machines used for transportation that are free from toxic chemicals and pests and diseases of other products.

96.7% (n=145) of farmers knew the soil must be free from the chemical and biological toxicity and cultivate the crops by using integrated pest management (IPM) to decrease the use of chemicals. 94.7% (n=142) of farmers knew that fuel, lubricant and another chemicals (which are not used for agriculture) should be used, stored and discarded to decrease the lowest toxicity to crops and they should attend training of integrated pest management (IPM).

96% (n=144) of farmers understood that cultivated area must be free from the places built for hospital, livestock and rubbish from municipal. 86% (n=129) of farmers recorded the region from which seeds were received, quantity, date and seller. 98.7% (n=148) of farmers should use the microbial pesticides and plant extract pesticides. 99.3% (n=149) of respondents correctly understood to obey the pre-harvest interval (PHI) pesticides. 95.35 (n=143) of farmers had the record for pesticide buying, storage, usage and disposal systematically. 97.3% (n=146) of farmers knew that designated pesticides with designated dosage were used to control the storage pests during the storage period.

(ii) Attitude Status of Respondents on Food Safety Module

The attitude questionnaire of Food Safety Module included 19 attitude assessment questions with five level of attitude with a neutral point in the middle. The mean value to assess the attitude of respondents was shown in the table (4.5).

Table (4.5) Mean Value and Attitude Status Assessment

Mean Value	Attitude Status
1 to 1.80	Strongly Agree
1.81 to 2.60	Agree
2.61 to 3.40	Neutral
3.41 to 4.20	Disagree
4.21 to 5	Strongly Disagree

Source: https://www.researchgate.net/post/Which-method-should-I-use-to-present-the-Mean-of-a-5-point-Likert-scale

The area specific attitude status of farmers on Food Safety Module was shown in the table (4.6).

Table (4.6) Attitude Status of Respondents on Food Safety Module (n=150)

No.	Particular	Mean	Standard Deviation (SD)	Level
1	The soil must be free from the chemical and biological toxicity.	1.51	0.57	Strongly Agree
2	Cultivated area must be free from the places built for hospital, livestock and rubbish from municipal.	1.58	0.61	Strongly Agree
3	The water from the livestock, hospitals, factories and cast-off water from municipal area must be avoided.	1.64	0.58	Strongly Agree
4	Good quality seeds that are free from pests and diseases and adaptable to soil should be selected.	1.45	0.57	Strongly Agree
5	The region from which seeds are received, quantity, date and seller are recorded.	1.98	0.79	Agree
6	Integrated pest management (IPM) is used to decrease the use of chemicals.	1.53	0.58	Strongly Agree
7	The microbial pesticides and plant extract pesticides should be used.	1.58	1.04	Strongly Agree
8	The registered products should be used to control the pests and diseases if it is necessary to use the agrochemicals.	1.51	0.54	Strongly Agree

Table (4.6) Attitude Status of Respondents on Food Safety Module (n=150) (Continued)

No.	Particular	Mean	Standard Deviation (SD)	Level
9	Pre-harvest interval (PHI) of pesticides must be obeyed.	1.55	0.63	Strongly Agree
10	The farmers need to understand the ways of use of pesticide.	1.54	0.53	Strongly Agree
11	Pesticide buying, storage, usage and disposal must be done systematically and recorded.	1.83	0.67	Agree
12	Fuel, lubricant and another chemicals (which are not used for agriculture) should be used, stored and discarded to decrease the lowest toxicity to crops	1.75	0.61	Strongly Agree
13	Machines, tools and packaging materials must be cleaned.	1.65	0.59	Strongly Agree
14	The places for packaging and storage must be cleaned.	1.62	0.58	Strongly Agree
15	Suitable chemicals are selected to clean the storage area for the lowest damage to products.	1.70	0.57	Strongly Agree
16	Designated pesticides with designated dosage are used to control the storage pests during the storage period.	1.69	0.59	Strongly Agree
17	The instructions must be obeyed to prevent the storage pests during storage period for foreign countries which will import the products to get standardization of each country if there is export to foreign countries.	1.93	0.67	Agree
18	The machines used for transportation are checked to be free from toxic chemicals and pests and diseases of other products.	1.72	0.60	Strongly Agree
19	The farmers should attend basic training of integrated pest management (IPM).	1.67	0.55	Strongly Agree

Source: Survey data (2020)

In terms of mean value based on the survey data, the respondents revealed good attitude in terms of strongly agree (Mean value =1.51) on the soil must be free from the chemical and biological toxicity and standard deviation was 0.57. The respondents revealed good attitude in terms of strongly agree (Mean value =1.58) on cultivated area must be free from the places built for hospital, livestock and rubbish from municipal and standard deviation was 0.61. The respondents declared good attitude in terms of strongly agree (Mean value =1.64) on the water from the livestock, hospitals, factories and cast-off water from municipal area must be avoided and 0.58. The respondents revealed good attitude in terms of strong agree (Mean value =1.45) on good quality seeds that are free from pests and diseases and adaptable to soil should be selected and standard deviation was 0.57. The respondents declared good attitude in terms of agree (Mean value =1.98) on the region from which seeds are received, quantity, date and seller are recorded and standard deviation was 0.79.

The respondents affirmed good attitude in terms of strongly agree (Mean value =1.53) on integrated pest management (IPM, it is an ecosystem approach to crop production and protection that combines different management strategies and practices to grow healthy crops and minimize the use of pesticides such as biological, cultural and mechanical control etc.) is used to decrease the use of chemicals and standard deviation was 0.58. The respondents manifested good attitude in terms of strongly agree (Mean value =1.58) on the microbial pesticides and plant extract pesticides should be used and standard deviation was 1.04. The respondents revealed good attitude in terms of strongly agree (Mean value =1.51) on the registered products should be used to control the pests and diseases if it is necessary to use the agrochemicals and standard deviation was 0.54. The respondents declared good attitude in terms of strongly agree (Mean value =1.55) on pre-harvest interval (PHI) of pesticides must be obeyed and standard deviation was 0.63. The respondents revealed good attitude in terms of strongly agree (Mean value =1.54) on the farmers need to understand the ways of use of pesticide and standard deviation was 0.53. The respondents revealed good attitude in terms of agree (Mean value =1.83) on pesticide buying, storage, usage and disposal must be done systematically and recorded and standard deviation was 0.67. The respondents manifested good attitude in terms of strongly agree (Mean value =1.75) on fuel, lubricant and another chemicals (which are not used for agriculture) should be used, stored and discarded to decrease the lowest toxicity to crops and standard deviation was 0.61.

The respondents revealed good attitude in terms of strongly agree (Mean value =1.65) on machines, tools and packaging materials must be cleaned and standard deviation was 0.59. The respondents revealed good attitude in terms of strongly agree (Mean value =1.62) on the places for packaging and storage must be cleaned and standard deviation was 0.58. The respondents affirmed good attitude in terms of strongly agree (Mean value =1.70) on suitable chemicals are selected to clean the storage area for the lowest damage to products and standard deviation was 0.57. The respondents revealed good attitude in terms of strongly agree (Mean value =1.69) on designated pesticides with designated dosage are used to control the storage pests during the storage period and standard deviation was 0.59. The respondents declared good attitude in terms of agree (Mean value =1.93) on the instructions must be obeyed to prevent the storage pests during storage period for foreign countries which will import the products to get standardization of each country if there is export to foreign countries and standard deviation was 0.67. The respondents manifested good attitude in terms of strongly agree (Mean value =1.72) on the machines used for transportation are checked to be free from toxic chemicals and pests and diseases of other products and standard deviation was 0.60. The respondents affirmed good attitude in terms of strongly agree (Mean value =1.67) on the farmers should attend basic training of integrated pest management (IPM) and standard deviation was 0.55.

(iii) Practice Status of Respondents on Food Safety Module

The area specific practice status of farmers on Food Safety Module was shown in the table (4.7).

Table (4.7) Practice Status of Respondents on Food Safety Module (n=150)

No.	Particular	No. of Respondent	Percentage
1	The soil must be free from the chemical and biological toxicity.	138	92.0
2	Cultivated area must be free from the places built for hospital, livestock and rubbish from municipal.	132	88.0
3	The water from the livestock, hospitals, factories and cast-off water from municipal area must be avoided.	136	90.7
4	Good quality seeds that are free from pests and diseases and adaptable to soil should be selected.	149	99.3
5	The region from which seeds are received, quantity, date and seller are recorded.	72	48.0
6	Integrated pest management (IPM) is used to decrease the use of chemicals.	122	81.3
7	The microbial pesticides and plant extract pesticides should be used.	142	94.7
8	The registered products should be used to control the pests and diseases if it is necessary to use the agrochemicals.	148	98.7
9	Pre-harvest interval (PHI) of pesticides must be obeyed.	142	94.7
10	The farmers need to understand the ways of use of pesticide.	141	94.0
11	Pesticide buying, storage, usage and disposal must be done systematically and recorded.	87	58.0

Table (4.7) Practice Status of Respondents on Food Safety Module (n=150) (Continued)

No.	Particular	No. of Respondent	Percentage
12	Fuel, lubricant and another chemicals (which are not used for agriculture) should be used, stored and discarded to decrease the lowest toxicity to crops	119	79.3
13	Machines, tools and packaging materials must be cleaned.	139	92.7
14	The places for packaging and storage must be cleaned.	148	98.7
15	Suitable chemicals are selected to clean the storage area for the lowest damage to products.	144	96.0
16	Designated pesticides with designated dosage are used to control the storage pests during the storage period.	136	90.7
17	The instructions must be obeyed to prevent the storage pests during storage period for foreign countries which will import the products to get standardization of each country if there is export to foreign countries.	116	77.3
18	The machines used for transportation are checked to be free from toxic chemicals and pests and diseases of other products.	111	74.0
19	The farmers should attend basic training of integrated pest management (IPM).	100	67.1

Source: Survey data (2020)

Regarding the practice status of farmers on Food Safety Module, 94.7% (n=142) of farmers used the microbial pesticides and plant extract pesticides and they correctly obey the pre-harvest interval (PHI) pesticides. 98.7% (n=148) of farmers chose the registered products to control the pests and diseases and cleaned the places for packaging and storage. 92.0% (n=138) of farmers choose the soil that must be free from the chemical and biological toxicity.

88% (n=132) of farmers chose cultivated area must be free from the places built for hospital, livestock and rubbish from municipal. 90.7% (n= 136) of farmers used the water that should be free from the livestock, factories and avoided to use cast-off water from municipal area. 99.3% (n=149) of farmers selected good quality seeds that are free from pests and diseases. 48% (n=72) of farmers recorded the region from which seeds were received, quantity, date and seller. 81.3% (n=122) of growers cultivated the crops by using integrated pest management (IPM) to decrease the use of chemicals. 94% (n=141) of farmers used the pesticides systematically to control the pests in green gram cultivation.

58.0% (n= 87) of farmers recorded for pesticide buying, storage, usage and disposal systematically. 79.3% (n=119) of growers used fuel, lubricant and another chemicals (which are not used for agriculture), stored and discarded it to decrease the lowest toxicity to crops. 92.7% (n=139) of farmers cleaned the machines, tools and packaging materials used in farm. 96.0% (n=144) chose the chemicals to clean the storage area that should be the lowest damage to products.

90.7% (n=136) of farmers used the designated pesticides with designated dosage were used to control the storage pests during the storage period. 77.3 % (n=116) obey the instruction to control the storage pests for foreign countries which will import the products. 74.0% (n=111) of growers checked the machines used for transportation that are free from toxic chemicals and pests and diseases of other products. 67.1%55 (n=100) of farmers attended basic training of integrated pest management (IPM).

The economic access to a healthy diet is a key parameter indicated the overall status of a society and sufficient quantity of affordable, nutritious food as well as the aspects of food safety is the indicator of the status of agriculture sector and its efficiency. According to survey data, most of the farmers correctly used pesticides with pre-harvest interval when the crop was being harvested. The farmers selected the green gram cultivated soil free from hazardous area and they used the pesticides in storage period systematically. In agricultural transformation, to adopt the modern technologies and the best practices for farm-level transformation plays as crucial role for producing safe food.

A food safety hazard is anything in food and it can harm consumer's health. Biological hazards are living organisms such as bacteria, virus, mold and parasites that produce the toxins to be injurious to human health. Chemical hazards produced by industry are injurious to health and agrochemicals used by farmers to control the pests and diseases and to increase the plant growth and yield are hazardous to human health without having systematic ways in farm level. Therefore, Food Safety Module is very important in crop production by using GAP because most of harmful practices in on-farm and post-production processes are avoided for not being injurious to human health.

(b) Knowledge, Attitude and Practice Status of Respondents on Environmental Management Module

The knowledge, attitude and practice status of farmers on Environmental Management Module were assessed by using knowledge, attitude and practice questionnaire shown in Appendix. The questionnaire included 6 in each knowledge, attitude and practice assessment questions. The area specific knowledge, attitude and practice status of farmers were shown in the following:

(i) Knowledge Status of Respondents on Environmental Management Module

The area specific knowledge status of farmers on Environmental Management Module was shown in the table (4.8).

Table (4.8) Knowledge Status of Respondents on Environmental Management Module (n=150)

No.	Particular	No. of Respondent	Percentage
1	Three to five tons of natural fertilizer (humus) and green manure should be added yearly to increase physical and chemical properties soil.	150	100
2	Use of natural fertilizer (humus) and green manure increases physical properties of soil.	149	99.3
3	Disease free plants should be used if the remains of plants are used to do compost.	149	99.3
4	Crop cultivation concerning land use is recorded.	132	88.0
5	Mixing and storage of fertilizer or soil additives and place of decomposition of organic matter should be free from contamination to soil and water.	144	96.0
6	The region from which fertilizer or soil additives are received, amount, date and seller must be recorded.	135	90.0

Source: Survey data (2020)

Regarding the knowledge status of respondents on Environmental Management Module, 100% (n=150) of respondents knew that three to five tons of natural fertilizer (humus) and green manure should be added yearly to increase physical and chemical properties soil. 99.3% (n=149) of farmers understand the use of natural fertilizer (humus) and green manure increases physical properties of soil and disease free plants should be used if the remains of plants are used to do compost.

88.0% (n=132) of farmers recorded crop cultivation concerning land use. 96.0% (n=144) of growers knew mixing and storage of fertilizer or soil additives, place of decomposition of organic matter should be free from contamination to soil and water. 90.0% (n=135) of growers also recorded the region from which fertilizer or soil additives are received, amount, date and seller.

(ii) Attitude Status of Respondents on Environmental Management Module

The attitude questionnaire of Environmental Management Module included 6 attitude assessment questions with five level of attitude with a neutral point in the middle. The mean value to assess the attitude of respondents was shown in the table (4.5).

The area specific attitude status of farmers on Environmental Management Module was shown in the table (4.9).

Table (4.9) Attitude Status of Respondents on Environmental Management Module (n=150)

No.	Particular	Mean	Standard Deviation (SD)	Level
1	Three to five tons of natural fertilizer (humus) and green manure should be added yearly to increase physical and chemical properties soil.	1.70	0.66	Strongly Agree
2	Use of natural fertilizer (humus) and green manure increases physical properties of soil.	1.55	0.57	Strongly Agree
3	Disease free plants should be used if the remains of plants are used to do compost.	1.60	0.60	Strongly Agree
4	Crop cultivation concerning land use is recorded.	2.04	0.73	Agree
5	Mixing and storage of fertilizer or soil additives and place of decomposition of organic matter should be free from contami-nation to soil and water.	1.74	0.58	Strongly Agree
6	The region from which fertilizer or soil additives are received, amount, date and seller must be recorded.	2.01	0.76	Agree

Source: Survey data (2020)

In terms of mean value based on survey data, the respondents revealed positive attitude in terms of strongly agree (Mean value =1.70) on three to five tons of natural fertilizer (humus) and green manure should be added yearly to increase physical and chemical properties soil and standard deviation was 0.66. The respondents affirmed positive attitude in terms of strongly agree (Mean value =1.55) on use of natural fertilizer (humus) and green manure increases physical properties of soil and standard deviation was 0.57. The respondents manifested positive attitude in terms of strongly agree (Mean value =1.60) on disease free plants should be used if the remains of plants are used to do compost and standard deviation was 0.60. The respondents declared positive attitude in terms of agree (Mean value =2.04) on crop cultivation concerning land use is recorded and standard deviation was 0.73. The respondents revealed positive attitude in terms of strongly agree (Mean value =1.74) on mixing and storage of fertilizer or soil additives and place of decomposition of organic matter should be free from contamination to soil and water and standard deviation was 0.58. The respondents manifested positive attitude in terms of agree (Mean value =2.01) on the region from which fertilizer or soil additives are received, amount, date and seller must be recorded and standard deviation was 0.76.

(iii) Practice Status of Respondents on Environmental Management Module

The area specific practice status of farmers on Environmental Management Module was shown in the table (4.10).

Table (4.10) Practice Status of Respondents on Environmental Management Module (n=150)

No.	Particular	No. of Respondent	Percentage
1	Three to five tons of natural fertilizer (humus) and green manure should be added yearly to increase physical and chemical properties soil.	116	77.3
2	Use of natural fertilizer (humus) and green manure increases physical properties of soil.	125	83.3
3	Disease free plants should be used if the remains of plants are used to do compost.	138	92.0
4	Crop cultivation concerning land use is recorded.	88	58.7
5	Mixing and storage of fertilizer or soil additives and place of decomposition of organic matter should be free from contamination to soil and water.	121	80.7
6	The region from which fertilizer or soil additives are received, amount, date and seller must be recorded.	82	54.7

Source: Survey data (2020)

Regarding the practice status of respondents on Environmental Management Module, 77.3 % (n=116) of farmers added three to five tons of natural fertilizer (humus) and green manure yearly to increase physical and chemical properties soil.83.3 % (n=125) of growers used of natural fertilizer (humus) and green manure increases physical properties of soil. 92.0 % (n= 138) of farmers used disease free plants if the remains of plants are used to do compost. 58.7% (n=88) recorded crop cultivation concerning land use. 80.7% (n=121) did mixing and storage fertilizers or soil additives and place of decomposition of organic matter are free from contamination to soil and water. 54.7 % (n=82) of farmers recorded region from which fertilizer or soil additives are received, amount, date and seller.

Modern agriculture significantly affects the sustainable exploitation of natural resources being a major factor for environmental degradation such as pollution, soil and water degradation etc. Environmental management means that management of the activities and behavior of individuals for preservation and improvement of natural environment such as soil, water, biodiversity etc. Agriculture relies as a serious burden on the environment being process of providing food and fibres for humanity. It is the largest consumer of surface water and ground water and nutrients in the soil. Nowadays, most farmers use the chemical fertilizers and soil additives to increase the yield of crops grown because inadequate amount of nutrients in the soil can't help to increase the yield.

The use of chemical fertilizers and soil additives in crop production helps not only to increase the crop yield but also to be soil and water degradation when it is not being used in appropriate and systematic ways. According to survey data, most of farmers use the natural fertilizers and green manures in green gram production and it can cause not only increasing yield but also reducing the soil degradation. The use of natural fertilizers (humus) and green manures in GAP helps soil conservation in nature. Most of farmers use the chemical fertilizers in systematic ways for plant growth and development. It helps to increase yield in crop production and it cannot be degradable to the soil and water when using it with appropriate dosage.

(c) Knowledge, Attitude and Practice Status of Respondents on Produce Quality Module

The knowledge, attitude and practice status of farmers on Produce Quality Module were assessed by using knowledge, attitude and practice questionnaire shown in Appendix. The questionnaire included 21 in each knowledge, attitude and practice assessment questions. The area specific knowledge, attitude and practice status of farmers were shown in the following:

(i) Knowledge Status of Respondents on Produce Quality Module

The area specific knowledge status of farmers on Produce Quality Module was shown in the table (4.11).

Table (4.11) Knowledge Status of Respondents on Produce Quality Module (n=150)

No.	Particular	No. of Respondent	Percentage
1	Soil pH is 6.5 to 7.5 to grow green gram.	141	94.0
2	The water is tested in laboratory which is suitable for green gram cultivation	140	93.3
3	Seed rate of one acre should be 4-6 pyi in raining season and 6-8 pyi in winter season.	150	100
4	Plant spacing (18 inch x 4 inch) and plant population (85000) of green gram should be used per acre in raining season, plant spacing (12 inch x 4 inch) and plant population (130000 plants) should be in used per acre in winter season.	149	99.3
5	Bean after bean cultivation must be avoided.	150	100
6	Twenty pyi of fertilizer containing five percent of sulphur nutrient in green gram growing time and foliar fertilizer can be used.	140	93.3
7	75 to 85 percent of ripening pods should be harvested.	150	100
8	Late harvesting and pre-harvesting before ripening time should be avoided in green gram production.	149	100
9	Winnowing and drying process of green gram seeds should be done on concrete floor and ground sheet.	150	100
10	Agrochemical and other dangerous chemical bags are avoided for packaging and storing green gram.	147	98.0

Table (4.11) Knowledge Status of Respondents on Produce Quality Module (n=150) (Continued)

No.	Particular	No. of Respondent	Percentage
11	Green gram should be stored systematically by using super bags, airtight bags and bucket made with iron.	149	99.3
12	Green gram bags were transported and stored in warehouse separately form chemical, biological and physical toxic products.	143	95.3
13	Buildings are constructed away from humus storage area, livestock area and animal feed storage area.	149	99.3
14	Bamboo floor or floor board are used to prevent the green gram bags from direct contact to floor or wall of warehouse.	150	100
15	Warehouse is prepared in good aeration and to prevent mouse, birds and other pests.	150	100
16	Insect pests are being prevented around the storage area.	150	100
17	The records concerning GAP are stored at least two years.	129	86.0
18	The current production procedure is recorded in designated form.	135	90.0
19	The distinct logo and registered logo on green gram packaging were made to recheck the production site	125	83.3
20	Transported places, amount and date of transportation for green gram are recorded.	123	82
21	Technical team concludes either farmers correctly use GAP or they did not use GAP in farm at least one time per production season. Conclusion and operating procedures are recorded.	138	92

Source: Survey data (2020)

Regarding the knowledge status of respondents on Produce Quality Module, 100% (n=150) of farmers knew that seed rate of one acre should be 4-6 pyi in raining season and 6-8 pyi in winter season, bean after bean cultivation must not be done, 75 to 85 percent of ripening pods should be harvested, late harvesting and pre-harvesting before ripening time should be avoided in green gram production. Winnowing and drying process of green gram seeds should be done on concrete floor and ground sheet. Bamboo floor or floor board were used to prevent the green gram bags from direct contact to floor or wall of warehouse. Warehouse should be prepared in good aeration and to prevent mouse, birds and other pests. Farmers should manage to prevent the insect pests around the storage area.

93% (n=140) growers knew to test the water in laboratory which is available for green gram cultivation and twenty pyi of fertilizer containing five percent of sulphur nutrient in green gram growing time and foliar fertilizer can be used. 99.3% (n=149) knew plant spacing18 inch x 4 inch and plant population of green gram should be 85000 plants per acre in raining season, plant spacing (12 inch x 4 inch) and plant population (130000 plants) should be in used in winter season. They should use super bags, airtight bags and bucket made with iron to store green gram. Buildings should be away from humus storage area, livestock area and animal feed storage area. 94.0% (n=141) of growers knew that soil pH was 6.5 to 7.5 to be adaptable for green gram cultivation. 98.0% (n=147) of farmers avoided agrochemical and other dangerous chemical bags for packaging and storing green gram.

95.3% (n=143) of farmers knew green gram bags were transported and stored in warehouse separately form chemical, biological and physical toxic products. 86.0% (n=129) of growers stored the records concerning GAP at least two years. 90.0% (n=135) of farmers recorded current production procedure in designated form. 83.3% (n=125) of growers knew that distinct logo and registered logo on green gram packaging were made to recheck the production site. 82% (n=123) of farmers recorded transported places, amount and date of transportation for green gram and 92% (n=138) of growers knew that technical team concludes either farmer correctly use GAP or they did not use GAP in farm at least one time per production season. Conclusion and operating procedures are able to record.

(ii) Attitude Status of Respondents on Produce Quality Module

The attitude questionnaire of Environmental Produce Quality Module included 21 attitude assessment questions with five level of attitude with a neutral point in the middle. The mean value to assess the attitude of respondents was shown in the table (4.5).

The area specific attitude status of farmers on Produce Quality Module was shown in the table (4.12).

Table (4.12) Attitude Status of Respondents on Produce Quality Module (n=150)

No.	Particular	Mean	Standard Deviation (SD)	Level
1	Soil pH is 6.5 to 7.5 to grow green gram.	1.70	0.68	Strongly Agree
2	The water is tested in laboratory which is suitable for green gram cultivation	1.83	0.76	Agree
3	Seed rate of one acre should be 4-6 pyi in raining season and 6-8 pyi in winter season.	1.64	0.55	Strongly Agree
4	Plant spacing (18 inch x 4 inch) and plant population (85000) of green gram should be used per acre in raining season, plant spacing (12 inch x 4 inch) and plant population (130000 plants) should be in used per acre in winter season.	1.70	0.72	Strongly Agree
5	Bean after bean cultivation must be avoided.	1.48	0.57	Strongly Agree
6	Twenty pyi of fertilizer containing five percent of sulphur nutrient in green gram growing time and foliar fertilizer can be used.	1.83	0.70	Agree
7	75 to 85 percent of ripening pods should be harvested.	1.64	0.66	Strongly Agree
8	Late harvesting and pre-harvesting before ripening time should be avoided in green gram production.	1.61	0.56	Strongly Agree
9	Winnowing and drying process of green gram seeds should be done on concrete floor and ground sheet.	1.59	0.56	Strongly Agree

Table (4.12) Attitude Status of Respondents on Produce Quality Module (n=150) (Continued)

No.	Particular	Mean	Standard Deviation (SD)	Level
10	Agrochemical and other dangerous chemical bags are avoided for packaging and storing green gram.	1.71	0.56	Strongly Agree
11	Green gram should be stored systematically by using super bags, airtight bags and bucket made with iron.	1.65	0.60	Strongly Agree
12	Green gram bags were transported and stored in warehouse separately form chemical, biological and physical toxic products.	1.72	0.54	Strongly Agree
13	Buildings are constructed away from humus storage area, livestock area and animal feed storage area.	1.67	0.50	Strongly Agree
14	Bamboo floor or floor board are used to prevent the green gram bags from direct contact to floor or wall of warehouse.	1.63	0.49	Strongly Agree
15	Warehouse is prepared in good aeration and to prevent mouse, birds and other pests.	1.60	0.49	Strongly Agree
16	Insect pests are being prevented around the storage area.	1.67	0.53	Strongly Agree
17	The records concerning GAP are stored at least two years.	1.70	0.74	Strongly Agree
18	The current production procedure is recorded in designated form.	1.89	0.71	Agree
19	The distinct logo and registered logo on green gram packaging were made to recheck the production site	2.07	0.75	Agree
20	Transported places, amount and date of transportation for green gram are recorded.	2.01	0.61	Agree
21	Technical team concludes either farmers correctly use GAP or they did not use GAP in farm at least one time per production season. Conclusion and operating procedures are recorded.	1.00	0.55	Strongly Agree

Source: Survey data (2020)

In terms of mean value based on the survey data, the respondents revealed good attitude in terms of strongly agree (Mean value =1.70) on soil pH is 6.5 to 7.5 to grow green gram and standard deviation was 0.68. The respondents affirmed good attitude in terms of agree (Mean value =1.83) on the water is tested in laboratory which is suitable for green gram cultivation and standard deviation was 0.76. The respondents manifested good attitude in terms of strongly agree (Mean value =1.64) on seed rate of one acre should be 4-6 pyi in raining season and 6-8 pyi in winter season and standard deviation was 0.55. The respondents revealed good attitude in terms of strongly agree (Mean value =1.70) on plant spacing (18 inch x 4 inch) and plant population (85000) of green gram should be used per acre in raining season, plant spacing (12 inch x 4 inch) and plant population (130000 plants) should be in used per acre in winter season and standard deviation was 0.72.

The respondents affirmed good attitude in terms of strongly agree (Mean value =1.48) on bean after bean cultivation must be avoided and standard deviation was 0.57. The respondents revealed good attitude in terms of agree (Mean value =1.83) on twenty pyi of fertilizer containing five percent of sulphur nutrient in green gram growing time and foliar fertilizer can be used and standard deviation was 0.70. The respondents declared good attitude in terms of strongly agree (Mean value =1.64) on 75 to 85 percent of ripening pods should be harvested and standard deviation was 0.66. The respondents revealed good attitude in terms of strongly agree (Mean value =1.61) on late harvesting and pre-harvesting before ripening time should be avoided in green gram production and standard deviation was 0.56. The respondents manifested good attitude in terms of strongly agree (Mean value =1.59) on winnowing and drying process of green gram seeds should be done on concrete floor and ground sheet and standard deviation was 0.56. The respondents affirmed good attitude in terms of strongly agree (Mean value =1.71) on agrochemical and other dangerous chemical bags are avoided for packaging and storing green gram and standard deviation was 0.56.

The respondents revealed good attitude in terms of strongly agree (Mean value =1.65) on green gram should be stored systematically by using super bags, airtight bags and bucket made with iron and standard deviation was 0.60. The respondents affirmed good attitude in terms of strongly agree (Mean value =1.72) on green gram bags were transported and stored in warehouse separately form chemical, biological and physical toxic products and standard deviation was 0.54. The respondents showed good attitude in terms of strongly agree (Mean value =1.67) on buildings are constructed away from humus storage area, livestock area and animal feed storage area and standard deviation was 0.50. The respondents manifested good attitude in terms of strongly agree (Mean value =1.63) on bamboo floor or floor board are used to prevent the green gram bags from direct contact to floor or wall of warehouse and standard deviation was 0.49. The respondents affirmed good attitude in terms of strongly agree (Mean value =1.60) on warehouse is prepared in good aeration and to prevent mouse, birds and other pests and standard deviation was 0.49.

The respondents revealed good attitude in terms of strongly agree (Mean value =1.67) on insect pests are being prevented around the storage area and standard deviation was 0.53. The respondents showed good attitude in terms of strongly agree (Mean value =1.70) on the records concerning GAP are stored at least two years and standard deviation was 0.74. The respondents revealed good attitude in terms of agree (Mean value =1.89) on the current production procedure is recorded in designated form and standard deviation was 0.71. The respondents manifested good attitude in terms of agree (Mean value =2.07) on the distinct logo and registered logo on green gram packaging were made to recheck the production site and standard deviation was 0.75. The respondents affirmed good attitude in terms of agree (Mean value =2.01) on transported places, amount and date of transportation for green gram are recorded and standard deviation was 0.61. The respondents revealed good attitude in terms strongly of agree (Mean value =1.00) on Technical team concludes either farmers correctly use GAP or they did not use GAP in farm at least one time per production season. Conclusion and operating procedures are recorded and standard deviation was 0.55.

(iii) Practice Status of Respondents on Produce Quality Module

The area specific practice status of farmers on Produce Quality Module was shown in the table (4.13).

Table (4.13) Practice Status of Respondents on Produce Quality Module (n=150)

No.	Particular	No. of Respondent	Percentage
1	Soil pH is 6.5 to 7.5 to grow green gram.	117	78.0
2	The water is tested in laboratory which is suitable for green gram cultivation	86	57.3
3	Seed rate of one acre should be 4-6 pyi in raining season and 6-8 pyi in winter season.	147	98.0
4	Plant spacing (18 inch x 4 inch) and plant population (85000) of green gram should be used per acre in raining season, plant spacing (12 inch x 4 inch) and plant population (130000 plants) should be in used per acre in winter season.	132	88.0
5	Bean after bean cultivation must be avoided.	149	99.3
6	Twenty pyi of fertilizer containing five percent of sulphur nutrient in green gram growing time and foliar fertilizer can be used.	112	74.7
7	75 to 85 percent of ripening pods should be harvested.	140	93.3
8	Late harvesting and pre-harvesting before ripening time should be avoided in green gram production.	148	98.7
9	Winnowing and drying process of green gram seeds should be done on concrete floor and ground sheet.	150	100
10	Agrochemical and other dangerous chemical bags are avoided for packaging and storing green gram.	145	96.7

Table (4.13) Practice Status of Respondents on Produce Quality Module (n=150) (Continued)

No.	Particular	No. of Respondent	Percentage
11	Green gram should be stored systematically by using super bags, airtight bags and bucket made with iron.	136	90.7
12	Green gram bags were transported and stored in warehouse separately form chemical, biological and physical toxic products.	129	86.0
13	Buildings are constructed away from humus storage area, livestock area and animal feed storage area.	126	84.0
14	Bamboo floor or floor board are used to prevent the green gram bags from direct contact to floor or wall of warehouse.	145	96.7
15	Warehouse is prepared in good aeration and to prevent mouse, birds and other pests.	147	98.0
16	Insect pests are being prevented around the storage area.	149	99.3
17	The records concerning GAP are stored at least two years.	90	60.4
18	The current production procedure is recorded in designated form.	95	63.3
19	The distinct logo and registered logo on green gram packaging were made to recheck the production site	83	55.3
20	Transported places, amount and date of transportation for green gram are recorded.	78	52.0
21	Technical team concludes either farmer correctly use GAP or they did not use GAP in farm at least one time per production season. Conclusion and operating procedures are recorded.	82	54.7

Source: Survey data (2020)

Regarding the practice status of farmers in Product Quality Module, 98.0% (n=147) of farmers farmers grew seed rate of one acre should be 4-6 pyi in raining season and 6-8 pyi in winter season, Warehouse had been prepared in good aeration and prevented mouse, birds and other pests. 99.3% (n=149) did not cultivated bean after bean in green gram production and they managed to prevent the insect pests around the storage area. 78% (n=117) of farmers grew green gram in adaptable soil for green gram cultivation.

57.3% (n=86) of growers tested the water in laboratory which is available for green gram cultivation.88.0% (132) of farmers grew green gram with plant spacing18 inch x 4 inch and 85000 plants per acre in raining season. They cultivate green gram with plant spacing (12 inch x 4 inch) and plant population (130000 plants) was completed in green gram cultivation in winter season.

74.7% (n=112) of green gram growers used foliar fertilizer containing sulphur nutrient in green gram growing season. 93.3(n=140) of farmers harvested 75 to 85 percent of ripening pods should be harvested green gram when 75 to 85 percent of pods were ripe in the plant. 98.7%(n=148) of growers avoided late harvesting and pre-harvesting before ripening time in green gram production and 100% (n=150) of green growers did the winnowing and drying process of green gram seeds on concrete floor and ground sheet.

96.7% (n=145) of farmers avoided agrochemical and other dangerous chemical bags for packaging and storing green gram. 90.7% (n=136) of farmers used super bags, airtight bags and bucket made with iron. 86.0% (n=129) of farmers transported and stored green gram in warehouse separately form chemical, biological and physical toxic products. 84.0% (n=126) of growers constructed the buildings away from humus storage area, livestock area and feed storage area. 96.7% (n=145) farmers stored green gram by using bamboo floor or floor board to prevent the green gram bags from direct contact to floor or wall.

60.4% (n=90) of farmers stored the records concerning GAP at least two years and 63.3% (n=95) of growers recorded current production procedure in designated form. 55.3% (n=83) of growers made distinct logo on green gram packaging to recheck the production site. 52.0% (n=78) of farmers recorded transported places, amount and date of transportation for green gram and 54.7% (n=82) of growers practice that technical team concluded either farmer correctly use GAP or they did not use GAP in farm at least one time per production season. Conclusion and operating procedures had been recorded.

The economic thinking about the role of agriculture for development has evolved in several years. In economic development, modern technology and practices used to get high quality and high yield instead of being used traditional ways is a part of agricultural transformation. In the developing countries, the major constraint of agricultural performance is resource endowment and technological availability in production and post-harvest process. In the production process, not only high yield but also good quality of product is crucial to get higher income for farmers.

According to survey data in Produce quality Module, most of famers used GAP guidelines in green gram production to get high quality product. In survey area, increase in green gram yield was found and price of green gram produced by GAP is higher than price of green gram produced by traditional ways in the market. Farmers knew that adopting GAP in green gram production can result high yield, high quality and higher income for their family. The higher income for farmers can create well-being of their daily life.

(d) Knowledge, Attitude and Practice Status of Respondents on Worker Health, Safety and Welfare Module

The knowledge, attitude and practice status of farmers on Worker health, Safety and Welfare Module were assessed by using knowledge, attitude and practice questionnaire shown in Appendix. The questionnaire included 5 in each knowledge, attitude and practice assessment questions. The area specific knowledge, attitude and practice status of farmers were shown in the following:

(i) Knowledge Status of Respondents on Worker health, Safety and Welfare Module

The area specific knowledge status of farmers on Worker health, Safety and Welfare Module was shown in the table (4.14).

Table (4.14) Knowledge Status of Respondents on Worker health, Safety and Welfare Module (n=150)

No.	Particular	No. of Respondent	Percentage
1	The rules of pesticide application are written and announced for worker' safety.	143	95.3
2	The instructions for hygiene are distributed among the workers.	143	95.3
3	The cast-off waste and lavatorial water must be abandoned carefully.	142	94.7
4	Worker's health and social welfare are performed.	140	93.3
5	Organization for social welfare and bookish meeting should be performed.	134	89.3

Source: Survey data (2020)

Regarding the knowledge status of respondents on Worker health, Safety and Welfare Module, 95.3% (n=143) of growers knew that rules of pesticide application have been written and announced for worker' safety and instructions for hygiene are distributed among the workers. 94.7% (n=142) of respondents knew that cast-off waste and lavatorial water must be abandoned carefully. 93.3% (n=140) of respondents performed worker's health and social welfare in their farm and 89.3% (n=134) of farmers knew that organization for social welfare and bookish meeting should be performed.

(ii) Attitude Status of Respondents on Worker health, Safety and Welfare Module

The attitude questionnaire of Worker health, Safety and Welfare Module included 5 attitude assessment questions with five level of attitude with a neutral point in the middle. The mean value to assess the attitude of respondents was shown in the table (4.5).

The area specific attitude status of farmers on Worker health, Safety and Welfare Module were shown in the table (4.15).

Table (4.15) Attitude Status of Respondents on Worker health, Safety and Welfare Module (n=150)

No.	Particular	Mean	Standard Deviation (SD)	Level
1	The rules of pesticide application are written and announced for worker' safety.	1.67	0.53	Strongly Agree
2	The instructions for hygiene are distributed among the workers.	1.65	0.53	Strongly Agree
3	The cast-off waste and lavatorial water must be abandoned carefully.	1.63	0.50	Strongly Agree
4	Worker's health and social welfare are performed.	1.60	0.53	Strongly Agree
5	Organization for social welfare and bookish meeting should be performed.	1.69	0.55	Strongly Agree

Source: Survey data (2020)

In terms of mean value based on the survey data, the respondents revealed positive attitude in terms of strongly agree (Mean value =1.67) on the rules of pesticide application are written and announced for worker' safety and standard deviation was 0.53. The respondents showed positive attitude in terms of strongly agree (Mean value =1.65) on the instructions for hygiene are distributed among the workers and standard deviation was 0.53. The respondents manifested positive attitude in terms of strongly agree (Mean value =1.63) on the cast-off waste and lavatorial water must be abandoned carefully and standard deviation was 0.50. The respondents affirmed positive attitude in terms of strongly agree (Mean value =1.60) on worker's health and social welfare are performed and standard deviation was 0.53. The respondents declared positive attitude in terms of strongly agree (Mean value =1.69) on organization for social welfare and bookish meeting should be performed and standard deviation was 0.55.

(iii) Practice Status of Respondents on Worker health, Safety and Welfare Module

The area specific practice status of farmers on Worker health, Safety and Welfare Module was shown in the table (4.16).

Table (4.16) Practice Status of Respondents on Worker health, Safety and Welfare Module (n=150)

No.	Particular	No. of Respondent	Percentage
1	The rules of pesticide application are written and announced for worker' safety.	121	80.7
2	The instructions for hygiene are distributed among the workers.	121	80.7
3	The cast-off waste and lavatorial water must be abandoned carefully.	137	91.3
4	Worker's health and social welfare are performed.	134	89.3
5	Organization for social welfare and bookish meeting should be performed.	85	56.7

Source: Survey data (2020)

Regarding the practice status of respondents on Worker health, Safety and Welfare Module, 80.7% (n=121) of growers wrote rules of pesticide application and announced it for worker' safety and they distributed instructions for hygiene among the workers. 91.3% (n=137) of respondents abandoned cast-off waste and lavatorial water carefully. 89.3% (n=134) of respondents performed worker's health and social welfare in their farm and 56.7% (n=85) of farmers performed organization for social welfare and bookish meeting in their farm.

Sustainable development involves sustainable agriculture and rural development. Sustainable agriculture involves economic, social and environmental issues that are three pillars of development. Agricultural workers have much to contribute to sustainable agriculture and food security in terms of knowledge, skills and experience. Crop production involves many tasks, requiring machines, many types of hazards for those farm labours work and live on the farm. Therefore, the particular circumstances and environment of farms need to be considered when managing the worker's health, safety and welfare in crop production and post-production processes. According to survey data of this module, majority of farmers announced the pesticides application rules to avoid the hazards of chemicals to farm labours and also worker' health and social welfare was performed in green gram production.

(e) Knowledge, Attitude and Practice Status of Respondents on GAP

Knowledge, attitude and practice status of farmers on GAP in green gram cultivation was shown in table (4.17)

Table (4.17) Knowledge, Attitude and Practice Level of farmers on GAP

No.	Module	Knowledge Level (Percent)	Attitude Level (Mean Value)	Practice Level (Percent)
1	Food Safety Module	97	2	85
2	Environmental Management Module	95	1.8	74
3	Produce Quality Module	95	1.7	82
4	Worker Health, Safety and Welfare Module	94	1.6	80
Average		95	2	80

Regarding the knowledge, attitude and practice status of farmers on GAP in green gram cultivation, average 95 percent of farmers have knowledge on GAP and average 80 percent of farmers follow the practice of GAP. According to the mean value and attitude status assessment, mean value 2 means that the farmers have positive attitude on GAP in green gram production.

4.3.3 Incentives and Disincentives for Farmers to Adopt GAP

The incentives for growers adopting GAP can be divided into economic incentives, regulatory/legal incentives and human capital incentives. The disincentives for farmers to adopt GAPs include economic disincentives, institutional infrastructure constraints and human capital constraints.

4.3.3 (a) Incentives for Respondents to adopt GAP

The economic incentives, regulatory or institutional incentives and human capital incentives for farmers who are adopting GAP were described in the following.

Table (4.18) Economic Incentives for Respondents to adopt GAP (n=75)

No.	Particular	No. of Respondent	Percentage
1	Price premium	75	100.0
2	Access to market	74	98.7
3	Access to reliable inputs	74	98.7
4	Product differentiation	65	86.7
5	Stabilizing yield	73	97.3
6	Reducing storage losses	72	96.0
7	Reducing wastage	74	98.7
8	Protection against market externalities	70	93.3
9	Reducing monitoring costs	65	86.7
10	Social capital	66	88.0

Source: Survey data (2020)

Regarding the economic knowledge status of farmers who are growing green gram by using GAP system on incentive to adopt GAP, 98.7% (n=74) of farmers have access to market for their products, access to reliable inputs for green gram cultivation and wastes are reduced in the whole crop growing season. 86.7% (n=65) of growers seem product differentiation and reduce monitoring costs as incentive for adopting GAP. 100% (n=75) of green gram growers received the premium price for product.

97.3% (n=73) of farmers accept stabilizing yield in green gram production. 96.0% (n=72) of farmers reduced the losses during the storage time, 93.3% (n=70) of farmers accept that negative externalities are protected in the market (i.e. bad quality, unclean product etc.). 88% (n=66) of farmers shared knowledges about the GAP among the green gram growers. Therefore, all of farmers wanted increase in yield and higher price for product to adopt new cultivation system.

Table (4.19) Regulatory or Institutional Incentives for Respondents to Adopt GAP (n=75)

No.	Particular	No. of Respondent	Percentage
1	Subsidies	69	92.0
2	Third party monitoring	53	70.7

Source: Survey data (2020)

Regarding regulatory or institutional knowledge status of farmers who are growing green gram by using GAP system on incentive to adopt GAP, 92.0% (n=69) of farmers have subsidies from Department of Agriculture in mobilization to grow the green gram with GAP. 70.7% (n=53) of farmers accepted third party monitoring as incentive to get recommendation for GAP.

Table (4.20) Human Capital Incentives for Respondents to Adopt GAP (n=75)

No.	Particular	No. of Respondent	Percentage
1	Expanding skill set	75	100

Source: Survey data (2020)

Regarding human capital knowledge status of farmers who are growing green gram by using GAP system on incentive to adopt GAP, 100% (n=75) of growers had expanded skill set in crop production.

4.3.3 (b) Disincentives for Respondents to adopt GAP

The economic disincentives, regulatory or institutional disincentives and human capital disincentives for farmers who are adopting GAP were described in the following.

Table (4.21) Economic Disincentives for Respondents to Adopt GAP (n=75)

No.	Particular	No. of Respondent	Percentage
1	Increase variable production costs (e.g. labour)	37	49
2	Increase fixed production costs (e.g. equipment)	48	64

Source: Survey data (2020)

Regarding economic knowledge status of farmers who grew green gram with GAP on disincentive to adopt GAP, all of farmers (n=75) revealed decrease in yield as disincentive to adopt GAP. 49% (n=37) of growers did not like increase in variable production costs (eg. labour) and 64% (n=48) of growers seemed increase in fixed production costs (eg. equipment) as disincentive to adopt GAP.

Table (4.22) Regulatory or Institutional Disincentives for Respondents to Adopt GAP (n=75)

No.	Particular	No. of Respondent	Percentage
1	Reliance on institutional infrastructure	24	32

Source: Survey data (2020)

Regarding regulatory or institutional knowledge status of farmers who grew green gram with GAP on disincentive to adopt GAP, 32% (n=24) of growers accepted reliance on institution as disincentive to adopt GAP.

Table (4.23) Human Capital Disincentives for Respondents to Adopt GAP (n=75)

No.	Particular	No. of Respondent	Percentage
1	Record-keeping (literacy)	27	36

Source: Survey data (2020)

Regarding regulatory or institutional knowledge status of farmers who grew green gram with GAP on disincentive to adopt GAP, 36% (n= 27) of growers assumed that that record-keeping is disincentive to adopt GAP.

CHAPTER V
CONCLUSION

5.1 Findings

The basic concept of Good Agricultural Practices (GAP) is the application of suitable techniques on-farm and post-production in agriculture regarding food production and security, food safety and quality, and the environmental sustainability of agriculture.

In a GAP approach, appropriate use of pesticides and chemical fertilizers is recommended, suitable post-harvest techniques and hygiene standards of agrochemicals all of which are socially acceptable and economically affordable.
Myanmar GAP was designed from ASEAN GAP to prevent or minimize the risk of hazards occurring in current agriculture sector. For promoting GAP among the green gram growers in Myanmar, what difficulties the farmers are facing from adopting GAP and to what extent the farmers are correctly adopting GAP in green gram production.

In Food Safety Module, 94.7% of farmers used the microbial pesticides and plant extract pesticides and they correctly obey the pre-harvest interval (PHI) pesticides. 98.7% of farmers chose the registered products to control the pests and diseases and cleaned the places for packaging and storage. 92.0% of farmers choose the soil that must be free from the chemical and biological toxicity. 99.3% of farmers selected good quality seeds that are free from pests and diseases. 48% of farmers recorded the region from which seeds were received, quantity, date and seller. 81.3% of growers cultivated the crops by using integrated pest management (IPM) to decrease the use of chemicals. 94% of farmers used the pesticides systematically to control the pests in green gram cultivation.

58.0% of farmers recorded for pesticide buying, storage, usage and disposal systematically. 90.7% of farmers used the designated pesticides with designated dosage were used to control the storage pests during the storage period. 74.0% of growers checked the machines used for transportation that are free from toxic chemicals and pests and diseases of other products. 67.1.% of farmers attended basic training of integrated pest management (IPM). In this study, 58.0% of farmers can record for pesticide buying, storage, usage and disposal systematically. The record-keeping is very important in adopting GAP in green gram production because monitoring team from Department of Agriculture checks the records from farmers using GAP and recommends the products produced by GAP.

In Environmental Management Module, 83.3% of growers used of natural fertilizer (humus) and green manure increases physical properties of soil. 92.0% of farmers used disease free plants if the remains of plants are used to do compost. 58.7% recorded crop cultivation concerning land use. 80.7% did mixing and storage fertilizers or soil additives, place of decomposition of organic matter are free from contamination to soil and water. 54.7% of farmers recorded region from which fertilizer or soil additives are received, amount, date and seller. In this module, half of the farmers can't record crop cultivation and chemical fertilizers amount, date and seller of it. Therefore, record-keeping is very important to check what fertilizers farmers used in green gram production by using GAP.

In Product Quality Module, 93.3 % of farmers harvested 75 to 85 percent of ripening pods should be harvested green gram when 75 to 85 percent of pods were ripe in the plant. 98.7% of growers avoided late harvesting and pre-harvesting before ripening time in green gram production and 100% of green growers did the winnowing and drying process of green gram seeds on concrete floor and ground sheet. 96.7% of farmers avoided agrochemical and other dangerous chemical bags for packaging and storing green gram. 63.3% of growers recorded current production procedure in designated form. 55.3% of growers made distinct logo on green gram packaging to recheck the production site.

52.0% of farmers recorded transported places, amount and date of transportation for green gram an 54.7% of growers practise that technical team concluded either farmer correctly use GAP or they did not use GAP in farm at least one time per production season. Conclusion and operating procedures had been recorded. In this module, half of the farmers did not practise to check to what extent adopting GAP guidelines and they did not recorded transportation procedure of product.

In Worker's health, Safety and social welfare Module, 80.7% of growers wrote rules of pesticide application and announced it for worker' safety and they distributed instructions for self- cleaning among the workers. 89.3% of respondents performed worker's health and social welfare in their farm and 56.7% of farmers performed organization for social welfare and bookish meeting in their farm.

In this study, 92.0% (n=69) of farmers received subsidies from Department of Agriculture in mobilization to grow the green gram with GAP. 86.7% (n=65) of growers thought product differentiation and reduce monitoring costs as incentive for adopting GAP. 88% (n=66) of farmers shared knowledge about the GAP among the green gram growers.

5.2 Suggestions

Based on the finding of this study, the following suggestions are made to improve the GAP system correctly adopted in green gram production. Record-keeping was found to be not enough to complete GAP guidelines in green gram production. Record-keeping may know to what extent the growers are adopting GAP guidelines and it is crucial in GAP used in crop production to get GAP recommendation of product. Basic training of Integrated Pest Management (IPM) is essential in GAP system to decrease the use of agrochemicals in production area. Third party monitoring should be performed in every year to conclude actual condition in adopting GAP.

The government should provide the subsidies like seeds, fertilizers and other inputs to green gram growers to be extendable the growing area of green gram by using GAP in long term production. The market policy for GAP products should be implemented in local market to be available higher price for growers. Department of Agriculture supports monitoring process of GAP for green gram growers to be free of charge in two years implementation period. After finishing implementation period, the government should support low cost of monitoring process to green gram growers. Knowledge sharing of GAP among the green gram growers should be encouraged to extend the adopting GAP in crop production.

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APPENDIX

QUESTIONNAIRES FOR KNOWLEDGE, ATTITUDE AND PRACTICE ON ADOPTING GAP

Yangon University of Economics

Part 1: Characteristics of Respondents

1. **How old are you?**

------------------ years old.

2. **Gender**

☐ **Male** ☐ **Female**

3. **How many acres are growing?**

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4. **How many baskets did you receive increase in yield per acre?**

Part 2: Knowledge, Attitude and Practices on Food Safety Module

Knowledge Status of Respondents on Food Safety Module

Question	Yes	No
The soil must be free from the chemical and biological toxicity.		
Cultivated area must be free from the places built for hospital, livestock and rubbish from municipal.		
The water from the livestock, hospitals, factories and cast-off water from municipal area must be avoided.		
Good quality seeds that are free from pests and diseases and adaptable to soil should be selected.		
The region from which seeds are received, quantity, date and seller are recorded.		
Integrated pest management (IPM) is used to decrease the use of chemicals.		
The microbial pesticides and plant extract pesticides should be used.		
The registered products should be used to control the pests and diseases if it is necessary to use the agrochemicals.		
Pre-harvest interval (PHI) of pesticides must be obeyed.		
The farmers need to understand the ways of use of pesticide.		
Pesticide buying, storage, usage and disposal must be done systematically and recorded.		
Fuel, lubricant and another chemicals (which are not used for agriculture) should be used, stored and discarded to decrease the lowest toxicity to crops		
Machines, tools and packaging materials must be cleaned.		
The places for packaging and storage must be cleaned.		
Suitable chemicals are selected to clean the storage area for the lowest damage to products.		
Designated pesticides with designated dosage are used to control the storage pests during the storage period.		
The instructions must be obeyed to prevent the storage pests during storage period for foreign countries which will import the products to get standardization of each country if there is export to foreign countries.		
The machines used for transportation are checked to be free from toxic chemicals and pests and diseases of other products.		
The farmers should attend basic training of integrated pest management (IPM).		

Attitude Status of Respondents on Food Safety Module

Question	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The soil must be free from the chemical and biological toxicity.					
Cultivated area must be free from the places built for hospital, livestock and rubbish from municipal.					
The water from the livestock, hospitals, factories and cast-off water from municipal area must be avoided.					
Good quality seeds that are free from pests and diseases and adaptable to soil should be selected.					
The region from which seeds are received, quantity, date and seller are recorded.					
Integrated pest management (IPM) is used to decrease the use of chemicals.					
The microbial pesticides and plant extract pesticides should be used.					
The registered products should be used to control the pests and diseases if it is necessary to use the agrochemicals.					
Pre-harvest interval (PHI) of pesticides must be obeyed.					
The farmers need to understand the ways of use of pesticide.					
Pesticide buying, storage, usage and disposal must be done systematically and recorded.					

Question	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Fuel, lubricant and another chemicals (which are not used for agriculture) should be used, stored and discarded to decrease the lowest toxicity to crops					
Machines, tools and packaging materials must be cleaned.					
The places for packaging and storage must be cleaned.					
Suitable chemicals are selected to clean the storage area for the lowest damage to products.					
Designated pesticides with designated dosage are used to control the storage pests during the storage period.					
The instructions must be obeyed to prevent the storage pests during storage period for foreign countries which will import the products to get standardization of each country if there is export to foreign countries.					
The machines used for transportation are checked to be free from toxic chemicals and pests and diseases of other products.					
The farmers should attend basic training of integrated pest management (IPM).					

Practice Status of Respondents on Food Safety Module

Question	Yes	No
The soil must be free from the chemical and biological toxicity.		
Cultivated area must be free from the places built for hospital, livestock and rubbish from municipal.		
The water from the livestock, hospitals, factories and cast-off water from municipal area must be avoided.		
Good quality seeds that are free from pests and diseases and adaptable to soil should be selected.		
The region from which seeds are received, quantity, date and seller are recorded.		
Integrated pest management (IPM) is used to decrease the use of chemicals.		
The microbial pesticides and plant extract pesticides should be used.		
The registered products should be used to control the pests and diseases if it is necessary to use the agrochemicals.		
Pre-harvest interval (PHI) of pesticides must be obeyed.		
The farmers need to understand the ways of use of pesticide.		
Pesticide buying, storage, usage and disposal must be done systematically and recorded.		
Fuel, lubricant and another chemicals (which are not used for agriculture) should be used, stored and discarded to decrease the lowest toxicity to crops		
Machines, tools and packaging materials must be cleaned.		
The places for packaging and storage must be cleaned.		
Suitable chemicals are selected to clean the storage area for the lowest damage to products.		
Designated pesticides with designated dosage are used to control the storage pests during the storage period.		
The instructions must be obeyed to prevent the storage pests during storage period for foreign countries which will import the products to get standardization of each country if there is export to foreign countries.		
The machines used for transportation are checked to be free from toxic chemicals and pests and diseases of other products.		
The farmers should attend basic training of integrated pest management (IPM).		

Part 3: Knowledge, Attitude and Practice on Environmental Management Module

Knowledge Status of Respondents on Environmental Management Module

Question	Yes	No
Three to five tons of natural fertilizer (humus) and green manure should be added yearly to increase physical and chemical properties soil.		
Use of natural fertilizer (humus) and green manure increases physical properties of soil.		
Disease free plants should be used if the remains of plants are used to do compost.		
Crop cultivation concerning land use is recorded.		
Mixing and storage of fertilizer or soil additives and place of decomposition of organic matter should be free from contamination to soil and water.		
The region from which fertilizer or soil additives are received, amount, date and seller must be recorded.		

Attitude Status of Respondents on Environmental Management Module

Question	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Three to five tons of natural fertilizer (humus) and green manure should be added yearly to increase physical and chemical properties soil.					
Use of natural fertilizer (humus) and green manure increases physical properties of soil.					
Disease free plants should be used if the remains of plants are used to do compost.					
Crop cultivation concerning land use is recorded.					
Mixing and storage of fertilizer or soil additives and place of decomposition of organic matter should be free from contami-nation to soil and water.					
The region from which fertilizer or soil additives are received, amount, date and seller must be recorded.					

Practice Status of Respondents on Environmental Management Module

Question	Yes	No
Three to five tons of natural fertilizer (humus) and green manure should be added yearly to increase physical and chemical properties soil.		
Use of natural fertilizer (humus) and green manure increases physical properties of soil.		
Disease free plants should be used if the remains of plants are used to do compost.		
Crop cultivation concerning land use is recorded.		
Mixing and storage of fertilizer or soil additives and place of decomposition of organic matter should be free from contamination to soil and water.		
The region from which fertilizer or soil additives are received, amount, date and seller must be recorded.		

Part 4: Knowledge, Attitude and Practice on Produce Quality Module

Knowledge Status of Respondents on Produce Quality Module

Question	Yes	No
Soil pH is 6.5 to 7.5 to grow green gram.		
The water is tested in laboratory which is suitable for green gram cultivation		
Seed rate of one acre should be 4-6 pyi in raining season and 6-8 pyi in winter season.		
Plant spacing (18 inch x 4 inch) and plant population (85000) of green gram should be used per acre in raining season, plant spacing (12 inch x 4 inch) and plant population (130000 plants) should be in used per acre in winter season.		
Bean after bean cultivation must be avoided.		
Twenty pyi of fertilizer containing five percent of sulphur nutrient in green gram growing time and foliar fertilizer can be used.		
75 to 85 percent of ripening pods should be harvested.		
Late harvesting and pre-harvesting before ripening time should be avoided in green gram production.		
Winnowing and drying process of green gram seeds should be done on concrete floor and ground sheet.		
Agrochemical and other dangerous chemical bags are avoided for packaging and storing green gram.		
Green gram should be stored systematically by using super bags, airtight bags and bucket made with iron.		
Green gram bags were transported and stored in warehouse separately form chemical, biological and physical toxic products.		
Buildings are constructed away from humus storage area, livestock area and animal feed storage area.		
Bamboo floor or floor board are used to prevent the green gram bags from direct contact to floor or wall of warehouse.		

Question	Yes	No
Warehouse is prepared in good aeration and to prevent mouse, birds and other pests.		
Insect pests are being prevented around the storage area.		
The records concerning GAP are stored at least two years.		
The current production procedure is recorded in designated form.		
The distinct logo and registered logo on green gram packaging were made to recheck the production site		
Transported places, amount and date of transportation for green gram are recorded.		
Technical team concludes either farmers correctly use GAP or they did not use GAP in farm at least one time per production season. Conclusion and operating procedures are recorded.		

Attitude Status of Respondents on Product Quality Module

Question	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Soil pH is 6.5 to 7.5 to grow green gram.					
The water is tested in laboratory which is suitable for green gram cultivation					
Seed rate of one acre should be 4-6 pyi in raining season and 6-8 pyi in winter season.					
Plant spacing (18 inch x 4 inch) and plant population (85000) of green gram should be used per acre in raining season, plant spacing (12 inch x 4 inch) and plant population (130000 plants) should be in used per acre in winter season.					
Bean after bean cultivation must be avoided.					
Twenty pyi of fertilizer containing five percent of sulphur nutrient in green gram growing time and foliar fertilizer can be used.					
75 to 85 percent of ripening pods should be harvested.					
Late harvesting and pre-harvesting before ripening time should be avoided in green gram production.					
Winnowing and drying process of green gram seeds should be done on concrete floor and ground sheet.					
Agrochemical and other dangerous chemical bags are avoided for packaging and storing green gram.					

Question	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Green gram should be stored systematically by using super bags, airtight bags and bucket made with iron.					
Green gram bags were transported and stored in warehouse separately form chemical, biological and physical toxic products.					
Buildings are constructed away from humus storage area, livestock area and animal feed storage area.					
Bamboo floor or floor board are used to prevent the green gram bags from direct contact to floor or wall of warehouse.					
Warehouse is prepared in good aeration and to prevent mouse, birds and other pests.					
Insect pests are being prevented around the storage area.					
The records concerning GAP are stored at least two years.					
The current production procedure is recorded in designated form.					
The distinct logo and registered logo on green gram packaging were made to recheck the production site					
Transported places, amount and date of transportation for green gram are recorded.					
Technical team concludes either farmers correctly use GAP or they did not use GAP in farm at least one time per production season. Conclusion and operating procedures are recorded.					

Practice Status of Respondents on Product Quality Module

Question	Yes	No
Soil pH is 6.5 to 7.5 to grow green gram.		
The water is tested in laboratory which is suitable for green gram cultivation		
Seed rate of one acre should be 4-6 pyi in raining season and 6-8 pyi in winter season.		
Plant spacing (18 inch x 4 inch) and plant population (85000) of green gram should be used per acre in raining season, plant spacing (12 inch x 4 inch) and plant population (130000 plants) should be in used per acre in winter season.		
Bean after bean cultivation must be avoided.		
Twenty pyi of fertilizer containing five percent of sulphur nutrient in green gram growing time and foliar fertilizer can be used.		
75 to 85 percent of ripening pods should be harvested.		
Late harvesting and pre-harvesting before ripening time should be avoided in green gram production.		
Winnowing and drying process of green gram seeds should be done on concrete floor and ground sheet.		
Agrochemical and other dangerous chemical bags are avoided for packaging and storing green gram.		
Green gram should be stored systematically by using super bags, airtight bags and bucket made with iron.		
Green gram bags were transported and stored in warehouse separately form chemical, biological and physical toxic products.		
Buildings are constructed away from humus storage area, livestock area and animal feed storage area.		
Bamboo floor or floor board are used to prevent the green gram bags from direct contact to floor or wall of warehouse.		
Warehouse is prepared in good aeration and to prevent mouse, birds and other pests.		

Question	Yes	No
Insect pests are being prevented around the storage area.		
The records concerning GAP are stored at least two years.		
The current production procedure is recorded in designated form.		
The distinct logo and registered logo on green gram packaging were made to recheck the production site		
Transported places, amount and date of transportation for green gram are recorded.		
Technical team concludes either farmers correctly use GAP or they did not use GAP in farm at least one time per production season. Conclusion and operating procedures are recorded.		

Part 5: Knowledge, Attitude and Practice on Worker Health, Safety and Welfare Module

Knowledge Status of Respondents on Worker Health, Safety and Welfare Module

Question	Yes	No
The rules of pesticide application are written and announced for worker' safety.		
The instructions for hygiene are distributed among the workers.		
The cast-off waste and lavatorial water must be abandoned carefully.		
Worker's health and social welfare are performed.		
Organization for social welfare and bookish meeting should be performed.		

Attitude Status of Respondents on Worker Health, Safety and Welfare Module

Question	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The rules of pesticide application are written and announced for worker' safety.					
The instructions for hygiene are distributed among the workers.					
The cast-off waste and lavatorial water must be abandoned carefully.					
Worker's health and social welfare are performed.					
Organization for social welfare and bookish meeting should be performed.					

Practice Status of Respondents on Worker health, Safety and Welfare Module

Question	Yes	No
The rules of pesticide application are written and announced for worker' safety.		
The instructions for hygiene are distributed among the workers.		
The cast-off waste and lavatorial water must be abandoned carefully.		
Worker's health and social welfare are performed.		
Organization for social welfare and bookish meeting should be performed.		

Part 6: Economic Incentive and Disincentive for Respondents to Adopt GAP

Particular	Incentive	Disincentive
Price premium		
Access to market		
Access to reliable inputs		
Product differentiation		
Stabilizing yield		
Reducing storage losses		
Reducing wastage		
Protection against market externalities		
Increasing variable production costs (e.g. labour)		
Increasing fixed production costs (e.g. equipment)		
Reducing monitoring costs		
Social capital		

Part 7: Regulatory or Institutional Incentive and Disincentive for Respondents to Adopt GAP

Particular	Incentive	Disincentive
Subsidies		
Reliance on institutional infrastructure		
Third party monitoring		

Part 8: Human Capital Incentive and Disincentives for Respondents to Adopt GAP

Particular	Incentive	Disincentive
Expand skill set		
Record-keeping (literacy)		