STATUS AND DETERMINANTS OF SUSTAINABLE CULTIVATION PRACTCIES FOLLOWED BY PINEAPPLE (*Ananas comosus* L.) GROWERS IN NAGALAND

Thesis

submitted to

NAGALAND UNIVERSITY

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of

DOCTOR OF PHILOSOPHY

in

AGRICULTURAL EXTENSION

by

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DECLARATION

I, Sentibenla Pongener, hereby declare that the subject matter of this thesis is the record of work done by me, that the contents of this thesis did not form the basis of the award of any previous degree to me or to the best of my knowledge to anybody else, and that the thesis had not been submitted by me for any research degree in any other university/institute.

This is being submitted to Nagaland University for the degree of Doctor of Philosophy in Agricultural Extension.

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CERTIFICATE – I

This is to certify that the thesis entitled **"Status and Determinants of Sustainable Cultivation Practices followed by Pineapple (*Ananas comosus* L.) growers in Nagaland"** submitted to Nagaland University in partial fulfillment of the requirements for the award of degree of Doctor of Philosophy in Agricultural Extension is the record of research work carried out by Ms. Sentibenla Pongener, Registration No. Ph.D./AEX/00111 under my personal supervision and guidance.

The result of the investigation reported in the thesis have not been submitted for any other degree or diploma. The assistance of all kinds received by the student has been duly acknowledged.

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CERTIFICATE – II

VIVA VOCE ON THESIS OF DOCTOR OF PHILOSOPHY IN AGRICULTURAL EXTENSION

This is to certify that the thesis entitled **“Status and Determinants of Sustainable Cultivation Practices followed by Pineapple (*Ananas comosus* L.) growers in Nagaland”** submitted by Sentibenla Pongener, Admission No. Ph- 217/16 Registration No. Ph.D./AEX/00111 to the NAGALAND UNIVERSITY in partial fulfillment of the requirements for the award of degree of Doctor of Philosophy in Agricultural Extension has been examined by the Advisory Board and External examiner on ………………............

The performance of the student has been found **Satisfactory/Unsatisfactory.**

Member	Signature
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Dated: *(SENTIBENLA PONGENER)*

Place:

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF ABBREVIATIONS

FAO	: Food and Agriculture Organization
MIDH	: Mission for Integrated Development of Horticulture
TSS	: Total Soluble Solids
Mha	: Million Hectares
IPM	: Integrated Pest Management
INM	: Integrated Nutrient Management
IFS	: Integrated Farming System
SAPs	: Sustainable Agricultural Practices
FYM	: Farm Yard Manure
HLVI	: Household Livelihood Vulnerability Index
IPCC	: Intergovernmental Panel on Climate Change
LVI	: Livelihood Vulnerability Index
NGO	: Non- Governmental Organization
APMC	: Agricultural Produce Market Committee
MOVCDNER	: Mission Organic Value Chain Development for North North East Region
GDP	: Gross Domestic Product
TRC/WRC	: Terrace Rice cultivation/ Wet Rice Cultivation
RD	: Rural Development
SD	: Standard Deviation
∑	: Summation
%	: Percentage
χ	: Mean
F	: Frequency
N	: Number of respondents
SMS	: Short Message Service

AFA	: Agriculture Field Assistant
AO	: Agriculture Officer
SDAO	: Sub Divisional Agriculture Officer
HO	: Horticulture Officer
HEA	: Horticulture Extension Assistant
KVK	: Krishi Vigyan Kendra
ATMA	: Agricultural Technology Management Agency
CIH	: Central Institute of Horticulture
ISSI	: Input self-sufficiency index
DDT	: Dichloro-diphenyl-trichloroethane

"Status and determinants of sustainable cultivation practices followed by pineapple (*Ananas comosus* L.) growers in Nagaland"

ABSTRACT

Pineapple (*Ananas comosus* L.), one of the most important commercial fruits of the world is widely grown in India. Nagaland is ranked 7th in production among the India states. Nagaland pineapple is known for its distinctive sweetness and high Total Soluble Solids. Pineapple cultivation has uplifted the farming community to a large extent. However, with lack of proper market, infrastructures, insufficient knowledge on the latest technologies coupled with change in climatic conditions, it was imperative to analyze the practices followed by the pineapple growers. Hence, the present study was conducted in three leading pineapple producing districts in Nagaland *viz,* Dimapur, Peren and Mokokchung with the major objectives to analyze knowledge, adoption, technological gap, attitude and constraints faced by the farmers with respect to sustainable pineapple cultivation in Nagaland. Thirteen villages were purposively selected from four RD blocks by following random proportionate sampling procedure by including 275 respondents. Findings revealed that majority of the respondents were middle aged, male, married and had medium level of experience in pineapple cultivation, medium level family size and close to half of the respondents were educated upto middle school. More than 80 per cent of the respondents were engaged in farming as their occupation, majority of the respondents had 2.5-5.0 acres of landholding under agriculture and less than 2.5 acres under pineapple cultivation. It was also found that majority of the respondents had medium level Input self sufficiency, employment generated, Integrated Nutrient Management and Integrated Pest Management. Mean annual income from agriculture and pineapple cultivation were Rs. 2,59,032 and Rs.1,47,441.1 respectively. Average profitability from pineapple cultivation was Rs. 50,237.48/acre and average productivity 13.65 mt/ha. Household vulnerability (LVI) was found to be moderate. Majority of the respondents had medium level of information sources utilization, extension contact, social participation, innovativeness, risk taking ability, market innovativeness, achievement motivation, decision making ability, management orientation, scientific orientation, economic motivation and market orientation. More than half of the respondents had attended training on sustainable cultivation practices of pineapple. Majority of the respondents had medium level knowledge, adoption and technological gap on sustainable cultivation practices of pineapple. Majority of the respondents had favourable attitude towards adoption of sustainable cultivation practices of pineapple. Independent variables such as education, employment generated, Integrated Nutrient Management, sources of information utilization, decision making ability, management orientation, market orientation, size of landholding under pineapple, training exposure, extension contact and experience had positive and significant relationship with knowledge variable. Variables such as education, social participation, information sources utilization, decision making ability, size of landholding under agriculture and pineapple, annual income, employment generated, economic motivation, management orientation, IPM, INM, training exposure and experience were found to be significant with adoption positively. Education, sources of information utilization, decision making ability, size of land holding under agriculture and pineapple, annual income, employment generated, economic motivation, management orientation, IPM, INM, training exposure and experience were negatively significant with technological gap. Attitude of farmers had positive relationship with education, social participation, sources of information utilization, innovativeness, risk bearing ability, achievement motivation, land holding under pineapple, annual income, productivity, employment generated, economic motivation, market orientation, management orientation, IPM, INM, training exposure, experience and scientific orientation. Path analysis showed that the largest direct effect and indirect effect on knowledge level of sustainable cultivation practices of pineapple was channelled by employment generated and extension contact respectively. Path analysis further revealed that the largest direct effect and indirect effect on adoption level of sustainable cultivation practices of pineapple was channelled by employment generated and size of land holding under pineapple cultivation respectively. Eight (8) factors that influence the adoption of sustainable cultivation practices of pineapple were extracted through conglomeration of independent variables which was later renamed. Major constraints faced by the respondents were high wage rate, poor economic condition of farmers, lack of knowledge on Integrated Pest Management, lack of reliable market, lack of contact with extension agent, insufficient organic manure, lack of storage facilities, damage by insect, increase in temperature and weeding problem. The study recommended sensitizing farmers about adoption of low cost and innovative technology, increasing input self sufficiency, proper guidance and training by extension agencies, aggregation of products and promoting marketing of pineapple through FPOs and e marketing platforms for attaining sustainable pineapple farming and assured income by the farmers.

Keywords: Pineapple, knowledge, adoption, attitude, technological gap, sustainable practices, constraints, Nagaland

CHAPTER I

INTRODUCTION

INTRODUCTION

Pineapple (*Ananas comosus* L.) is one of the most important commercial fruits of the world. It is believed to have originated in Brazil and has spread to other tropical parts of the world from Brazil. The important pineapple producing countries of the world are Philippines, Costa Rica, Brazil, Indonesia, China, India, Thailand, Nigeria, Mexico and Colombia (Faostat, 2023). In India, the cultivation of pineapple is confined to high rainfall and humid coastal regions in the peninsular India and hilly areas of north-eastern region of the country. At present, pineapple is grown commercially in Assam, Meghalaya, Tripura, Mizoram, Nagaland, West Bengal, Kerala, Karnataka and Goa and on a small scale in Gujarat, Maharashtra, Tamil Nadu, Andhra Pradesh, Orissa, Bihar and Uttar Pradesh (Chadha, 2015).

Pineapple is a plant of humid tropics but is known to adapt well in subtropical areas. The optimum temperature range for successful pineapple cultivation is between 22 to 32°C. It can be grown upto an elevation of 1,100 metres above sea level. Planting in the month of July- August is considered best for establishment and growth of plant (Bal, 2013). The most popular commercial pineapple variety in India is Giant Kew. Other important varieties are Queen, Kew, Mauritius, Charlotte, Rothchild, Jaldhup, Desi, Lakhat, etc. According to FAO Corporate Statistical Database, the estimated production of pineapple in the world in 2020 was 27,816,403 metric tonnes. Philippines is the highest pineapple producing country (2,702,554 tonnes), followed by Costa Rica with 2,624,118 tonnes and Brazil (2,455,689 tonnes). India is ranked 6th in the world with 1,799,000 tonnes. According to the Ministry of Agriculture and Farmers Welfare, Government of India (2020 – 2021), pineapple was cultivated in the country in an area of 1,05,580 ha with a production of 17,98,710 metric tonnes during 2020-21. West Bengal had the highest production among the states

(3,54,640 metric tonnes). Nagaland ranked 7th with a total production 1,14,770 metric tonnes.

Pineapple is grown in almost all the North-eastern states of India. Pineapple grown in the state of Nagaland is of excellent quality in terms of size, appearance, TSS and other aspects. Pineapple has been cultivated organically by default and as a rainfed crop. It is one of the crops which have been cultivated in this region by farmers since time immemorial using their traditional knowledge. Giant Kew, Kew and Queen varieties of pineapple are grown in Nagaland and fruit availability is in two seasons, July - August in summer and October – January in winter. Government of Nagaland has identified pineapple as one of the main horticultural crop and various steps have been taken under Horticulture Technology Mission and Mission for Integrated Development of Horticulture (MIDH) to boost up pineapple cultivation. The state has achieved the unique distinction of branding the pineapple with the tag name, "Naga Pineapple" due to its distinctive flavor and high Total Soluble Solids (TSS) ranging from 16.5- 18%, which is the first of its kind in the whole of North- East. The concerned department, organizations and stakeholders have initiated various opportunities for commercialization and upliftment of the pineapple growing community. This has provided a great opportunity for more organized organic pineapple cultivation, focusing on the global market. Progress has been made in the cultivation and commercialization of pineapple in the state and many rural people have shifted from paddy cultivation, an age-old practice, to pineapple production and thereby improving their livelihood to a great extent. This has led to many districts of Nagaland having taken up pineapple cultivation on a commercial scale (Sema *et. al*, 2009).

Green Revolution in India initiated during 1964 – 65 with an objective to increase food production by introducing high yielding varieties of various crops. This intervention brought significant upliftment in self- sufficiency and livelihood of the farmers. However, increased area under farming, highly increased use of large number of chemical fertilizers, weedicides, fungicides and pesticides, increased mechanization, increased water utilization by irrigation schemes exploited the environment at an alarming rate and these adverse effects are felt over the years. These negative impacts coupled with the climate change is one of the most important and urgent concern of today's world which has altered the earth's ecosystem manifolds. Unprecedented increase in temperature, precipitation variability, increased events of droughts, floods, heat waves, cyclones, hurricanes, water shortages are the impacts experienced in every nook and corner of the globe, of which these impacts vary from region to region. As a result of climate change, agricultural sector is one among the many sectors greatly affected. Some cultivable areas many years back have become unsuitable for crop production, increase in pest and disease population, tropical grasslands becoming more arid, loss of agricultural biodiversity and yield reduction.

Nearly 29% (96.4 Mha) of India's total geographical area (328.7 Mha) is subjected to degradation majorly by soil erosion by water (36.1 Mha), followed by vegetation degradation, referred to as a decline in the above-ground biomass resulted from deforestation/overgrazing (29.3 Mha), wind erosion (18.2 Mha), salinity (3.7 Mha), frost shattering (3.3 Mha), and human interventions that include mining, urbanization, and industrial activities (2.3 Mha), mass movement or mass wasting that includes all forms of downward movement of soil and rock under the influence of gravity (0.9 Mha), waterlogging (0.7 Mha), and others (1.9 Mha) (Periasamy and Shanmugam, 2022).

These abrupt changes have direct impact on agricultural production which, in turn, threatens the food security at global scale. With limited availability of natural resources and these available limited resources affected by unsustainable management practices and changing climatic conditions, it is imperative for the agricultural sector to manage the agricultural practices sustainably, adopt practices pertinent to climate change and also ensure food security globally. Thus, sustainable agriculture is the need of the hour in today's ever-changing world. Sustainable agriculture is farming in sustainable ways meeting society's present food and textile needs, without compromising the ability for current or future generations to meet their needs. Food and Agriculture Organization (FAO) defined sustainable agricultural development as the management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. The concept of sustainability has three dimensions: economic, environment and social. A sustainable farming system is one which ensures that there are mutually beneficial relationships among workers and the community and judicious management of the available natural resources. Agricultural practices such as mulching, crop rotation, diversified farming, agroforestry, no- till farming, contour farming, organic animal raising, permaculture, cover crops, Integrated Pest Management (IPM), organic farming, conservation agriculture, precision farming, hydroponics, intercropping, multiple cropping, rainwater harvesting, canopy management, Integrated Farming System (IFS) enhances productivity, maintain or restore the soil fertility, increase the efficiency in management of water and energy resources, conserve and harness the genetic resources. With optimal utilization of natural resources and the increase in efficiency of agricultural production, sustainable agriculture can also contribute to economic equity.

Rotating crops and embracing diversity, organic farming, planting cover crops and perennials, reducing or eliminating tillage, applying integrated pest management (IPM), integrating livestock and crops, applying Integrated Nutrient Management (INM), applying precision agriculture, and adopting agroforestry practices are some of the activities in sustainable agricultural practices (Muhie, 2022 and Mehra and Singh, 2022).

Sustainable agricultural practices can help restore degraded soils, improve soil fertility and retain carbon to mitigate climate change effect and preserve the environment and productive resources. Combining several sustainable agricultural practices can allow farmers to benefit from the agronomic effects linked to the complementarities between these techniques. The adoption of several sustainable agricultural practices is potentially necessary to overcome the constraints of water stress, continued land degradation and low soil fertility. Multiple adoption of sustainable agricultural practices allows more efficient use of soil nutrients and water in production. Sustainable agricultural practices adoption and combination by farmers is strategic to overcoming multiple agricultural constraints and achieving productive and sustainable agriculture (Maré, 2022).

The adoption of Sustainable Agricultural Practices (SAPs) will help protect the environment by reducing the usage of hazardous pollutants and non-renewable energy sources, which further helps to replenish the agricultural land and other natural resources (air and water) for rising population and their food demands. Further, the lower use of chemical inputs also reduces the cost of cultivation and increases profits, ultimately enhancing the farmers' income. It improves food security by improving the quality and nutritious value of food. In addition, the crop rotation and inter-cropping practices make agriculture more diversified, enhancing agricultural role in the economy and society, generating more employment opportunities and, hence, sustainable rural development (Mehra and Singh, 2022).

Gupta *et al.* (2021) identified 30 sustainable agricultural practice (SAP) and systems based on FAO's agroecological elements. Only 5 (crop rotation; agroforestry; rainwater harvesting; mulching and precision) SAPs scaling beyond 5 per cent of the net sown area were adopted by Indian farmers. Crop rotation is the most popular SAPS in India, covering around 30 million hectares

(Mha) of land and approximately 15 million farmers. Agroforestry, mainly popular among large cultivators, and rainwater harvesting have relatively high coverage - 25 Mha and 20-27 Mha, respectively. Organic farming currently covers only 2.8 Mha — or two per cent of India's net sown area of 140 Mha. Natural farming is the fastest growing sustainable agricultural practice in India and has been adopted by around 800,000 farmers. Integrated Pest Management (IPM) has achieved a coverage area of 5 Mha after decades of sustained promotion.

Statement of the problem

Pineapple cultivation in Nagaland has proved to have a positive impact in uplifting their livelihood. However, factors such as limited availability of markets coupled with non-availability of scientific storage facilities, lack of knowledge on improved practices discourages the pineapple farmers. Due to inadequate transportation and communication facilities, farmers find it difficult and a costly affair to bring their produce from their fields. In addition, pineapple being an exhaustive crop, damage is done to the soil. Setting up of plantation and conversion area from its pre-existing state often requires deforestation. It disrupts the environment affecting the flora and fauna. It may harm the natural characteristics of the site, by soil degradation and erosion. Since water requirement is high in pineapple cultivation, assessment is needed whether the farmers harness water in a sustainable manner. Farmers may fail to recognize the adverse impact of their farming practices on the environment and its surroundings in the long run. Thus, it is imperative to analyse whether the farmers' knowledge and cultivation practices followed by them for pineapple cultivation are sustainable so that a suitable policy may be developed. Therefore, the present study entitled "**Status and Determinants of Sustainable Cultivation Practices Followed by Pineapple (***Ananas comosus* L.) **Growers in Nagaland"** was undertaken with the following objectives:

Objectives

1. To study the knowledge level of pineapple growers about sustainable pineapple cultivation practices.
2. To analyze the extent of adoption of sustainable cultivation practices among pineapple growers.
3. To assess the technological gap in adoption of sustainable cultivation practices among the pineapple growers.
4. To study the attitude of pineapple growers towards adoption of sustainable cultivation practices of pineapple.
5. To know the determinants of knowledge and adoption in relation to sustainable cultivation practices of pineapple.
6. To find out the constraints perceived by the pineapple growers in adopting sustainable pineapple cultivation practices and suggest strategies to overcome.

Significance of the study

The study attempts to give an insight about the extent of sustainable practices followed by pineapple growers in Nagaland and identify the areas of concern which may be improved upon for benefitting the target farmers It also aims to identify the factors affecting knowledge and adoption of sustainable pineapple cultivation practices and undertaking corrective measures to promote profitable and sustainable cultivation. Scales on attitude of farmers towards sustainable cultivation practices of pineapple and market innovativeness scale will be developed which will be helpful and useful for further researchers. The findings of the study are expected to help in formulating strategies and policy guidelines in further improving the prospect of pineapple cultivation in the state. This study would also give ample opportunities for the extension workers to analyze and disseminate necessary technologies to the farmers. Further, the study will also highlight the constraints faced by the pineapple growers and suggestions to eliminate the constraints in the improved pineapple cultivation.

Limitations of the study

The study conducted by the researcher had its limitations such as time, lack of resources, transportation, funds and respondents' biases. In spite of this, the researcher made utmost and rigorous effort to devise the study as systematic, scientific and objective as possible. However, the results of the study can be generalized only to similar situations elsewhere, in the state or in the country.

Organization of the study

The present thesis has been presented in five chapters with the following sequence:

1. **Introduction**: This chapter deals with the background of situation, an explanation of the problem statements, objectives. It also elucidates on the significance and limitations of the study.
2. **Review of literature**: This chapter encompasses the review of past studies relevant to the objectives of the present study.
3. **Research Methodology**: This chapter contains the methodology adopted for the study, location and description of the study area, sampling procedure followed, quantification of variables selected for the study, nature and sources of data, procedure involved in test construction and statistical techniques adopted.
4. **Findings and discussion**: The fourth chapter focuses on results under appropriate subheads and results on the discussion of the study.
5. **Summary and conclusions**: The last chapter summarizes the findings of the study with implications and conclusion of the study.

CHAPTER II

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The review of literature helps to have a comprehensive idea of the research that is to be undertaken. It provides a broad insight into the operational definitions of major concepts and forms a basis for interpretation of the findings through results founded by different researchers. Gupta (2006) stated that review of literature provides information on 'what has been done' and further guidance to 'what is to be done'. In this chapter, relevant and available literature on similar aspects of the study had been reviewed to give a rigorous support to the present study. The literature review for the present research is presented under the following aspects:

2.1. Profile characteristics of the pineapple growers
2.2. Knowledge level of the pineapple growers about sustainable cultivation practices
2.3. Extent of adoption of sustainable cultivation practices among pineapple growers
2.4. Technological gap in adoption of sustainable cultivation practices among the pineapple growers
2.5. Attitude of pineapple growers towards adoption of sustainable cultivation practices of pineapple
2.6. Determinants of knowledge and adoption in relation to sustainable cultivation practices of pineapple
2.7. Constraints perceived by pineapple growers in adopting sustainable pineapple cultivation practices.

2.1 Profile characteristics of the pineapple growers

2.1.1 Personal and socio-economic characteristics of the pineapple growers

2.1.1.1 Age

Jha (2008) in his study on entrepreneurial characteristics and attitude of pineapple growers found that most (66.67%) of pineapple growers belonged to middle age between 34-54 years.

Nanda *et al.* (2012) found from their study on the socio-economic status of pineapple growers under contract farming condition that 42 per cent of pineapple cultivators belonged to 36 – 50 years.

Akter *et al.* (2018) revealed from their study on pineapple production at in Tangail district of Bangladesh that 43.00 per cent of the respondents were middle aged (36-50 years) followed by old (29.00%) and young (28.00%) age.

Alam and Usmani (2019) conducted a study on impact of pineapple cultivation on the socio-economic status of farmers: A case study of Chopra Block, Uttar Dinajpur district (West Bengal) and indicated that 56 per cent of the respondents belonged to middled aged group (31 – 50 years).

Das *et al.* (2019) revealed from their study on adoption gap and constraints faced by pineapple growers that majority (72.92 %) of the pineapple growers belonged to middle age group (35-50 years).

Suhaimi and Fatah (2019) conducted a study on profitability of pineapple production (Ananas comosus) among smallholders and found that majority of the farmers were middle aged.

Saryam and Jirli (2020) from their study on orange farmers found that 42.5 per cent of them were middle aged while 31.5 per cent and 26 per cent were old and young respectively.

Deb *et al.* (2021) observed from their study on pineapple farmers in Sreemangal Upazila under Moulvibazar district that 42.7 per cent of the respondents were middle aged followed by young (40.00%) and old (17.3%) age.

Rabina *et al.* (2021) revealed from their study on knowledge of the pineapple growers toward improved pineapple production practices in Imphal East district of Manipur that 45 per cent of the respondents were middle aged followed by young (28.33%) and old (26.67%) age.

Kakki *et al.* (2022) found from their study on mandarin growers that majority (67.50%) of the respondents were middle aged followed by young (19.17%) and old (13.33%) respectively.

Lotha and Jha (2022) observed that majority (55.00%) of the horticultural farmers were middle aged while 35 per cent and 10.00 per cent of them were old aged and young aged respectively.

Moumita and Mazhar (2022) from their study on pineapple cultivation in Sepahijala district of Tripura that majority (60.00%) of the respondents were middle aged followed by young (22.50%) and old (17.50%) aged.

2.1.1.2 Gender

Akhilomen *et al.* (2015) conducted a study on profitability analysis and perceived constraints of farmers in pineapple production and revealed that 76.00 per cent of the respondents were male and 24.00 per cent female.

Phukan *et al.* (2017) revealed from their study on socio-economic characteristics and constraints faced by horticultural growers of East Sikkim that 63.3 per cent of the respondents were male 36.7 per cent were female.

Balogun *et al.* (2018) from their study on Pineapple Production in Ogun State of Nigeria reported that majority (77.2%) of the respondents were male while 22.8 per cent were female.

Das *et al.* (2019) in their study on identification of adoption gap and constraints faced by the pineapple growers in the selected districts of Tripura found that majority (79.17%) of the respondents had medium family size followed by large (18.75%) and small (2.08%) family size.

Suhaimi and Fatah (2019) from their study on profitability of pineapple production (*Ananas comosus*) among smallholders indicated that majority (51.8%) of the farmers were male.

Nahar *et al.* (2020) found from their study on pineapple smallholder growers in Samarahan, Sarawak, Malaysia that more than half (52.00%) of the respondents were male and 48.00 per cent of them were female.

Saryam and Jirli (2020) observed from their study on socio economic status of orange farmers in Chhindwara district of Madhya Pradesh that 94 per cent of the respondents were male and 6 per cent of them were female.

Kharlukhi and Jha (2021) reported from their study that majority (54.38%) of the respondents were male while 45.62 per cent were female.

Kehinde *et al.* (2021) from their study on profitability assessment of pineapple production in Osun state of Nigeria found that majority (76.7%) were male and only 23.3 per cent of them were female.

Rhonben *et al.* (2021) revealed from their study that majority (56.67%) of the respondents were male.

Lairenjam *et al.* (2022) revealed from their study that majority (83.00%) of the respondents were male and 17.00 per cent of them were female.

Lotha and Jha (2022) found that 58.33 per cent of the respondents were male while 41.67 per cent of them were female.

2.1.1.3 Marital status

Fawole (2008) observed from their study that majority (66.4%) of the pineapple farmers in Nigeria were married and 33.6 per cent were unmarried.

Akhilomen *et al.* (2015) in their study found that 95.4 per cent of the respondents were married.

Khrishnamurthy (2015) revealed from his study that 95 per cent of the respondents were married.

Phukan *et al.* (2017) observed from their study that majority (82.7%) of the horticultural growers were married and 17.3 per cent were unmarried.

Datta *et al.* (2020) inferred from their study on impact of socio-economic Status of Pineapple Growers that 81 per cent of the respondents were married.

Kehinde *et al.* (2021) from their study on profitability assessment of pineapple production in Osun state of Nigeria reported that 67.5 per cent and 16.7 per cent of the respondents were married and unmarried respectively.

Sodjinou *et al.* (2022) revealed from their study on pineapple production and challenges in Southern Benin that 94.84 per cent of the respondents were married while only 5.16 per cent of them were unmarried.

2.1.1.4 Family size

Jha (2012) conducted a study on entrepreneurial behaviour of pineapple growers and revealed that most of them (51.67%) had family size of 4 to 8 members.

Boruah *et al.* (2015) through their study on entrepreneurial behaviour of tribal winter vegetable growers revealed that majority (50.84%) of the respondents belonged to medium sized family.

Das *et al.* (2019) reported from their study on adoption gap and constraints faced by pineapple growers that majority (79.17%) of the respondents belonged to medium family size.

Saryam and Jirli (2020) found from their study on orange growers that majority (75.5%) of the respondents had medium family size while 13 per cent and 11.5 per cent had large and small family size.

Singh *et al.* (2020) revealed from their study on organic farmers that 56.66 per cent of the respondents that majority (56.66%) of the respondents had medium (5-8 members) family size followed by small (1-4 members) and large (9 and above) family size with a percentage of 28.75 and 14.58 respectively.

Deb *et al.* (2021) conducted a study on pineapple farmers in Sreemangal Upazila under Moulvibazar district and found reported that 48.00 per cent of the respondents had medium family size (5-6 members) followed by large family size (41.3%) and small family size (10.7%).

Rhonben *et al.* (2021) in their study conducted in Dimapur district stated that 70.00 per cent of the respondents belonged to medium family size followed by small (18.33%) family size and large (11.67) family size.

Lotha and Jha (2022) reported from their study on farmers growing horticultural crop that 68.33 per cent of the respondents belonged to medium family size while 17.5 per cent and 14.16 per cent belonged to small and large family size respectively.

2.1.1.5 Education

Nanda *et al.* (2012) inferred from their study on the socio-economic status of pineapple growers under contract farming condition that 46 per cent of the respondents had education up to middle school followed by primary (34.00%), highschool (14.00%) and 2 per cent illiterate.

Das *et al.* (2019) revealed from their study on identification of adoption gap and constraints faced by the pineapple growers that 31.25 per cent of the respondents were educated up to secondary level, followed by up to middle school (22.92%), up to higher secondary (16.67%), up to primary education (10.42%), graduation and above (10.42%) and no education (8.33%).

Patra and Kense (2021) reported from their study on mandarin growers that 34.17 per cent of the respondents were educated up to middle school, while 20.00 per cent up to highschool, 19.17 per cent were illiterate, 10.00 per cent up to primary and 8.33 per cent of them were educated up to higher secondary and graduation.

Rashid *et al.* (2021) found from their study that majority 41.87 per cent of the growers were educated up to middle level, 34.06 per cent of the growers were illiterate, 10.31 per cent of the growers were graduate, 5.62 per cent were educated up to 12th standard, 31.67 per cent of the growers and 5.32 per cent of growers were educated up to matric and only 2.82 per cent of growers were post-graduate.

Rhonben *et al.* (2021) from their study on pineapple cultivation revealed that 28.33 per cent of the respondents were educated up to middle school level, 27.51 per cent were illiterate, 20.00 per cent up to highschool level, 15.83 per cent went up to pre-university level and 8.33 per cent up to primary level.

Lairenjam *et al.* (2022) found from their study that 37 per cent of the respondents were educated up to middle school, 29.00 per cent were educated up to highschool and higher secondary, 14.00 up to primary, 13.00 per cent graduated and 7.00 per cent illiterate.

2.1.1.6 Occupation

Datta *et al*. (2020) found from their study on pineapple growers in Moulvibazar district of Bangladesh almost all the respondents (91.00%) of the respondents were engaged in agriculture as their main occupation whereas, only 7.00 per cent and 2.00 per cent were engaged in business and service respectively as their main occupation.

Saryam and Jirli (2020) conducted a study on orange growers in Chhindwara district of Madhya Pradesh and revealed that majority (87.00%) of the respondents were engaged in agriculture while 10.00 per cent and 3.00 per cent of them were engaged in business and services as their subsidiary occupation respectively.

Kumar *et al*. (2021) revealed from their study on papaya growers that the occupation of more than half (52.50%) of the papaya growers was agriculture alone, 24.17 per cent had occupation of both agriculture and labour, while, 15.00 per cent and 8.33 per cent were engaged in agriculture and business and agriculture and Government/Private services respectively.

Rabina *et al.* (2021) conducted a study on knowledge of the pineapple growers toward improved pineapple production practices in Imphal East district of Manipur and found that 65.83 per cent of the respondents were engaged only in farming and 34.17 per cent of the respondents were engaged in both farming and business.

Rashid *et al.* (2021) observed from their study that majority (72.81%) of the growers were engaged only in agriculture, followed by 15.32 per cent of the growers engaged both in agriculture and business and 11.87 per cent of the growers engaged both in agriculture and service sector.

Kakki *et al.* (2022) found from their study on adoption behaviour of Khasi mandarin growers tribal farmers in Arunachal Pradesh that 66.67 per cent of the respondents were engaged only in mandarin cultivation, while 23.33 per cent were engaged in Mandarin + allied agriculture, 5.00 per cent engaged in Mandarin + business, 1.67 per cent engaged in Mandarin + service and 3.33 per cent engaged in Mandarin + other activities.

Lairenjam *et al.* (2022) revealed from their study that 84.00 per cent of the respondents had farming as their primary occupation and 16.00 per cent of them had subsidiary occupation (beekeeping, labour, dairy farming).

Moumita and Mazhar (2022) found from their study that majority (61.66%) of the pineapple growers had farming alone as their main occupation while, 17.50 per cent, 12.50 per cent and 8.34 per cent of them had farming+ labour, farming+ service and farming+ business as their main occupation respectively.

Rana *et al.* (2022) conducted a study on mango growers in Jammu and Kashmir and observed that more than half (58.75%) of the respondents were engaged in agriculture alone as their occupation, while 35.00 per cent were engaged in both farming and service and 6.25 per cent on farming and business as their source of income.

2.1.1.7 Experience

Jha (2010) in his study on correlates of farmers' attitude towards pineapple cultivation in Nagaland observed that majority (62.00%) of the respondents had medium level of experience while 27.00 per cent of the respondents had high level of experience and 11.00 per cent had low level of experience.

Prasanth *et al.* (2018) in their study on knowledge level of farmers regarding improved cultivation practices of pomegranate crop in Chitradurga district of Karnataka found that more than half (60.83%) of the respondents had medium level of experience while 28.33 per cent and 10.84 per cent of the respondents had low and high level of experience respectively.

Budve *et al.* (2021) observed from their study on pomegranate growers that more than half (58.61%) of the respondents had medium level of experience followed by high (21.67%) and low (19.72%) level of experience.

Kharlukhi and Jha (2021) revealed from their study on horticultural farmers in East Khasi Hills and Ri-Bhoi districts of Meghalaya that 74.38 per cent of the respondents had medium level experience followed by high (10.00%) and low (10.62%) level of experience.

Patra and Kense (2021) in their study conducted in Nagaland stated that most of the respondents (85.00%) had medium level of experience whereas, 14.17 per cent of the respondents had high level of experience and only 0.83 per cent had low level of experience.

Rashid *et al.* (2021) observed from their study on socio-economic and demographic status of apple growers in relevance to soil health card scheme in Kashmir Valley of Jammu and Kashmir, India that 58.75 per cent of the respondents had medium level of experience followed by high level (21.57%) and low (19.68%) level of experience.

Rhonben *et al.* (2021) found from their study on pineapple growers in that 63.33 per cent of the respondents had medium level experience and 19.17 per cent and 17.5 per cent of them had high and low level experience respectively.

Gayathri *et al.* (2022) revealed from their study on fruits and vegetable growers that majority (67.50%) of the respondents had medium level experience followed by low (17.50%) and high (15.00%) level of experience.

Kakki *et al.* (2022) revealed from their study that majority (60.83%) of the respondents had medium (10 – 22 years) of experience followed by high level (20.00%) and low level (19.17%) years of experience.

Hiwarale *et al.* (2023) found from their study on sweet orange growers that majority (67.50%) of the respondents had medium level (6-12 years) of experience while 17.50 per cent of them low level and 15.00 per cent high level of experience.

2.1.1.8 Size of land holding under agriculture

Phukan *et al.* (2017) revealed from their study on socio-economic characteristics and constraints faced by horticultural growers of East Sikkim that half (50.00%) of the respondents belonged to small farmers category followed by 24.7 per cent medium farmers, 20.00 per cent marginal farmers and 5.3 per cent large farmers.

Datta *et al.* (2020) reported from their study on pineapple growers Moulvibazar district of Bangladesh that majority (44.00%) of the respondents were small farmers followed by medium (30.00%) and large farmers (26.00%).

Kumar *et al.* (2021) conducted a study on papaya production technology in Muzaffarpur, Bihar and found that half (50.83%) of the papaya farmers had 2.5-5.0 acres followed by 32.5 per cent with landholding above 5 acres and 16.67 per cent with landholding up to 2.5 acres.

Rashid *et al.* (2021) revealed from their study that 14. 69 per cent of the respondents belonged to marginal category, half (51.56%) of the respondents belonged to small farmers category followed by 33.44 per cent under semi – medium farmers category and 0.31 per cent under medium farmers category.

Kakki *et al.* (2022) reported from their study on Khasi mandarin growers in Arunachal Pradesh that majority (64.17%) of the growers had small landholding followed by marginal (15.00%), semi-medium (12.50%) and medium (8.33%) landholding.

Lotha and Jha (2022) conducted a study on imperatives of technology adoption among farmers growing horticultural crops in Wokha district of Nagaland and indicated that more than half (60.00%) of the respondents belonged to small farmer category, 29.17 per cent to marginal farmers and 10.83 belonged to semi- medium category of farmers.

Jadhav *et al.* (2023) reported from their study on pomegranate growers in Aurangabad district of Marathwada region of Maharashtra that more than half (54.17%) of the respondents had medium landholding (1-2 ha) while 33.33 per cent and 12.50 per cent had small (up to 1 ha) and high (2.01 ha) respectively.

2.1.1.9 Size of landholding under pineapple cultivation

Alam and Usmani (2019) revealed from their study that majority (58.00%) of the farmers were marginal. 20 per cent respondents had small holding having up to 1.0 hectare, 14 per cent farmers had holding between 1-2 hectares and only 8 per cent of the respondents have large farm holding *i.e.*, above 2 hectares.

Rana and Parihar (2020) reported from their study on mango growers in Jammu and Kashmir that 47.50 per cent of the respondents had small landholding size (1-2 ha), while 26.25 per cent had landholding size of 2-4 ha followed by marginal farmers (15.00%), medium farmers (8.75%) and large farmers (2.50%).

Saryam and Jirli (2020) revealed from their study on orange farmers in Chhindwara district of Madhya Pradesh that majority (32.00%) of the respondents had landholding less than 1 ha (marginal), followed by 30.00 per cent with landholding of 2.1-4.0 ha (semi-medium), 26.5 per cent with landholding of 1.1-2.0 ha (small), 10.5 per cent with landholding of 4.1-10.0 ha (medium) and 1 per cent of the orange growers with landholding above 10.0 ha (large).

Kharlukhi and Jha (2021) conducted a study on horticultural farmers and found that almost all (80.00%) the respondents belonged to marginal category and 18.76 per cent of the respondents belonged to small farmers.

Rabina *et al*. (2021) in their study on knowledge of the pineapple growers toward improved pineapple production practices in Imphal East District of Manipur found that majority (93.33%) of the respondents had less than 1 hectare of landholding while 4.17 per cent and 2.50 per cent had landholding 1-2 hectares and more than 3 hectares respectively.

Lairenjam *et al.* (2022) found from their study that half (55.00%) of the respondents had marginal landholding followed by small (33.00%) and medium (12.00%) landholdings.

Hiwarale *et al*. (2023) revealed from their study on study on profile of sweet orange grower that 41.67 per cent of the sweet orange growers had 2.1-4.00 hectares followed by 30.00 per cent respondents with 1.01-2.00 hectares, 13.33 per cent with 4.01-10.00 hectares, 9.17 per cent with landholding up to 1.00 hectares and 5.83 per cent above 10.1 hectares.

2.1.1.10 Input self – sufficiency

Hansen *et al*., (2001) stated that input self-sufficiency in organic farms is achieved through the greater use of on-farm resources and the non-use of mineral fertilisers and pesticides, thereby leading to a low environmental impact per hectare.

According to López-Ridaura *et al*., (2002), input self-sufficiency has often been considered as interesting to promote farm sustainability, faced with an increase in energy and input costs.

Vilain (2008) defined input self-sufficiency as 'the capacity of a farm to produce goods and services from its own resources, *i.e*., with a minimal number of external inputs'. Input self-sufficiency is usually associated with the diversification of farm activities in order to perform synergies and exchanges.

Bonny (2010) and Bell and Moore (2012) stated that a mixed farm could increase its self-sufficiency by using manure for the crops or by producing animal feedstuff on the farm.

According to Bernués *et al*. (2011), self-sufficiency is 'the capacity of the system to regulate and control its interaction with the environment'. The most self-sufficient systems will keep lower production costs, giving them a comparative economic advantage. Indeed, systems that are less dependent on inputs are less affected by resource scarcity and price volatility.

Lebacq *et al.* (2015) stated that input self-sufficiency is usually considered as a key aspect to promote sustainable farming systems and increasing input self-sufficiency constitutes a possible pathway to design systems that are more sustainable and able to operate in this changing context.

2.1.1.11 Employment generated

Satyanarayana *et al.* (2010) in their study revealed that majority (80.62%) of the farmers belonged to the medium category of employment generation followed by 12.40 per cent high and 6.98 per cent low categories of employment generated.

Jeevapriya (2013) in her study on pattern of employment and income in Erode district revealed that majority (66.66%) of the respondents had employment generation of 81 -100 days per year followed by 16.67 per cent with upto 80 days and more than 100 days of employment generation.

Beck (2015) conducted a study on assessment of socio-economic status and employment generation among vegetable growers and revealed that majority (74.17%) of the respondents' families got total employment by 201-250 man days from vegetable cultivation followed by 20 per cent from more than 251 man days and 5.83 per cent respondents got employment for less than 200 man days/ family.

Mahesh *et al.* (2017) reported from their study that most (47.50 %) of the respondents belonged to medium category followed by low (30.80%) and high (21.70%) employment generation.

Gupta *et al.* (2018) revealed from their study on employment generation for rural youth in Dewas district of Madhya Pradesh that more than half (60.83%) of the respondents had employment generation of 10 – 130 days, 24.17 per cent had medium (131 – 250 days) and 15.00 per cent had high (251 – 360 days) of employment generation.

Ghonmode (2018) revealed from her study on employment, income and expenditure pattern of tribal farm families in Gadchiroli district of Maharashtra that small size male worker was engaged in crop production for 171.37 days, medium size male worker for 193.57 days, large size male worker for 238.9 days and overall 201.28 days. Small size female workers were engaged in crop production for 122.84 days, medium size female workers for 144.33 days, large size female workers for 212.64 days and overall for 159.72 days.

Sahoo (2019) revealed from their study that majority (41.66%) of the contract goat farming farmers had medium level of employment through contract goat farming farmers followed by low level (31.66%) and high level (26.66%) of employment.

2.1.1.12 Integrated Nutrient Management

Abel-aziz *et al.* (2005) shared in their study on composting technology and the impact of compost on soil biochemical properties that composting offers several benefits such as to enhance soil fertility and soil health, thereby increasing agricultural productivity, improving soil biodiversity, reducing ecological risks and improving the environment.

Ju *et al.* (2009), Selim and Owied (2017) and Selim (2020) found that various materials can be used as a constituent of Integrated Nutrient Management combinations, *viz.* farmyard manures, natural and mineral fertilizers, soil amendments, crop residues and farm waste recycling, agroforestry, green manures, and compost.

Gopalasundaram *et al.* (2012) stated that the concept of integrated soil and nutrient management implies practices such as appropriate crop rotations, cover crops, use of manure, crop residues and fertilizers, conservation and no-tillage, moisture management, etc.

Zhang *et al.* (2012) in their study stated that nutrient management is an important component in orchard management for high efficiency and high fruit quality. Compared to other organic fertilizers, animal manures are most extensively used in orchards in conventional practice.

Shanthy and Subramaniam (2015) stated in their study that integrated nutrient management is the maintenance of soil fertility and plant nutrient supply at an optimum level to sustain the desired crop productivity. They further revealed that 50 per cent of the respondents applied either FYM or Sakthi bio compost @5-15 tonnes/ac. Nearly 30 per cent of the respondents applied green manures like sun hemp / daincha as in situ application. Around 63 per cent of the respondents applied bio fertilizer in the liquid form. The liquid bio-fertilizer like Azospirillum, and phospobacteria were mostly used along with FYM.

Selim (2020) in his article on introduction to the Integrated Nutrient management Strategies and their contribution to yield and soil properties stated that Integrated nutrient management is described as the technique of using minimum effective dose of sufficient and balanced quantities of organic and inorganic fertilizers in combination with specific microorganisms to make nutrients more available and most effective for maintaining high yields without exposing soil native nutrients and polluting the environment. The key component of the INM goal is to reach the most effective and homogeneous combination that could lead to good management and be an effective target of the fertilizers, sufficient and balanced use of their quantity and quality, and be straightforwardly up taken by plants for higher yield without jeopardizing soil native nutrients or polluting the environment. The recycling of organic wastes, by the farmers themselves, may be a valuable and acceptable option for many of agriculture planners and numerous farmers to overcome the traditional methods of organic waste disposal, with or without the slight risk to the plants, groundwater or ecological pollution, and human health to achieve the best use of existing natural resources.

2.1.1.13 Integrated pest management

Mauceri (2004) stated that Integrated pest management (IPM) enables farmers to reduce their reliance on pesticides while maintaining or increasing yields, crop quality and profitability.

According to Helali and Ahmadpour (2011), Integrated Pest Management (IPM) is agricultural management that aims to minimize pest attacks naturally and at the same time, reduce the danger of chemical pesticides on humans, plants and the environment.

Naranjo *et al*. (2015) stated that IPM techniques protect the natural enemies of pest insects and aid in the restoration of ecosystem activities.

According to Alam *et al.* (2016), Integrated pest management (IPM) is an environmentally friendly technology. It is a multifaceted approach to pest management that seeks to minimize negative impacts on the environment.

According to Aung *et al.* (2020), IPM techniques encompass a combination of controlling methods including cultural, physical, mechanical, biological control practices. It can be cost effective and safe for both farmers and consumers.

2.1.1.14 Annual income

Prashanth *et al.* (2018) revealed from their study on pomegranate growers that 43.33 per cent of the respondents had annual income of ₹.3.1-6 lakh, 31.66 per cent with annual income of ₹.1-3 lakh and 25.00 of them with income above 6 lakh.

Singh *et al.* (2020) indicated from their study on organic farmers in eastern Uttar Pradesh that 63.33 per cent of the respondents had annual income of ₹. 93,624-2,95,483, 18.75 per cent above ₹.2,95,484 and 17.91 per cent up to ₹. 93,623 annual income.

Deb *et al.* (2021) conducted a study on modern pineapple cultivation in Moulvibazar district which revealed that 36.00 per cent of the pineapple grower had annual income of 1,16,000- 2,30,000 Bangladeshi Taka, followed by 32. 00 per cent of them with annual income of up to 1,16,000 Bangladeshi Taka and 32.00 per cent 2,30,000 Bangladeshi Taka annual income.

Kumar (2021) conducted a study on mango farmers in Lucknow district of Uttar Pradesh which revealed that 60.00 per cent of the respondents had annual income from ₹.1,00,001 - ₹.4,00,000, 6.66 per cent above ₹.4,00,001 and 3.33 per cent up to ₹.1,00,000 annual income.

Kumar *et al.* (2021) observed from their study on papaya growers in Muzaffarpur district of Bihar that 35.00 per cent of the papaya growers had annual income above ₹.5 lakh, 30.00 per cent between ₹.3-5 lakh, 28.33 per cent between ₹.1-3 lakh and 6.67 per cent of the respondents up to ₹.1 lakh annual income.

Kakki *et al.* (2022) indicated from their study on Khasi mandarin growers in Arunachal Pradesh that majority (72.50%) of the respondents had ₹.52,375-₹.1,38,355 annual income from the mandarin orchard, 17.50 per cent had income above ₹.1,38,355 while 10.00 per cent of them had less than ₹.52,375 annual income from the mandarin orchard.

Kamble *et al.* (2022) found from their study that 65.83 per of the respondents had annual income of ₹. 1,01,349 - ₹. 3,16,816, 25.00 per cent had up to ₹.1,01,348 annual income and 9.17 per cent above ₹. 3,16,817 annual income.

Lairenjam *et al.* (2022) revealed from their study that 40.00 per cent of the respondents had annual income of ₹. 50,001-₹. 1 lakh, 36.00 per cent had income up to ₹. 50,000, 16.00 per cent between ₹. 1 lakh- ₹. 1.5 lakh and 8.00 per cent above ₹. 1.5 lakh of annual income.

Hirawale *et al.* (2023) observed from their study on sweet orange growers in Maharashtra that 79.17 per cent of the respondents had annual income of ₹.2,15,653 to ₹. 4,15,847, 11.68 per cent with annual income above ₹.4,15,848 and 9.17 per cent up to ₹.2,15,652 annual income.

2.1.1.15 Profitability

Keerthi (2008) on a study on economic analysis on production and marketing of pineapple in Shimoga district of Karnataka reported that the average net return/year of pineapple cultivation was ₹.5,33,155.26.

Baruwa (2013) reported from his study on profitability and constraints of pineapple production in Osun state of Nigeria that the gross margin and return from pineapple production were ₦1,82,725 and ₦1,62,045, respectively.

Bhat *et al.* (2017) conducted a study on profitability and marketing of fruit and vegetable crops in Chenani block of Udhampur district of Jammu and Kashmir and found that the net return per hectare was found to be ₹.2,045.52 for maize, ₹.1,538.37 for mustard, ₹.2,58,272.86 for tomato, ₹.14,616.23 for cucumber, ₹.1,60,944.32 for radish, ₹.32,675.24 for beans and ₹.85,080.68 for garlic. In case of fruits, the net return per hectare for walnut, Apricot Khubani and Plum Aloobukhara were ₹.55,180.69, ₹.1,085.50 and ₹. 401.67 respectively.

Afzal *et al.* (2018) from their study on growth analysis of productivity, dispersal and profitability of pineapple in India observed that the performance of north-eastern states is comparatively lower than the southern states of Kerala and Karnataka. During 2015-2016, the areas of high productivity include Karnataka (62.74 mt/hectare, West Bengal (30.01 mt/hectare), and Kerala (27.86 mt/hectare), while Manipur (9.41 mt/hectare) and Meghalaya (10.64 mt/hectare) come under low productivity area. Nagaland state had productivity of 14.2

mt/hectare. Lack of adequate farm management techniques, lack of financial assistance for buying chemical and bio fertilizers, lack of knowledge about updated technologies of pineapple cultivation to the farmers specially in Nagaland, Manipur and Meghalaya and lack of financial assistance to the pineapple growers in states like West Bengal, Bihar and Orissa were some of the factors which hindered in its productivity.

Alam and Usmani (2019) from their study on pineapple cultivation in Uttar Dinajpur district of West Bengal reported that the gross return for own land was ₹.2,69,968.6/hectare while it was ₹.3,15,394.4/hectare for leased/rented land. It was also found that the net return for own land was ₹.70,178.8/hectare and ₹.53,423.3/hectare for leased/rented land.

Kausadikar (2019) revealed from their study on sweet orange in Marathwada region of Maharashtra that the net profit was ₹.1,31,665.75/hectare.

Rymbai *et al.* (2019) observed from their study on pineapple growers in Meghalaya state that the net returns on small (up to 1.99 ha), medium (2 to 3.99 ha) and large (4 ha and above) farms were found to be ₹.50,795.07, ₹.51,637.23 and ₹.63,401.94 respectively. The gross return was ₹.1,20,600.29, ₹.1,36,340.93, ₹. 1,65,060.18 for small, medium and large farms respectively.

Suhaimi and Fatah (2019) observed from their study on profitability of pineapple production among smallholders in Malaysia that that the gross margin for pineapple cultivation was RM57,202.04 and the net return profit per hectare was RM36,174.01.

Uddin *et al.* (2022) from their study on financial profitability and value chain analysis of pineapple in Tangail, Bangladesh that the estimated gross margin and net return from pineapple production was Tk. 540,000 and Tk. 2,02,813/hectare, respectively.

2.1.1.16 Productivity

Keerthi (2008) conducted an economic analysis on production and marketing of pineapple in Shimoga district of Karnataka that the productivity of pineapple in the study area was found to be 66 tonnes/hectare.

Rymbai *et al.* (2019) from their study on pineapple growers in Meghalaya state found that the productivity of pineapple orchard was 18.68 t/ha, 18.70 t/ha and 21.99 t/ha on small (up to 1.99 ha), medium (2 to 3.99 ha) and large (4 ha and above) category.

Bidve *et al.* (2021) revealed from their study on pomegranate growers in western Maharashtra that 57.22 per cent growers had medium level of productivity which ranged from 17 to 51 ton /ha while 23.61 percent and 19.17 per cent growers had low and high level of productivity of pomegranates respectively.

Poudel *et al.* (2022) reported from their study on mandarin growers in Myagdi district of Nepal that the average productivity of mandarin was 12.39 Mt/ha in the year 2019/020 and 10.82 Mt/ha in the year 2020/021.

2.1.1.17 Household vulnerability

Han *et al.* (2009) developed an index system for calculating the Livelihood Vulnerability Index that incorporated the IPCC (Intergovernmental Panel on Climate Change) vulnerability definition. The vulnerability was assessed on seven major components; socio- demographic profile, livelihood, health, social networks, food, water and natural disasters and climate variability where each component is comprised of sub-components. They found from their study that the vulnerability index on socio-demographic profile was higher for Mabote (0.411) compared to Moma (0.175). Mabote also showed greater vulnerability on the livelihood strategies component (0.297) than Moma (0.246). It was also found that for social networks component, Mabote households were more vulnerable (0.480) compared to Moma households (0.475). In case of health component, the vulnerability index was higher for Moma (0.317) than Mabote (0.241). Moma households had slightly higher vulnerability (0.364) for major component food than Mabote households (0.361). Mabote households showed lower vulnerability (0.099) for water component compared to Moma (0.370). For natural disaster and climate variability major component, Mabote households (0.409) were more vulnerable than Moma households (0.312). Mabote households were found to have higher (0.326) overall Livelihood Vulnerability Index (LVI) than Moma households (0.316).

Etwire *et al.* (2013) found from their study that the vulnerability index for water component of the LVI for Upper West region was 0.489 followed by Upper East region (0.427) and Northern region (0.371). In terms of socio-demographic profile component, Northern region (0.326) was found to be the most vulnerable followed by Upper East (0.307) and Upper West (0.301). Upper East region was found to be most vulnerable (0.582) in terms of livelihood strategies component followed by Upper West (0.576) and Northern region (0.528). Under major component social networks, Upper East region was found most vulnerable (0.54) followed by Northern region (0.538) and least vulnerable was Upper West region (0.505). Northern region was most vulnerable (0.259) in case of health component followed by Upper West (0.232) and Upper East region (0. 174). Upper West (0.348) was found to be the most vulnerable under the food major component followed by Upper East (0.336) and Northern region (0.324). Under natural disasters and climate variability component, Northern region (0.452) was most vulnerable, Upper East (0.424) moderate vulnerable and Upper West region (0.391) least vulnerable.

Madhuri *et al.* (2014) applied the livelihood vulnerability index (LVI) of Hahn *et al.* (2009) with slight modifications in their study to identify the variability in vulnerability of affected households in seven blocks of Bihar district. The vulnerability of socio-demographic profile was highest in Bihpur

(0.37), followed by Kharik (0.33), Ismailpur (0.32), Gopalpur (0.30), Rangra Chowk (0.29), Narayanpur (0.27) and lowest in Naugachia (0.21). Under the major component of livelihood strategies, the highest vulnerability was observed in Naugachia (0.41) and lowest in Narayanpur (0.26). The vulnerability of social network component was highest in Narayanpur (0.44) followed by Kharik (0.42), Rangra Chowk (0.41), Gopalpur (0.41), Bihpur (0.40), Ismailpur (0.34) and lowest in Naugachia (0.25). The highest vulnerability for food component was found in Gopalpur (0.49) and lowest in Kharik (0.31). Narayanpur (0.36) and Ismailpur (0.36) were found to be most vulnerable under the component natural capital and least vulnerable was observed in Naugachia (0.28). In case of water component, the most vulnerable was Narayanpur (0.38) followed by Gopalpur (0.36), Bihpur (0.35), Ismailpur (0.35), Rangra Chowk (0.34), Kharik (0.31) and Naugachia (0.25). Gopalpur (0.39) was observed to be the most vulnerable incase of health component and least vulnerable was Naugachia (0.28) and Kharik (0.28). Under natural disaster component, the vulnerability was highest in Naugachia (0.39), followed by Kharik (0.35), Rangra Chowk (0.34), Ismailpur (0.34), Narayanpur (0.33), Bihpur (0.33) and Gopalpur (0.32). The highest overall LVI was Narayanpur (0.34), Bihpur (0.34), Rangra Chowk (0.34), followed by Gopalpur (0.33), Kharik (0.33), Ismailpur (0.31) and Naugachia (0.30).

Panthi *et al.* (2015) conducted a study on the topic Livelihood vulnerability approach to assessing climate change impacts on mixed agro-livestock smallholders around the Gandaki River Basin in Nepal. Han *et al.* (2009) approach to LVI was followed in their study. Dhading smallholders were found to be more vulnerable in socio-demographic profile, water, natural disaster and climate variability components. Kapilvastu had more vulnerability in the livelihood strategies, social networks, and health and food components. Overall, Dhading (0.2889) had higher LVI than Kapilvastu (0.2883) and Syangja (0.2592).

Amuzu *et al*. (2018) used LVI by Hahn *et al.* (2009) in to study households' Livelihood vulnerability to climate change and climate variability in the Gambia. The major component socio-demographic profile showed greater vulnerability for Lower Niumi (0.273) district than Kombo South (0.229). For livelihood strategies component, Lower Niumi (0.501) showed greater vulnerability than Kombo South (0.495). Lower Niumi (0.501) was found to have greater vulnerability than Kombo South (0.453) in social networking component. In case of health component, Kombo South (0.435) had higher vulnerability than Lower Niumi (0.384). Kombo South (0.537) was also found to have higher food vulnerability than Lower Niumi (0.347). Water component had greater vulnerability for Lower Niumi (0.31) than Kombo South (0.262). In case of Natural Disasters and Climate Variability component, vulnerability score for Kombo South (0.441) was higher than Lower Niumi (0.441). The overall LVI score showed that Kombo South (0.404) was more vulnerable than Lower Niumi (0.391).

Shahzad *et al.* (2019) in their study evaluated livelihood vulnerability through a composite indicator as livelihood vulnerability index (LVI) and LVI-IPCC. It was found that union council (UC) Balakot (0.43) had higher overall LVI than UC Kawai (0.33). UC Balakot (0.4) had higher vulnerability for socio-demographic profile major component than UC Kawai (0.28). UC Balakot (0.32) had higher vulnerability than UC Kawai (0.24) in case of livelihood strategies. For social networks component, UC Balakot (0.43) was more vulnerable than UC Kawai (0.33). Under health component, UC Kawai (0.45) had slightly higher vulnerability than UC Balakot (0.46). UC Kawai (0.34) was also found to have higher vulnerability than UC Balakot (0.24) under major component food. In case of water issues component, UC Balakot (0.49) had higher vulnerability than UC Kawai (0.45). Under natural disasters major component, UC Balakot (0.78) was highly vulnerable compared UC Kawai

(0.52). Both the UCs were found to have equal vulnerability (0.172) in case of climate variability component.

Suryanto and Rahman (2019) in their study applied the LVI calculations by Han *et al.* (2009) which consisted of seven major components; Socio-demographic profile, Livelihood strategies, Health, Food, Water, Social networks and Natural disasters and climate variability. Under socio-demographic component, it was found that Sonorejo village was more vulnerable at 0.235 compared to Jiwo Wetan village at 0.336. In case of livelihood strategy, Jiwo Wetan village (0.499) was more vulnerable compared to Sonorejo village (0.392). The level of vulnerability for food component in Sonorejo and Jiwo Wetan villages were 0.426 and 0.445 respectively. Under water component, the vulnerability index for Sonorejo village was 0.274 while the vulnerability index for Jiwo Wetan village was 0.145. The vulnerability index for social network and Natural disasters and climate variability components in Sonorejo village was very high (0.482 & 0.495) compared to Jiwo Wetan village at 0.203 and 0.208 respectively. Overall, the LVI index was found to be 0.355 for Sonorejo village and 0.275 for Jiwo Wetan village.

Thao *et al.* (2019) used livelihood vulnerability index (Han *et al.*, 2009) and the IPCC vulnerability index to assess Livelihood Vulnerability to Drought in Vietnam. The study revealed that Quang Phu community (0.248) had the most vulnerable socio-demographic profile major component followed by Nam N’dir (0.246), Krong No District (0.168), Duc Xuyen (0.130), Dak D’ro (0.113) and Dak Nang (0.103). The highest vulnerability for livelihood strategy component was found in Quang Phu community (0.748) and the least vulnerability was in Dak D’ro (0.603). In case of food component, the highest vulnerability was observed in Nam N’dir community (0.472) followed by Dak D’ro (0.468), Quang Phu (0.455), Krong No District (0.429), Dak Nang (0.380) and Duc Xuyen (0.370). The highest vulnerability under water component was in Dak Nang (0.884), followed by Quang Phu (0.855), Nam N’dir (0.839), Krong No

District (0.774), Dak D’ro (0.647) and Duc Xuyen (0.644). Under health component, Quang Phu (0.446) had the highest vulnerability and Dak D’ro (0.255) had the least vulnerability. Nam N’dir (0.458) had the highest social network component vulnerability followed by Quang Phu (0.419), Duc Xuye (0.358), Krong No District (0.353), Dak D’ro (0.268) and Dak Nang (0.260). Quang Phu (0.399) was the most affected when it came to drought component and least affected was Duc Xuyen (0.367). Quang Phu (0.510) had the highest overall livelihood vulnerability index followed by Nam N’dir (0.486), Krong No District (0.444), Dak Nang (0.427), Duc Xuyen (0.404) and Dak D’ro (0.392).

Shen *et al.* (2022) applied a composite HLVI-IPCC and multiple regression model to estimate household livelihood vulnerability to climate change in West China. Their study revealed that Ningxia was the most vulnerable to with an HLVI of 0.449 compared to Gansu, at 0.439; Yunnan, at 0.37; and Guangxi, at 0.36.

Venus *et al*. (2021), the Livelihood Vulnerability Index (LVI) developed by Hahn *et al.* (2009) and LVI- IPCC was used in their study conducted in the Indo- Gangetic Plains. Their study revealed that the vulnerability for socio-demographic profile major component was higher for Vaishali district (0.236) than Karnal district (0.173). Karnal district (0.674) had higher vulnerability for livelihood strategies than Vaishali district (0.658). In case of health and food components, Vaishali district was found to be highly vulnerable compared to Karnal district with index values of 0.591 and 0.507 for Vaishali and 0.376 and 0.181 for Karnal respectively. Karnal district (0.468) was more vulnerable for water component compared to Vaishali district (0.366). Under social networks component, Vaishali district was more vulnerable with an index value of 0.708 than Karnal district (0.623). Vaishali district (0.306) had higher natural disaster and climate variability vulnerability compared to Karnal district (0.298). Vaishali district (0.44) had higher overall LVI compared to Karnal district (0.35).

2.1.2. Communication characteristics of the pineapple growers

2.1.2.1 Sources of information utilized

Das *et al*. (2019) identified from their study that more than half (66.67%) of pineapple growers from selected districts of Tripura had medium level of sources of information utilised followed by 18.75 per cent of both low and high level of sources of information utilised.

Bidve *et al*. (2021) conducted a study on socio-economic, communicational and psychological characteristics of pomegranate growers from western Maharashtra and found that 61.66 per cent of the respondents had medium level use of all sources of information followed by 22.78 per cent (low level) and 15.56 per cent (high level) use of all sources of information

Karangami *et al.* (2021) revealed from their study on sources of agricultural information in utilization pattern of pesticides by grape growers that 67.92 per cent of the respondents had medium level of use of information sources followed by 20.41 per cent and 11.67 per cent having low and high level of use of information sources respectively.

Patra and Kense (2021) conducted a study on socio-economic features of Mandarin (Citrus Reticulata Blanco) grower in Nagaland and revealed that under formal information sources, about 3.33 per cent of the mandarin growers received information most from the functionaries of NGO. Further, 10.00 per cent of them received information often from the functionaries of the Land Resource Department. In case of informal information sources, 70.83 per cent received information most frequently from neighbours, followed by 25 per cent from friends, 15 per cent from relatives and 5 per cent from progressive farmers. Under mass media sources of information, 12.50 per cent and 9.17 per cent received information sometimes from radio and television. 12.50 per cent of the respondents were found to have received information from the newspaper.

Kharlukhi and Jha (2021) in their study on entrepreneurial behaviour of horticultural farmers found that majority (68.13%) of the respondents had medium level of information source utilization followed by low level (16.25%) and high level (15.62%) of information source utilization.

Rabina *et al.* (2021) conducted a study on knowledge of the pineapple growers towards improved pineapple production practices in Imphal East District of Manipur and revealed from their study that majority (67.50%) of the respondents had medium level of source of information followed by low level (16.66%) and high level (15.87%) of sources of information.

Das *et al.* (2022) revealed from their study on information sources utilization among potato farmers in North East India found that under Assam and Tripura states, utilization of informal information sources was ranked first followed by mass-media and formal sources of information. In case of Meghalaya and Nagaland states, informal information sources utilization was ranked first followed by formal information sources and mass-media.

Hiwarale *et al*. (2023) revealed from their study on profile of sweet orange growers that 61.67 per cent of the orange growers had medium level of sources of information and 22.5 per cent and 15.83 per cent had low level and high level of sources of information respectively.

2.1.2.2 Extension contact

Akter *et al.* (2018) revealed from their study on pineapple production at Madhupur Upazila of Tangail district of Bangladesh that majority (73.00%) of the respondents had no extension contacts while only 27.00 per cent had extension contacts.

Balogun *et al*. (2018) revealed from their study on pineapple that 63.4 per cent of the respondents had no contact with extension agent whereas only 36.6 per cent had contact with extension agent.

Ahmed (2019) from his study on organic farming practices in Southern Karnataka observed that 37.50 per cent of the respondents had high level of extension contact while 36.67 per cent 25.83 per cent of them had medium and low level of extension contact respectively.

Wani *et al*. (2019) conducted a study on apple growers in Kashmir valley and found that more than half (53.50%) of the respondents had medium level of extension contact followed by low (27.50%) and high (19.00%) level of extension contact.

Ali (2022) from their study on farming system in Arunachal Pradesh reported that 46.00 per cent of the respondents had medium level of extension contact followed by high (40.00%) and low (10.00%) of extension contact.

Hiwarale *et al.* (2023) conducted a study on sweet orange growers in Marathwada region of Maharashtra and found that 55.83 per cent of the respondents had medium level of extension contact while 24.17 per cent and 20.00 per cent had low and high level of extension contact respectively.

Jadhav *et al.* (2023) revealed from their study on pomegranate growers in Aurangabad district of Marathwada region that 67.50 per cent of the pomegranate growers had medium level of extension contact. 17.50 per cent of the respondents had high level and 15.00 per cent of them had low level of extension contact.

2.1.2.3 Social Participation

Ramesh and Singh (2016) in their study of behavioural traits of grape exporters in Maharashtra that more than half (55.6%) of the respondents had medium level of social participation.

Amaladeepan and Pushpa (2018) conducted a study on profile characteristics of banana growers in Thoothukudi district of Tamil Nadu and found that majority (87.50%) of the banana growers had medium level of social participation followed by high (7.50%) and low (5.00%) level of social participation.

Dharmanand *et al.* (2020) revealed from their study on organic farming that more than half (55.00%) of the respondents had medium level social participation followed by low (31.67%) and high (13.33%) level of social participation.

Saryam and Jirli (2020) found from their study on socio economic status of orange farmers in Chhindwara district of Madhya Pradesh that 56.5 per cent of the respondents had medium level organisational participation followed by low (32.5%) and high (11.00%) level organisational participation.

Kharlukhi and Jha (2021) revealed from their study that majority (71.25%) of the respondents had medium level social participation followed by low (20.00%) and high (8.75%) level of social participation.

Jhansi and Kalal (2022) observed from their study on post-harvest activities of dry chilli in Byadgi APMC of Karnataka and Guntur APMC of Andhra Pradesh that half (50.00%) of the respondents had medium level social participation followed by high (35.00%) and low (15.00%) level social participation respectively.

Hiwarale *et al.* (2023) reported from their study on profile of sweet orange grower that 63.33 per cent of the respondents had medium level social participation while 22. 50 per cent and 14.17 per cent of the respondents had low and high level of social participation respectively.

Jadhav *et al*. (2023) conducted a study on profile characteristics of pomegranate cultivators Aurangabad district of Maharashtra and found that majority (70.83%) of the respondents had medium level of social participation followed by high (17.50%) and low (11.67%) level of social participation.

2.1.2.4 Training exposure

Akter *et al.* (2018) from their study on efficiency of pineapple production at Madhupur Upazila of Tangail district of Bangladesh found that majority (85.00%) of the respondents did not attend training programmes while only 15.00 per cent pf them had attended training programmes.

Patra *et al.* (2018) concluded from their study on mandarin growers in Upper Subansiri district of Arunachal Pradesh that 69.00 per cent of the mandarin growers have not attended training while 31.00 per cent have attended training on mandarin cultivation.

Datta *et al.* (2020) revealed from their study on pineapple farmers in Moulvibazar district of Bangladesh that 65.9 per cent of small farmers, 76.7 per cent of medium farmers, half (50.00%) of large farmers and overall (65.00%) of the respondents received one day training every month on pineapple cultivation.

Adikhari *et al.* (2021) concluded from their study on mandarin orchard management in Dailekh, Nepal that 55.00 per cent of mandarin farmers received training while 45.00 per cent of them did not receive training on mandarin cultivation.

Patra and Kense (2021) observed from their study that 65.83 per cent of the mandarin growers did not attend trainings whereas only 34.17 per cent of them had attended training on mandarin cultivation.

Rhonben *et al.* (2021) reported from their study on pineapple cultivation in Dimapur district of Nagaland that 76.67 per cent of the respondents have attended training and 23.33 per cent have not attended any training on pineapple cultivation.

Kakki *et al.* (2022) conducted a study on mandarin growers in Arunachal Pradesh and reported that 66.67 per cent of the mandarin growers had no training exposure while 33.33 per cent had training exposure.

2.1.3. Psychological characteristics of the pineapple growers

2.1.3.1 Innovativeness

Amaladeepan and Pushpa (2018) found from their study on profile characteristics of banana growers in Thoothukudi district of Tamil Nadu that more than half (57.67%) of the banana growers had medium level innovativeness while 35.83 per cent and 7.50 per cent had high and low level innovativeness respectively.

Mir *et al* (2019) conducted a study on apple growers in Kashmir valley of Jammu and Kashmir and observed that majority (84.00%) of the respondents had medium level innovativeness followed by low (13.00%) and high (3.00%) level innovativeness.

Sunitha (2019) revealed from her study on sustainability of farming system in Karnataka that 40.83 per cent of the respondents had medium level innovativeness followed by high (34.17%) and low (25.00%) level of innovativeness.

Dharmanand *et al.* (2020) conducted a study on attitude of farmer towards organic farming in Jabalpur district of Madhya Pradesh and found that more than half (57.50%) of the respondents had medium level innovativeness, 23.33 per cent had high level and 19.17 per cent had low level innovativeness.

Rashid *et al.* (2021) reported from their study on apple growers in Kashmir valley of Jammu and Kashmir that majority (75.62%) of the respondents had medium level innovative proneness while only 16.87 per cent and 7.00 per cent of them had low and high level of innovative proneness respectively.

Londhe and Kadam (2023) conducted a study on farmers practicing organic practices in selected districts of Maharashtra and found that more than half (69.44%) of the respondents had medium level innovativeness followed by low (18.33%) and high (12.23%) level innovativeness.

2.1.3.3 Risk taking ability

Amaladeepan and Pushpa (2018) found from their study on banana growers in Thoothukudi district of Tamil Nadu that 56.67 per cent of the respondents had medium level risk orientation while 25.83 per cent and 17.50 per cent of them had high and low level risk orientation respectively.

Shwetha and Shivalingaih (2018) observed from their study on farmers adopting different farming systems in Chickaballapura District of Karnataka that majority (75.83%) of the respondents had medium level risk bearing ability followed by high (13.33%) and low (10.83%) level risk bearing ability.

Sunitha (2019) revealed from her study on sustainability of farming systems in selected agro-climatic zones of Karnataka that majority (70.83%) of the respondents had medium level while 15.00 per cent had high level and 14.17 per cent had low level risk bearing ability.

Kumar *et al*. (2021) conducted a study on assessment of socio-economic characteristics, knowledge and extent of adoption of improved papaya production technology in farmers of Muzaffarpur, Bihar and found that 49.67 per cent of the respondents had medium level risk orientation followed by high (29.17%) and low (21.67%) level of risk orientation.

Bidve *et al*. (2021) observed from their study that 56.67 per cent of the pomegranate growers medium level risk orientation while 24.44 per cent had low level and 18.89 per cent had high level risk orientation.

Kakki *et al*. (2022) reported from their study that majority (70.83%) of mandarin growers had medium level risk bearing ability followed by high (15.83%) and low (13.34%) level risk bearing ability.

Jadhav *et al*. (2023) revealed that more than half (68.33%) of the pomegranate growers had medium level risk orientation whereas 17.50 per cent and 14.17 per cent of them had low and high level risk orientation respectively.

2.1.3.3 Market innovativeness

According to Schumpeter (1942), market innovativeness is highly connected to product innovativeness, and often studied as product-market innovativeness.

According to Ali *et al*. (1995), market innovativeness is considered as identification of new market opportunities and entry into new markets.

Weerawardena (2003) described marketing innovation as new pricing methods, new distribution methods, new sales approaches, leasing arrangements, and entering a new market.

Gupta *et al*. (2016) defined marketing innovation as development of new services, new price-setting strategy, new advertising promotions, new distribution channels and marketing information systems.

Fuentes-Blasco *et al*. (2017) described marketing innovation as new techniques and tools to improve sales.

According to Lee *et al*. (2019), marketing innovativeness as firms' ability to approach the market, effectively use the channels of communication, and deliver product and service to capture potential or existing customers.

Thuita *et al.* (2023) concluded from their study innovativeness reflects the firm's ability to incorporate new ideas and creative processes that may result in new products, markets, or technological process.

2.1.3.9 Achievement motivation

Ramesh and Singh (2016) conducted a study on grape growers in Maharashtra and observed that 34.4 per cent had medium level achievement motivation, followed by low (25.56%), high (21.1%), very high (12.2%) and low (6.7%) level of achievement motivation.

Ahmed (2019) revealed from his study on organic practices in Southern Karnataka that 43.33 per cent of the respondents had medium level achievement motivation while 36.67 per cent had high level and 20.00 per cent of them had low level of achievement motivation.

Sunitha (2019) reported from her study on sustainability in Karnataka that 47.50 per cent of the respondents had medium level achievement motivation followed by high (29.17%) and low (23.33%) level of achievement motivation.

Kamble *et al.* (2022) observed from their study on rural youth towards farming in Latur district of Maharashtra that 47.50 per cent of the respondents had medium level achievement motivation while 30.83 per cent and 21.67 per cent of them had high and low level achievement motivation respectively.

Kumar *et al.* (2022) conducted a study on dairy entrepreneurs in Udaipur district of Rajasthan and revealed that majority (68.33%) of the respondents had medium level achievement motivation followed by low (16.67%) and high (15.00%) level achievement motivation.

2.1.3.5 Decision making ability

Raut (2018) conducted a study on entrepreneurial behaviour of gram seed producer and found that 73.33 per cent of gram seed producers had medium level decision making ability followed by low (15.84%) and high (10.83%) level of decision making ability.

Shwetha and Shivalingaih (2018) observed from their farmers adopting different farming systems in Chickaballapura district of Karnataka revealed that more than half (61.66%) of the respondents had medium level decision making ability while 22.50 per cent and 15.83 per cent had low and high level decision making ability respectively.

Gaware (2019) revealed from his study on entrepreneurial behaviour of onion seed producers and reported that majority (71.67%) of the onion seed producers belonged to medium decision making ability category followed by 15.83 per cent of them were in high and 12.50 per cent of them were in low level of decision making ability, respectively.

Mali (2020) in her study on seed growers in selected districts of North Karnataka found from his study on that 44.50 per cent had medium level decision making ability while 30.00 per cent and 25.50 per cent had low and high level decision making ability respectively.

Ali (2022) observed from her study in Arunachal Pradesh that 44.00 per cent of respondents had medium level decision making ability while 36.00 per cent had high level and 20.00 per cent had low decision making ability.

Gayathri and Sahana (2022) in their study on fruit and vegetable growers that majority (77.50%) of the respondents had medium level decision making ability followed by low (12.50%) and high (10.00%) level decision making ability.

2.1.3.7 Management orientation

Chitra and Ramanna (2017) reported from their study on farmers practicing selected farming systems in Mandya district of Karnataka that 56.7 per cent of the respondents had medium level management orientation, 30.00 per cent had high level and 13.3 per cent had low level management orientation.

Shwetha and Shivalingaih (2018) conducted a study on farmers adopting different farming systems in Chickaballapura district of Karnataka and found that 49.16 per cent of the respondents had medium level management orientation 31.66 per cent and 19.16 per cent had high and low level management orientation respectively.

Farooq *et al.* (2020) revealed from a study conducted on entrepreneurial behavior of grape growers in Ganderbal district of Jammu and Kashmir that 59.00 per cent of the respondents had medium level management orientation, 21.00 per cent had low level and 20.00 per cent had high level of management orientation.

Jamir and Jha (2020) in their study on king chilli growers in Peren district of Nagaland that more than half (67.50%) of the respondents had medium level management orientation followed by high (16.67%) and low (15.53%) level of management orientation.

Khan *et al.* (2021) from their study on farm women in Navsari district of south Gujarat found that more than half (66.00%) of the respondents had medium level management orientation while 20.00 per cent and 14.00 per of them had high and low level management orientation respectively.

Bushetti and Krishnamurthy (2022) revealed from their study on entrepreneurial behaviour of Byadagi chilli growers in Haveri district of Karnataka that 53.89 per cent of the respondents had medium level of management orientation while 29.44 per cent had low level and 16.67 per cent had high level of management orientation.

Kakki *et al.* (2022) revealed from their study on mandarin growers in Arunachal Pradesh that majority (70.83%) of the respondents had medium level management orientation followed by high (16.67%) and low (12.50%) level management orientation.

2.1.3.7 Scientific orientation

Amaladeepan and Pushpa (2018) found from their study on banana growers in Thoothukudi district of Tamil Nadu that majority (60.00%) of the respondents had medium level scientific orientation followed by low (27.50%) and high (12.50%) level of scientific orientation.

Ahmed (2019) revealed from his study on organic farmers in Southern Karnataka that majority (48.33%) of the respondents had medium level scientific orientation followed by high (30.00%) and low (21.67%) level scientific orientation.

Bidve *et al*. (2021) reported that 60.00 per cent of the pomegranate growers had medium level scientific orientation. It was also found that 22.22 per cent and 17.78 per cent of them had high and low level scientific orientation respectively.

Kharlukhi and Jha (2021) observed that majority (75.00%) of the respondents had medium level scientific orientation while 13.75 per cent and 11.25 per cent had high and low level scientific orientation respectively.

Rashid *et al*. (2021) revealed from their study that 75.00 per cent of the apple growers had medium level scientific orientation whereas 17.81 per cent and 7.18 per cent had low and high level scientific orientation respectively.

Gayathri and Sahana (2022) found from their study on socio-economic profile of fruits and vegetable growers that 82.50 per cent of the respondents in public market intervention had medium level of scientific while, farmers in co-operative (72.50%) and private (60.00%) market intervention had medium level scientific orientation.

Jadhav *et al*. (2023) identified that 58.33 per cent of the respondents had medium level scientific orientation followed by 29.17 per cent low level and 12.50 per cent high level of scientific orientation.

2.1.3.8 Economic motivation

Amaladeepan and Pushpa (2018) from their study on banana growers in Thoothukudi district of Tamil Nadu revealed that 41.67 per cent of the respondents had medium level of economic motivation followed by high (30.83%) and low (27.50%) level of economic motivation.

Farooq *et al.* (2020) from their study on entrepreneurial behavior of grape growers in district Ganderbal of Jammu and Kashmir observed that majority

(73.00%) of the respondents had medium level of economic motivation, 19.00 per cent had high level and 8.00 per cent had low level of economic motivation

Jamir and Jha (2020) conducted a study on entrepreneurial behaviour of king chilli growers in Peren district of Nagaland and found that majority (90.83%) of the growers had medium level of economic motivation followed by high (7.50%) and low (1.67%) level of economic motivation.

Khan *et al.* (2021) reported from study conducted on farm women in Navsari district of south Gujarat that 48.00 per cent of the women farmers had moderate level of economic motivation while 27.00 per cent and 25.00 per cent had high and low level of economic motivation respectively.

Gayathri and Sahana (2022) observed from their study on fruits and vegetable growers in Davangere district of Karnataka that more than half (65.50%) per cent of the respondents had medium level of economic motivation, 22.50 per cent had high level and 15.00 per cent had low level of economic motivation.

Kamble *et al.* (2022) found from their study on rural youth towards farming in Latur district of Marathwada region of Maharashtra that 49.17 per cent of the respondents had medium level of economic motivation followed by high (33.33%) and low (17.50%) level of economic motivation.

2.1.3.9 Market Orientation

Jamir and Jha (2020) revealed from their study on king chilli growers in Peren district of Nagaland that almost all (99.17%) of the respondents had medium level of market orientation whereas only 0.83 per cent had low level of market orientation.

Gayathri and Sahana (2022) reported from their study on fruits and vegetable growers in Davangere district of Karnataka that majority (8.50%) of the respondents had medium level of market orientation while only 10.00 per cent and 2.50 per cent had low and high level of market orientation respectively.

Lairenjam *et al.* (2022) conducted a study on MOVCDNER beneficiaries of Imphal east district of Manipur which revealed that more than half (66.00%) of the respondents had medium level of market orientation, 25.00 per cent had low level and 9.00 per cent had high level of market orientation.

Hiwarale *et al.* (2023) conducted a study on sweet orange growers and found that more than half (60.83%) of the respondents had medium level of market orientation followed by high (20.83%) and low (18.33%) level of market orientation.

2.2. Knowledge level of the pineapple growers about sustainable cultivation practices

Prashanth *et al.* (2018) reported from their study on improved cultivation practices of pomegranate crop in Chitradurga district of Karnataka that 55.83 per cent of the respondents had medium knowledge level followed by high (23.33%) and low (20.84%) knowledge level. Personal characteristics of the respondents such as age, education, farming experience, land holding, annual income, mass media participation and innovative proneness were found to have a positive and significant relationship with the knowledge.

Jamir and Jahanara (2019) revealed from their study on pineapple farmers in Dimapur district of Nagaland that half (50.00%) of the respondents had medium level of knowledge about improved management practices while 33.33 per cent and 16.67 per cent had high and low level of knowledge respectively.

Kaur *et al.* (2020) conducted a study on knowledge level of the farmers about fruit cultivation practices in Mohali district of Punjab and found that 43.50 per cent of the respondents had followed by low (33.00%) and high (23.50%) knowledge level.

Patra and Kense (2020) observed from their study on mandarin growers in Nagaland that majority (75.84%) of the respondents had medium knowledge level of improved cultivation practices of mandarin while only 13.33 per cent and 10.83 per cent had high and low knowledge level respectively. Furthermore, socio-economic factors such as type of house, education, size of total land holding, size of land holding under mandarin, total annual income, income from mandarin, number of trees in the orchard, training exposure, social participation and mass media had positive and significant relationship with the knowledge level of the mandarin growers.

Wani *et al.* (2020) found from their study on apple growers of Kashmir Valley that variables namely education, mass media exposure, extension contacts, economic motivation, scientific orientation, innovative proneness and risk proneness had a positive and significant relationship with their knowledge level of the respondents.

Deb *et al*. (2021) from their study on pineapple farmers in the hilly area of Sreemangal Upazila under Moulvibazar district found that more than half (57.3%) of the respondents had medium level of knowledge followed by low (28.00%) and high (14.7%) level of knowledge. The study further revealed that variables such as age, educational qualification, annual income, experience of pineapple cultivation and communication exposure had significant positive relationship with their knowledge level on pineapple cultivation.

Kumar (2021) from his study on mango farmers in Lucknow district of Uttar Pradesh that variables such as adoption, attitude, social participation, caste, education, extension contact had highly significant and positive relationship with the knowledge level of mango growers about improved mango cultivation practices. Size of family and age had highly significant and negative relationship with knowledge. Variables such as material possession, marital status, and land holding were found to have significant and negative relationship with knowledge.

Kumar *et al.* (2021) revealed from their study on improved papaya production technology in Muzaffarpur, Bihar that more than half (52.50%) of the respondents had medium knowledge while 27.50 per cent and 20.00 per cent of them had high and low knowledge level respectively. It was also revealed that educational status, extension agency contact and risk bearing capacity had positive and significant association with the knowledge of the farmers on improved papaya production technology at 5 per cent level of probability. While variables like size of the land holding and economic motivation had positive and significant association with the knowledge level of the farmers improved papaya production technology at 1 per cent level of probability.

Rabina *et al.* (2021) conducted a study on pineapple growers towards improved pineapple production practices in Imphal East district of Manipur and observed that more than half (65.83%) of the respondents had medium level of knowledge while 20.83 per cent and 13.33 per cent of them had high and low knowledge level respectively. Further, the study revealed that the variables occupation, educational status, income, family size, landholding size, farm power, material possession, mass media exposure, extension contact, sources of information and membership had significant and positive relationship with the knowledge level of the respondents.

Moumita and Mazhar (2022) reported from their study on adoption of recommended cultivation practices regarding pineapple cultivation in Sepahijala district of Tripura that 51.67 per cent of the pineapple growers had medium knowledge level of recommended cultivation practices of pineapple followed by low (32.50%) and high (15.83%) knowledge level of recommended cultivation practices of pineapple. The study further revealed that age, caste, education, size of family, land holding, annual income, farming experience, extension agent contact, social participation, mass media exposure, source of information and risk orientation and economic motivation were positively and significantly correlated with knowledge of Pineapple growers towards Pineapple production practices.

Roy and Ghosh (2022) revealed from their study on pineapple cultivation in Tripura that variables family size, education, earning members of the family, available farm implement, annual income, annual expenditure, cultivable land, use of mass media were positively significant with knowledge level of the respondents.

2.3. Extent of adoption of sustainable cultivation practices among pineapple growers

Chanu *et al.* (2014) revealed from their study on adoption of pineapple cultivation practices by the farmers in Manipur state that majority (65.33%) of the respondents had medium extent of adoption followed by high (24.67%) and low (10.00%) level of adoption. The socio-economic attributes like education, land holding, annual income and attitude towards modern agricultural technology showed positive and significant relationship with the adoption level of the pineapple growers.

Marak *et al.* (2015) conducted a study on adoption of pineapple production technology in West Garo Hills district of Meghalaya and found that 42.00 per cent of the respondents had low level of adoption, 35.00 per cent had medium level and 23.00 per cent had high level of adoption of pineapple production technology. It was also found that variables size of landholding, area in pineapple cultivation, annual income, planning orientation, production orientation, market orientation, risk orientation, innovation proneness, economic motivation and farmers' attitude had positive and significant relationship with the adoption level of the respondents.

Singhal and Vatta (2017) from their study on improved agricultural practices found that 48.3 per cent of the respondents had medium level of adoption followed by high (35.8%) and low (15.8%) level of adoption. Their study further revealed that independent variables such as education, social participation, extension participation, knowledge, landholdings, annual income, mass media exposure, innovation proneness, economic motivation and extension contact had positive and significant relationship with the adoption level of the respondents.

Jamir and Jahanara (2019) revealed from their study on the knowledge and adoption level of pineapple growers about improved management practices in Dimapur district of Nagaland that 48.33 per cent of the respondents had medium level of adoption while 31.67 and 20.00 per cent of the respondents had high and low level of adoption of recommended practice of pineapple. Independent variables such as age, education, land holding, farming experience, type of house, family size, media exposure, extension contact, innovativeness and knowledge were found to be positively significant with the adoption level of the respondents.

Patra and Kense (2020) conducted a study on knowledge and adoption of improved cultivation practices of mandarin (Citrus Reticulata Blanco) growers in Nagaland and observed that majority (75.83%) of the respondents had medium level followed by high (17.50%) and low (6.67%) level of adoption of improved practices of mandarin cultivation. The study further revealed that socio-economic variables such as age, education, size of landholding under mandarin, total annual income, income from mandarin, number of trees in the orchard, experience in mandarin cultivation, training exposure, social participation and mass media showed a positive and significant association with status of adoption of improved mandarin cultivation practices of the respondents.

Kakki *et al.* (2022) in their study on adoption behaviour of Khasi mandarin growers tribal farmers in Arunachal Pradesh observed that majority (64.17%) of the respondents had medium level of adoption while 25.00 per cent and 10.83 per cent of the respondents had low and high level of adoption of recommended technology of mandarin. It was also revealed that socio-economic variables such as total land holding, area under mandarin orchard, total annual income, extension contacts, training exposure, management orientation and risk bearing ability were positively significant with the level of adoption of the respondents.

Lotha and Jha (2022) conducted a study on horticultural crops in Wokha district of Nagaland and found that majority (61.67%) of the respondents had medium level of adoption followed by high (23.33%) and low (15.00%) level of adoption. It was also found that independent variables family size, experience in cultivation, size of land holding, knowledge and attitude showed positive and significant relationship with the adoption of improved cultivation practices.

Roy and Ghosh (2022) reported from their study on pineapple growers in Tripura that farmer's attributes like age, family size, education, earning members of the family, available farm implement, annual income, annual expenditure, cultivable land, use of personal cosmopolite sources, use of mass media sources and knowledge level had positive and significant relationship with the adoption level of the farmers.

Warshini *et al.* (2022) from their study on adoption of banana production technology among banana growers in Vaishali district of Bihar found that majority (61.00%) of the respondents had medium level of adoption followed by low (24.00%) and high (15.00%) level of adoption of banana production technology. Further, variables such as education, family type, area under banana cultivation, annual income of banana, banana cultivation experience, risk orientation, extension contact and source of information were found to be positively and significantly correlated with the extent of adoption level, while age was found to be negatively but significantly correlated with the extent of adoption level of the pineapple growers.

2.4 Technological gap in adoption of sustainable cultivation practices among the pineapple growers

Roy *et al.* (2013) revealed from their study on pineapple cultivation in some selected areas of West Bengal that the technological gap was high for practices like treatment of planting material, desuckering, fertilizer application and micro nutrient application. It was also found that independent variables such as caste, education, category of farmer, family type, family size, size of holding, material possession, social participation, market orientation, production orientation, risk orientation, mass media exposure, personal cosmopolite, and personal localite were negatively and significantly associated with the technological gap of the respondents.

Das *et al.* (2017) carried out a study on pineapple productivity in Meghalaya and found that practice wise technological gap in fertilizer application, irrigation and pest control were 56.67 per cent, 46.58 per cent and 39.16 per cent respectively.

Roy and Bandyopadhyay (2019) from their study on technological gaps in pineapple cultivation in Darjeeling district of West Bengal revealed that the technological gap for marginal farmers ranged from 97.11 to 32.00 per cent. The highest technological gap was found in fertilizer application (97.11%). The second major technological gap (78.50%) was found in post- harvest practices. The technological gap in improved intercultural operations and pest, disease and other physiological disorder control were 62.66 per cent and 59.45 per cent respectively. The technological gap in case of small farmers ranged from 27.77 to 94.00 per cent. Technological gap in fertilizer application, intercultural operations, selection of variety and pest, disease and other physiological disorder control were 94.00 per cent, 56.16 per cent, 54.00 per cent and 44.36 per cent respectively. In case of medium farmers, the technological gap in fertilizer application, intercultural operations, selection of variety, irrigation and pest, disease and other physiological disorder control were 86.11 per cent, 38.50 per cent, 54.00 per cent, 31.00 per cent and 30.63 per cent respectively.

Yomgam *et al.* (2019) from their study on identification of technological gap in orange production technology in West Siang district of Arunachal Pradesh found that majority (69.00%) of the respondents had medium level of technological gap while 16.00 per cent had low level and 15.00 per cent had high level of technological gap. It further revealed that variables like education, extension participation, contact with extension agencies, innovative proneness and cosmopoliteness had a negative and significant relationship with the technological gap of orange production technology.

Rhonben *et al.* (2021) revealed from their study on pineapple cultivation in Dimapur district of Nagaland that the highest (100%) technological gap was found in recommended practices such as planting time, treatment of planting materials, manure and fertilizers, intercultural operations, growth regulators and Insect Disease Management. Technological gap was also reported in land preparation (52.78%) and irrigation (50.00%).

Sanghavi and Ekale (2021) reported from their study on technological gap in adoption of safflower production that variable age had positive and significant relationship with the technological gap of the safflower cultivators. Further, variables education, mass media exposure, innovativeness, market orientation, economic motivation and knowledge had negative and significant relationship with the overall technological gap of the respondents.

Shah *et al.* (2022) carried out a study on recommended practices of apple cultivation in Kashmir Valley and found that half (52.47%) of the respondents from Shopian district had medium level of technological gap followed by low (24.75%) and high (22.77%) technological gap. 45.53 per cent of the respondents from Budgam district had high technological gap while 40.70 per cent and 13.95 per cent had medium and low level of technological gap respectively. 53. 98 per cent of the respondents from Baramulla had medium level technological gap followed by high (30.97%) and low (15.04 %) level technological gap. Overall, it was found that 49.67 per cent of the respondents had medium level technological gap, 32.33 per cent high gap and 18.00 per cent low level of technological gap. Practice-wise, technological gap in preparation of land and planting for Shopian, Budgam and Baramulla farmers were 48.07, 67.09 and 63.61 respectively. In case of fertilizer application, technological gap Shopian, Budgam and Baramulla farmers were 69.35 per cent, 75.30 per cent and 70.86 per cent respectively. Technological gap in pest and disease management was 40.27 per cent, 66.51 per cent and 44.55 per cent for Shopian, Budgam and Baramulla farmers respectively. Further, socio- person characteristics such as age, education, annual income, innovative proneness, media exposure, extension contact, experience, economic motivation, risk orientation, scientific orientation and knowledge level had negative and significant relationship with the technological gap of the apple growers.

Hiwarale *et al.* (2023) revealed from their study on technological gap in adoption of recommended cultivation practices of sweet orange growers that 69.17 per cent had medium overall technological gap followed by low (17.50%) and high (13.33%) overall technological gap in adoption of recommended cultivation practices of sweet orange. Technological gap was observed in fertilizer application, water management and plant protection with a percentage of 47.91, 32.08 and 35.78 respectively.

Hiwarale *et al.* (2023) conducted a study on relationship between the profile of sweet orange growers with their extent of technological gap and found that variable experience was positively significant with the technological gap of the respondents while education, land holding, orchard size, annual income, extension contact, sources of information, risk orientation, social participation and market orientation had negative and significant relationship with the technological gap of the sweet orange growers.

Jadhav *et al.* (2023) conducted a study on pomegranate growers and observed that majority (77.50%) of the respondents had medium level of technological gap while 12.50 per cent had high and 10.00 per cent had low level of technological gap. Technological gap of 68.56 per cent, 22.29 per cent was found in pest management and land preparation practices respectively.

Jadhav *et al.* (2023) found from their study on pomegranate growers that independent variables, *viz.* education, social participation, extension contact, risk orientation, scientific orientation, mass media exposure and economic motivation had negative and significant relationship with technological gap. Land holding, orchard size, and knowledge had negative and highly significant relationship with the technological gap of pomegranate cultivators.

Marak *et al.* (2023) conducted a study on technological gap of tribal pineapple growers of Meghalaya, India and found that the average level of technological gap of pineapple growers from West Garo Hills was 61.78 per cent while the average level of technological gap of pineapple growers from Ri Bhoi district was 57.85 per cent.

2.5 Attitude of pineapple growers towards adoption of sustainable cultivation practices of pineapple

Kumar *et al.* (2012) found from their study knowledge and attitude of hill farmers towards improved agricultural practices that 51.66 per cent of the farmers had high level attitude towards improved agricultural practices while 45.83 per cent had medium level attitude and only 2.5 per cent of them had low level attitude towards improved agricultural practices. The socio-psychological variables, *viz.* education, landholding, farming experience, source of information utilization, annual income, scientific orientation and economic motivation, were positively and significantly related with attitude towards improved agricultural practices 0.01 level of probability.

Ghosh and Hasan (2013) conducted a study on farmers’ attitude towards sustainable agricultural practices and revealed that 65.6 per cent of the respondents that medium attitude followed by low (21.1%) and high (13.3%) attitude towards sustainable agriculture. Further, variables such as education, farm size, annual income, cosmopoliteness, extension and knowledge had positive and significant relationship with sustainable agriculture at 1% level significance.

Hasan *et al.* (2015) revealed from their study on Bangladeshi extension workers attitude towards sustainable agriculture that majority (70.00%) of the extension workers had moderate attitude towards sustainable agriculture and 15.00 per cent had low and high attitude towards sustainable agriculture. It was also revealed that variables such as sustainable agriculture training received, source of information communication and environmental awareness were found to have positive and significant relationship with the attitude of the extension workers towards sustainable agriculture.

Devi (2017) found from his study on organic farming that majority (67.00%) of the respondents were aware about organic farming while 18.00 per cent and 15.00 per cent were not aware and highly aware about organic farming respectively. Further, variables such as gender, age, education and family member positively and significantly influenced the farmers in attitude of farmers towards organic farming.

Patel *et al.* (2017) from their study on organic farming in Assam, India found that majority (67.51%) of the respondents had favourable attitude towards organic farming followed by highly favourable attitude (19.16%) and less favourable attitude (13.33%). The study further revealed that variables, *viz.* education, family size, occupation, land holding, herd size, annual income, mass media exposure, scientific orientation and innovativeness had positive and significant relationship with the attitude of the respondents while age had negative but significant relationship with the attitude of the respondents towards organic farming.

Rana *et al.* (2017) revealed from their study on farmer attitude towards organic vegetable cultivation in Rangunia Upazila, Chittagong, Bangladesh that majority (76.9%) of the respondents had favourable attitude followed by 18.5 per cent and 4.6 per cent of them had highly favourable and unfavourable attitude towards organic vegetable cultivation respectively. The study further revealed that variables level of education and agricultural training received were positively significant at 0.05 per cent level of probability with their attitude towards organic vegetable cultivation and extension media contact was positively significant at 0.01 per cent level of probability.

Alam and Usmani (2019) observed that 70.00 per cent of the pineapple farmers had positive response or agree to pineapple cultivation while 16.00 per cent were undecided about pineapple cultivation. 14.00 per cent of them disagreed to pineapple cultivation.

Ghosh *et al*. (2019) revealed from their study on farmers attitude towards organic farming in Chapainawabganj district that majority (80.00%) of the respondents had moderately favourable attitude towards organic farming followed by highly favourable attitude (12.5%) and unfavourable attitude (7.5%). Variables cosmopoliteness and extension contact had positive ad highly significant and significant relationship with the attitude of the respondents.

Nataraju *et al.* (2019) observed from their study that 42.00 per cent of the farmers had favourable attitude while 35.00 per cent and 23.00 per cent had more and less favourable attitude towards agriculture respectively. Further, the study revealed that variables such as, education, employment, risk orientation, innovative proneness, life style, mass media participation and extension participation of farmers were found to have a positive and significant to highly significant relationship with their attitude towards agriculture.

Pradip (2019) revealed from his study on attitude of farmers towards sustainable agricultural practices majority of the respondents (67.50%) had favourable attitude followed by unfavourable attitude (17.50%) and more favourable attitude (15.00%) towards sustainable agricultural practices. Variables like education, land holding, annual income, social participation and extension contact had positive and significant relationship with attitude of farmers towards sustainable agricultural practices. Variables like source of information and knowledge had positive and highly significant relationship with attitude of farmers towards sustainable agricultural practices.

Dharmanand *et al.* (2020) conducted a study on attitude of farmer towards organic farming in Jabalpur District of Madhya Pradesh and revealed that majority (70.00%) of the farmers had favourable attitude towards organic farming followed by 23.33 per cent natural attitude and 6.67 per cent unfavourable attitude. Also, variables such as livestock possession, extension participation, information source, mass media exposure, innovativeness, knowledge level and adoption level were found to be significantly associated with attitude towards organic farming.

Ingale (2020) found from her study on organic farming in Ratnagiri district of Konkan region and found that majority (69.00%) respondents had favourable attitude towards organic farming, while18.00 per cent and 13.00 per cent had most favourable respondents and unfavourable attitude towards organic farming respectively. Further, variables, *viz.* age, education, livestock possession, mass media, social participation, innovativeness, knowledge and organic farming practices followed by the respondents had positive and significant association with their attitude towards organic farming.

Kharlukhi and Jha (2021) reported from their study that majority (70.63%) of the horticultural farmers had favourable attitude towards improved practices whereas, 15.62 per cent and 13.75 per cent of the respondents had more favourable and less favourable attitude towards improved practices respectively.

Londhe and Kadam (2022) revealed from their study on farmers attitude towards organic farming in Marathwada region that majority (60.00%) of the respondents had favourable attitude while 23.34 per cent had less favourable attitude and 16.66 per cent had most favourable attitude towards organic farming.

Londhe and Kadam (2023) from their study on organic farmers found that variables namely education, annual income, social participation, mass media exposure, scientific orientation, economic motivation, innovativeness and knowledge had positive and high significantly relationship with the attitude towards organic farming. Variable area under organic cultivation was positively and significantly related with the attitude towards organic farming.

2.6. Determinants of knowledge and adoption in relation to sustainable cultivation practices of pineapple

2.6.1 Direct, indirect and largest indirect effects of independent variables on knowledge level of sustainable cultivation practices of pineapple

Ahire and Thorat (2007) conducted a study on knowledge level of paddy farmers on integrated management practices and found that annual income had the highest direct effect followed by decision-making pattern, farming experience, extension agency contact and educational status. In case of indirect effect, farm size had the highest indirect effect followed by participation in training, age, social participation and innovativeness. With respect to substantial effect, the first largest indirect effect was channelled through annual income in 10 variables. The study revealed that the variables farming experience, annual income, extension contact agency and decision-making pattern were crucial with the knowledge level of the respondents.

Shakya *et al.* (2008) reported from their study on knowledge level of chickpea growers that variable cosmopoliteness had maximum direct effect on knowledge followed by attitude, information source utilization and scientific orientation. Education contributed maximum total indirect effect on knowledge, followed by attitude, information source utilization, scientific orientation, cosmopoliteness, mass media exposure, economic motivation and extension participation. Out of the thirteen factors, maximum indirect effect was exerted through cosmopoliteness in eleven factors. Thus, cosmopoliteness, attitude towards chickpea production technology, scientific orientation, extension participation, economic motivation, mass media exposure and information source utilization were the important factors which had direct and indirect effect on knowledge of chickpea growers.

Satyapriya *et al.* (2013) on their study on knowledge level of fodder cultivating farmers about berseem production technology reported that farmers exposure had highest direct effect on knowledge followed by attitude towards berseem production technology, information source utilization and scientific orientation. With respect to total indirect effect, education exerted the highest total indirect effect on knowledge, followed by attitude, information source utilization and scientific orientation. Out of thirteen factors, eleven factors had maximum indirect effect through farmers exposure. It was found that farmers exposure, attitude, scientific orientation, extension participation, economic motivation, mass media exposure and information source utilization were important factors that had direct and indirect effect on knowledge of berseem growers.

Maji and Meena (2019) revealed from their study on knowledge of farmers about organic dairy farming practices that the highest direct effect was contributed by variables education, farming system, extension agency contact and locally available non-technical sources utilization. In case of infect effect, the highest effect was contributed by locally available non-technical sources utilization, risk orientation, male member engagement, land holding and management orientation to the knowledge level of the respondents.

Meena *et al.* (2020) found from their study on farmers towards technology training imparted by Krishi Vigyan Kendra (KVK) Jagatsinghpur, Odisha that in case of direct effect, social participation had the highest direct effect followed by education and age. In case of indirect effect, housing pattern contributed the highest indirect effect followed by holding size, family size and age of the respondents.

Kumar and Jeya (2021) conducted a study on Cashew growers in Ariyalur district of Tamil Nadu and found that variables market decision, trainings attended and market perception had the highest direct effect. In case of indirect effect, trainings attended, market perception and mass-media exposure had the three highest indirect effect. Variables economic motivation, mass media exposure, and educational status were found to be significant variables in understanding variation in knowledge level of cashew growers.

Khode *et al.* (2021) revealed from their study on effects of training on knowledge, adoption, and income of trained dairy farmers in comparison to non-trainees that the highest direct effect on knowledge was entrepreneurial behaviour followed by attitude and training participation. In case of total indirect effect, the three highest effects were by variables economic motivation, attitude towards dairy farming and mass media exposure. It was also found that eight out of twelve selected independent variables had their largest indirect effect on knowledge followed by experience in dairy farming in two variables.

Sengupta *et al.* (2023) reported from their study on knowledge level of the farmers associated with sericulture of West Bengal that variables mass media exposure, economic motivation and days engaged in sericulture per year were found to contribute the highest direct effect. It was also found that maximum indirect effect was contributed by variables economic motivation, socio economic status and utilization of information resources. Further, the substantial maximum indirect effect was channelled through economic motivation and family size in 6 variables. Mass media exposure, economic motivation, days engaged in sericulture per year, economic motivation, socio economic status and utilization of information resources were important which had direct and indirect effects on the knowledge level of sericulture farmers.

2.6.2 Factors influencing the adoption of sustainable cultivation practices of pineapple

Karki *et al.* (2011) showed from their study on factors influencing a conversion to organic farming in Nepalese tea farms that four factors *viz.*, environmental awareness, bright market prospects, observable economic benefit and health consciousness were the major factors influencing farmers' decisions on the conversion to organic production and explained 70.43 per cent of the total variance.

Marak *et al.* (2016) studied on factors that contributed towards adoption of scientific pineapple cultivation in West Garo Hills district of Meghalaya and found that the variables studied were clustered into 6 factors. First factor consisting of variables size of holding, area under pineapple cultivation, annual income, material possession and risk orientation was renamed as socio-economic dimension and explained 19.08 per cent variance. Second factor was renamed as 'Motivational Factor' which explained 15.23 per cent total variance and consisted of variables production orientation, market orientation, innovation proneness and economic motivation. 'Knowledge Dimension' was the third factor and consisted of two variables, *viz.* age and education with a total variance contribution of 8.74 per cent. Factor 4 'Family Status' was made up of variables family type and family size with a total variance of 8.61 per cent. 'Socio-

Behavioural Dimension' was the name given to Factor 5 with 8.35 per cent of the total variability and two variables namely; social participation and planning orientation. The sixth factor was renamed as 'Socio-Technical Dimension' comprising of two variables, cropping intensity and attitude towards pineapple cultivation. This factor explained 7.81 per cent total variance. The six factors explained a total of 67.85 per cent variance.

Pradhan *et al.* (2017) examined on factors influencing the adoption of organic farming by the farmers of North district of Sikkim and revealed that eight important factors with a total variation of 71.56 per cent were identified *i.e.,* motivator, family capacity, livelihood, farm economy, socio-economic, education, land holding and resource use efficiency. The first factor 'Motivator' explained a total variance of 19.14 of which the variables institutional approach towards promotion of organic farming, use of mass media, cosmopoliteness, innovation proneness and economic motivation contributed to this factor. Factor 2 'Family capacity' contributed a total variation of 12.70 and consisted of the variables family size, family type, farm power and organic farming experience. The third factor 'Livelihood' explained a total variance of 12.706 and included occupation, source of income and cropping intensity variables. Fourth factor consisting of variables annual income and farm implement possession with a total variance of 7.59 was renamed as 'Farm economy'. 'Socio-economic' was the fifth factor with a total variance of 7.06 and comprised of age and house type variables. Further, the sixth factor 'Education' explained a total variance of 5.58 per cent. The seventh factor was renamed as 'Landsize' which consisted of land holding / farm size variable with 5.27 per cent variance. Lastly, variables combined to form the eighth factor 'Resource use efficiency' and explain a total variance of 5.05.

Paramasivam *et al.* (2021) conducted a study on factors contributing and influencing organic agriculture practices by farmers in Tamil Nadu and found that 6 factors contributed with a total variation of 61.65 per cent. Factor 1 component with a variation of 21.41 per cent comprised of organic farming experience, scientific attitude, livestock ownership, perception of organic manure use, and perception of organic farming profitability and was referred as 'Organic farm perception potential' factor. Factor 2 consisted of variables perception on eco-friendly conservation practices and perception on environmental degradation with a variation of 14.09 per cent and was named 'Eco-friendly potential' factor. Factor 3 accounted for a variation of 7.47 per cent, comprised of variables educational status, training undergone in organic farming, mass media exposure and extension agency contact and referred to as Pro-activeness potential. Factor 4 composed of variable risk orientation, contributed a total variation of 6.83 per cent and referred as 'Pro - Autonomy behaviour' potential. Factor 5 with a variation of 6.15 per cent had variables farm size, cropping pattern and irrigation source and renamed as 'Farm resource' potential. Finally, factor 6 consisted of two variables age and annual income with a variation of 5.73. This factor was referred to as 'Personal' potential. It was concluded that farming expertise in organic farming, scientific orientation, animal ownership, perception of organic manure use, and perception of organic farming profitability were identified as the "Prime factor" with the adoption of organic farming.

Sengupta *et al.* (2023) from their study on factors to generate the knowledge level of the farmers associated with sericulture of West Bengal observed that a total of seven factors were identified through factor analysis with a total variance of 68.70 per cent. First factor with a total variance of 21.35 per cent consisted of variables education, social participation, training received, economic motivation and marketing support and renamed the factor as 'Social Exposer'. Second factor was renamed as 'Capability Factor' which had variables, *viz.* land holding area and under mulberry cultivation (acre) and explained 11.12 per cent of the total variance. Third factor was made up of the variables such as age, mass media exposure, types of rearing house and benefit:

cost ratio, renamed as ‘Motivation and economic factor’ with a 10.18 per cent of the total variance. Fourth factor, ‘Operational factor’ was a combination of variables no. of family member engaged in sericulture activities, production of mulberry leaf per unit area (kg) and cocoon production in kg with a 8.79 per cent variance. Variables occupation and no. of years engaged in silkworm rearing combined to form the fifth factor, ‘Experience factor’ which accounted for 6.44 per cent of the total variance. Sixth factor was renamed as ‘Social access factor’ which included utilization of information source and socio-economic status variables and contributed 5.66 per cent variance. Lastly, the seventh factor, ‘Labour cost factor’ as a result of combination of family type and no of employment days / year / labour variables explained 5.13 per cent of the total variance.

2.7 Constraints perceived by the pineapple growers in adopting sustainable pineapple cultivation practices

Baruwa (2013) examined the constraints of pineapple production in Osun state of Niigeria and indicated that lack of improved planting material, high fruit perishability, low fruit price, lack of access to formal credits and plant disease were the most prevalent constraints that affect production and profit of pineapple cultivation.

Marak *et al.* (2016) assessed from their study on pineapple production in West Garo Hills of Meghalaya and found that the highest constraints faced by the respondents were high infestation by pest and disease, scarcity of irrigation water, scarcity of labour, deterioration of soil fertility, lack of knowledge about improved practices, lack of suitable agricultural development technology, lack of training facility regarding cultivation technology, the visit of extension workers are not regular, lack of proper marketing channel, insufficient proper market price, high transportation cost, lack of proper storage facilities, lack of timely availability of fund for arranging inputs, non-availability of insurance when crop fails, lack of support from government and non-government organizations, high cost of inputs and high cost of labour.

Iwuchukwu *et al.* (2017) from their study on pineapple production in Enugu state of Nigeria revealed that the constraints faced by the respondents under technical and institutional constraints were lack of technology/innovation on pineapple production, wastages due to inability to process produce, lack of processing and storage facilities, poor access road for transportation, high cost/unavailability of other equipment, lack of collateral required to obtain loan, lack of technical knowledge on the use of improved technology, scarcity of farm input, and rodent attack. Under financial and input, the constraints faced were weeding problem, lack/insufficient organic manure, laborious nature of pineapple production, lack/high cost of fertilizer, and high cost/unavailability of labour. Pest and disease infestation and high interest rate on loan to boost production were the constraints under production and biotic stress constraints.

Dennis and Okpeke (2018) reported from their analysis of constraints faced by pineapple growers in Delta state, Nigeria that then constraints faced were lack of improved planting materials, high fruit portability, low fruit price, high cost of labour, lack of access to credit, insufficient land, rodent attack, weather and diseases, lack of processing and storage facilities and high cost of transportation.

Okal (2018) in his study on constraints of pineapple marketing in Kenya revealed that the major constraints faced were perishable nature of pineapples, poor market infrastructure, lack of high-quality planting material, poor rural access roads, lack of organized marketing groups, lack of grades and standards, lack of appropriate storage, lack of market information, inadequate value addition and transportation problems.

Sharma *et al.* (2018) from their study on pineapple growers in Nagaland observed that the foremost constraint was lack of warehouse/go down for proper storage, followed by lack of market information, problem of credit facilities and lack of transportation facilities.

Das *et al.* (2019) reported from their study on pineapple growers in Tripura that the highest constraint faced by the respondents was high pest and disease incidence followed by unavailability of post-harvest storage facilities, unavailability of quality planting materials, limited help from extension personnel during crop production, unavailability of inputs like fertilizers, plant protection chemicals, herbicides etc., other problems (like unavailability of water storage structures, electrical facility etc.), lack of technical knowledge for crop production and inadequate loan/credit facility.

Onyemekonwu *et al.* (2019) found from their study on improved pineapple production practices in Edo state, Nigeria that the constraints faced by the respondents were inadequate credit/finance, unavailability of improved sucker, pest and disease problems, labour shortage, high cost of farm chemicals, inadequate transportation facilities, sucker procurement problems, insufficient preservative/storage facilities, poor market, insufficient technical know-how, insufficient of irrigation facilities, inadequate extension services and unavailability of fertilizers.

Enibe and Raphael (2020) examined the constraints faced by pineapple growers in Awgu Local Government area of Enugu State, Nigeria and revealed that poor access road for transportation, high transportation cost, high labour cost, laborious nature of pineapple production, bush animal/rodent damage to the plant, lack of market for pineapple produced, lack of access to loan, loss in economic value due to pest and disease infestation, farm animal disturbances such as cattle, sheep and goat, high cost of planting materials and high cost of fertilizer were the constraints faced by the respondents.

Singh and Sharma (2020) conducted a study on constraints faced by pineapple growers in production and marketing in Nagaland and Manipur states and found the following. The constraints faced by Nagaland and Manipur pineapple growers were low reliability and low quality of seed, non-availability of skilled and unskilled labour in time, high wage rates, non-reliable irrigation facility, non-suitability of inorganic fertilizers, non-availability at proper time, lack of knowledge about chemicals for plant protection, pest and diseases and animals. Under market related constraints, the constraints faced were hand grading leads to quality deterioration, non-availability of packing materials in time, lack of linking roads, lack of all-weather/metallic roads, non-availability of quick and timely transportation facilities, high transportation charges, low prices and no support prices, no reliable sources of distant market information and lack of timely availability of market news, frequent ban and social boycott, non-availability of market shed, lack of cooperations among the producers and lack of government policies.

Kehinde *et al.* (2021) conducted a study on pineapple production in Ejigbo local government area of Osun state of Nigeria and reported that the constraints faced by the pineapple growers were unavailability of a ready market, high temperature, high cost of labour, theft, pest and disease infestation, high cost of fertilizer, lack of storage facility, irregular rainfall, presence of glut, presence of drought and high cost of planting material.

Olah and Okon (2022) studied the constraints associated with pineapple production in Central Agricultural Zone of Cross River State of Nigeria and found that the major constraints faced were storage facilities, limited access to credit, lack of extension services, pest and diseases and poor transport network.

Roy and Gosh (2022) revealed from their study on constraints faced by pineapple growers in Tripura that constraints was studied after categorising it into situational, technological, economic, social, environmental, infrastructure, and market related constraints. Under situational constraints, the highest constraints were scarcity of water, undulated topography and shortage of irrigation water. In case of technological constraint, highest constraints were observed in inadequate irrigation and labour intensiveness. Financial problem (lack of fund), high cost of cultivation and high labour wage were highest constraints faced under economic constraints. Low adoption of improved practices by neighbor and lack of group approach in farming were the social constraints faced by the pineapple growers. Under environmental constraints, low rainfall was the highest constraint faced. Lack of agro service centre, lack of soil testing laboratory and lacking of storage facilities were the highest infrastructure constraints. Under market related constraints, the highest constraints faced were lack of market facility, low price of farm produce, lack of postharvest value addition and non-availability of plant protection.

Devi *et al.* (2023) studied the constraints faced by pineapple growers in Manipur and found that the major constraints faced were lack of awareness on production technology, lack of seasonal labour, lack of capital, lack of training/awareness on pineapple processing, lack of physical facilities for processing, less government support, lack of market and road connectivity, lack of cold storage, lack of metallic and link roads, seasonal price fluctuations, quality deterioration due to handling, costly and unavailability of packaging materials and lack of government regulated market.

CHAPTER III

RESEARCH METHODOLOGY

RESEARCH METHODOLOGY

In this chapter, background information about the study area, general description of methods and procedures used for the study are presented under the following headings and sub headings:

3.1 Research design

3.2 Locale of the study and sampling procedure

3.2.1. Selection of districts

3.2.2. Selection of blocks

3.2.3. Selection of villages

3.2.4. Selection of respondents

3.3 Selection of variables

3.4 Operationalisation and measurement of the variables

3.5 Formulation of hypothesis

3.6 Tools and techniques used for data collection

3.7 Analysis of data.

3.1 Research Design

Research design is the most important and crucial aspect of research design. Research design according to Kerlinger (1978) is the plan, structure and strategy of investigations so as to obtain answers to research question and to control variance. It is a blueprint of what the investigator will do.

Ex- post facto research design was followed in the present study as it deals with a phenomenon which has already occurred. Kerlinger (1998), defined *Ex-post facto* research design as a systematic empirical enquiry in which the researcher does not have direct control over the variables as their manifestations have already occurred and they are not manipulable.

3.2 Locale of the research and sampling procedure

The present study was conducted in Nagaland, one of the seven sister states of North East India. The state covers an area of 16,579 square kilometres, lies between 260 7′ 33 N and 940 33′ 28 E with its highest point at an elevation of 3,825 metres above sea level. The state came into existence as the 16th state of India on 1st December, 1963. It is bounded by Myanmar and Arunachal Pradesh in the East, Assam in the West and Assam and Arunachal Pradesh in the North and Manipur in the South. The state has 16 administrative districts, *viz.* Kohima, Mokokchung, Tuensang, Mon, Wokha, Zunheboto, Phek, Dimapur, Peren, Longleng, Kiphire, Chumoukedima, Niuland, Tseminyu, Noklak and Shamator, inhabited by the 16 major tribes along with the other sub-tribes. The 16 major tribes of Nagaland are Angami, Ao, Chakesang, Chang, Kachari, Khiamniungan, Konyak, Kuki, Lotha, Phom, Pochury, Rengma, Sangtam, Sumi, Tikhir, Yimkhiung and Zeliang.

Geographically, the state has undulating terrain and some low-lying areas which give rise to a very conducive climate. The state is blessed with rich agro biodiversity, flora and fauna. The state usually experiences a largely monsoon climate with an average rainfall of 2000- 2500 mm, shorter summer season and longer duration of winter season. In Nagaland, agriculture has been the backbone of livelihood since time immemorial and today, more than 70% of the people are dependent on agriculture. Agriculture in Nagaland is the mainstay of the state’s economy because of its major contribution to the state’s annual Gross Domestic Product (GDP). Rice is the staple food of the Nagas and hence, most of the people cultivate rice. Other crops cultivated are maize, linseed, potato, soybean, sugarcane, jute, coffee, tea and cardamom.

Table 3.2: Basic information of state of Nagaland

1.	Capital	Kohima
2.	Geographical area	16, 579 sq. km
3.	Administrative districts	16
4.	Population	1,978,502 (Census 2011)
5.	Literacy rate	79.55%
	i. Male	82.75%
	ii. Female	76.11%
6.	Annual average rainfall	2, 500 mm
7.	Temperature	21℃- 40℃
8.	Highest peak	Mount Saramati
9.	Main rivers	Dikhu, Doyang and Dhansiri
10.	Climate	Sub- Alpine/ salubrious climate
11.	Soil type	Ferrugineous red soils and laterites
12.	Total forest area	8,629.30 sq.km
13.	Total forest cover	12,486.40 sq.km
14.	Area under agriculture	278.62 sq. km
15.	Gross sown area	3,83,670 (2019-20)
16.	Net sown area	1,867.00 sq. km

(https://nagalandgk.com/brief-statistics-on-nagaland-state/)

(https://forest.nagaland.gov.in/status-of-forests/)

(https://statistics.nagaland.gov.in/storage/statistical_data/2021/3551632204828.pdf)

3.2.1 Selection of districts

Based on the area covered under pineapple cultivation and highest production, three (3) best performing districts; Dimapur, Peren and Mokokchung districts were purposively selected for the study.

3.2.1.1 Dimapur district

Dimapur district, the 8th district of Nagaland is the largest district and known as the commercial hub of the state. Dimapur district was created on 2

December, 1997. It covers an area of 927 square kilometres and coordinates at 25.92° N latitude and 93.73° E longitude. The altitude of the district is 260 m. The district is bounded by Assam on its North and West, Kohima on the East and Peren District in the South. The climate is hot and humid during summer while the winter months are cool and pleasant. The average annual rainfall is 1504.7 mm.

The district being bestowed with unique topography and varied agro-climatic and soil conditions, boost in cultivating a wide variety of agricultural and horticultural crops. Terrace Rice cultivation (TRC), rainfed and traditional type of farming is practiced. With the favourable agro climatic condition, crops such as oilseeds such as groundnut, sesame, sunflower, maize, soybean, mustard, green and black gram, linseed, beans, ginger, pineapple, banana, lemon, cucurbits, etc are grown successfully in this district.

3.2.1.2 Peren district

Peren district, the land of the Kuki and Zeliang tribes was formed by the partition of Kohima district on 24th October, 2003. Peren district is located between longitude 93° E - 94° E and latitude 25° N- 26 ° N of the Equator. The total area of Peren district is 1799 sq kms with a density of 41 per sq kms. The district is bounded by Dimapur in the North, Kohima in the East, Manipur in the south and Assam in the West. It is located at an altitude of 1445 m above sea level. Peren district has tropical type to sub-tropical type to temperate types of climates moderate climate.

The district is basically a strip of mountainous territory having fertile foothill valley plains and very rich in natural vegetation. The land of Kuki and Zeliang tribes is popularly known as the “Green district of Nagaland” due to the highest concentration of flora and fauna. Due to its fertile land, most of the people of Peren district (80%) are engaged in agriculture. Jalukie Valley is known as the Rice Bowl of Nagaland and the people of the district earn their livelihood through paddy cultivation. Besides paddy, of late, the people have taken up crops like pineapple, yam, beans, ginger, banana, maize, king chilli, ginger and other horticultural products, which supplement the crops. The farmers of Peren district have also taken up cash crops cultivation like rubber, tea, turmeric, medicinal plants, and orchard, etc to enhance their income.

3.2.1.1 Mokokchung district

Mokokchung is one of the major districts in Nagaland and it is the home of the Ao Nagas. Mokokchung as a district was formed in 1957. It covers an area of 1,615 square kilometres. It is located between 94.29- and 94.76-degrees east longitude and 26.20- and 26.77-degrees north latitude and an altitude of 1,325m above sea level. The district is bordered by Wokha in the west, Assam in the north, Zunheboto in the south and Tuensang in the east. Mokokchung has a mild climate throughout the year with shortest duration of summer season and winter. Agriculture and allied activities are the main source of livelihood and agriculture remains to be the major part of the economy of the district. Both jhum cultivation and TRC/WRC are practised in the district but jhum cultivation continues to be the dominant type of land-use system due to its topography. Mixed cropping of different varieties of crop with rice are usually practised in the jhum fields. Besides rice, some other important crops grown in the district are maize, tapioca, pineapple, orange, soybean and tea.

3.2.2 Selection of Blocks

The Rural Development (RD) blocks from the three (3) selected districts were purposively selected for the study. Under Dimapur district, there are six (6) RD blocks, *viz.* Chumukedima, Aghunaqa, Dhansiripar, Kuhuboto, Medziphema and Niuland. Medziphema block widely known for producing the sweetest pineapple in the state was purposively selected. There are 4 RD blocks in Peren district Peren, Jalukie, Tening and Athibung blocks out of which extensive pineapple growing blocks, Peren and Jalukie were purposively selected. Mokokchung district has 9 RD blocks namely, Ongpangkong North, Ongpangkong South, Kubolong, Chuchuyimlang, Changtongya, Tuli, Mangkolemba, Longchem and Tsurangkong. Changtongya RD block has the highest number of villages cultivating pineapple and therefore, this block was purposively selected. Thus, a total of 4 Rural Development blocks from the 3 districts were purposively selected for the study.

3.2.3 Selection of villages

3.2.3.1 Dimapur district

Pineapple is grown in about five villages under Medziphema block. Highest number of pineapple growers is from Molvom, Bungsang and Medziphema villages. Therefore, these three villages were further selected purposively for the study.

3.2.3.2 Peren district

Pineapple cultivation is practised in many villages under Peren district. The villages which cultivate pineapple extensively are Samzuiram, Mhainamtsi, Kejanglwa and Jalukie under Jalukie RD block and Punglwa and Heningkunglwa under Peren RD block. Hence, all of these six villages were purposively selected for the study.

3.2.3.3 Mokokchung district

Under Changtongya RD block of this district, the villages with the highest number of pineapple growers namely; Changtongya, Nukshiyim, Liroyim and Yaongyimsen were purposively selected for the study.

3.2.4 Selection of respondents

Out of the selected 13 villages, 45 per cent of the pineapple growers were selected from the selected districts using proportionate random sampling procedure. Thus, a sample size of 275 respondents was selected for the present study. Sampling plan for the study is presented in the Figure 3.2.2.

3.3 Selection of Variables

Variables were selected based on the objectives of the study, extensive literature review and consultations with subject experts. A total of 30 independent variables and three dependent variables were selected for the present study. The selected variables were measured with the help of the available measurement procedures. Operational definition of each of the variables and their measurement technique used are enumerated below:

Table 3.3: List of variables and their empirical measurements

Sl. No.	Variables	Empirical measurements
I.	**Independent variables**	
1.	Age	Chronological age in years
2.	Gender	Male/ female
3.	Marital status	Scale developed by Mansingh (1993)
4.	Family size	Number of persons in a family
5.	Education	Modified scale of Venkataramaiah (1983) revised with slight modifications
6.	Occupation	Farming /Business/Service
7.	Experience in pineapple cultivation	Completed years of pineapple farming
8.	Size of land holding under agriculture	acre
9.	Size of land holding under pineapple cultivation	acre
10.	Annual income	Rs.
11.	Profitability from pineapple cultivation	Rs./acre
12.	Productivity of land under pineapple cultivation	t/acre
13.	Sources of information utilized	Scale developed by Ramchandran (1974)
14.	Extension contact	Procedure used by Byrareddy (1971) with slight modifications
15.	Social participation	Scale developed by Trivedi & Pareek (1963) with due modifications

16.	Training exposure	No of days exposed for training
17.	Input self sufficiency	Index developed by Chandregowda (1996)
18.	Household vulnerability	Livelihood Vulnerability Index (LVI) developed by Hahn, Riederer and Foster (2009)
19.	Employment generated	Mandays
20.	Integrated Nutrient Management	Index developed by Chandregowda (1996)
21.	Integrated Pest Management	Index developed by Chandregowda (1996)
22.	Innovativeness	Scale developed by Saharkar (1995)
23.	Risk taking ability	Scale developed by Supe (1969) with modifications
24.	Market innovativeness	Likert based scale was developed
25.	Achievement motivation	Scale developed by Singh and Singh (1974)
26.	Decision making ability	Modified scale developed by Supe (1969)
27.	Management orientation a) Planning orientation b) Production orientation c) Market orientation	Scale developed by Samanta (1977)
28.	Scientific orientation	Scale developed by Supe (1969) and modified by Nagaraja (1989)
29.	Economic motivation	Scale developed by Supe (1969)
30.	Market orientation	Scale developed by Samanta (1977)
II.	**Dependent variables**	
1.	Knowledge	Knowledge Index
2.	Adoption	Sustainable technology adoption index by Lakshminarayan (1997)
3.	Attitude	Likert based scale was developed

3.4 Operationalisation and measurement of the variables

3.4.1 Independent variables

3.4.1.1 Age

Age was operationalized as the number of completed years of the respondent at the time of conducting the interview. Based on the completed years, the respondents were grouped into the following categories using mean ($\bar{x}$)and standard deviation (σ):

Category	Criteria
Young	Less than 35 years
Middle Age	35 – 55 years
Old	More than 55 years

3.4.1.2 Gender

The respondents were categorized into either male or female and a score of 1 and 2 was assigned to male and female respectively. It was measured by using frequency and percentage.

Category	Score	Frequency	Percentage
Male	1		
Female	2		

3.4.1.3 Marital status

Marital status was operationalised as whether the individual was married or unmarried. The respondents were classified as married or unmarried and assigned score as detailed below. Marital status was measured by using frequency and percentage:

Category	Score	Frequency	Percentage
Unmarried	0		
Married	1		

3.4.1.4 Family size

Family size was operationally defined as total number of members residing in a single household with a common kitchen. Based on the family size, the respondents were grouped into following three categories based on mean and ± sd values:

Category	No of members	Frequency	Percentage
Small	≤ 4 members		
Medium	5-6 members		
Large	> 6 members		

3.4.1.5 Education

Education referred to the ability of the respondents to read and write or the extent of formal education possessed by them. It was quantified by using the modified scale of Venkataramaiah (1983) revised in 1991 with slight modifications. The number of respondents falling under each category was worked out through frequency and percentage:

Categories	Score	Frequency	Percentage
Illiterate	0		
Primary (till 4th grade)	1		
Middle (5 – 7)	2		
Highschool (til10th grade)	3		
Higher secondary (till 12th grade)	4		
Graduate	5		

3.4.1.6 Occupation

It was operationalised as the activities in which the farmers and their family are regularly engaged in an economic activity to generate income as a means of livelihood. The different categories were scored and measured by frequency and percentage as follows:

Category	Score	Frequency	Percentage
Farming	1		
Farming + Business	2		
Farming + Service	3		
Farming + Business + Service	4		

3.4.1.7 Experience in pineapple cultivation

Experience operationally referred to the number of years the respondents practised pineapple cultivation for their livelihood. Based on the mean ($\bar{x}$) and standard deviation (σ) of the scores obtained, the respondents were categorized into the following:

Category	**Criteria**
Low	Below ($\bar{x} - \sigma$)
Medium	Between ($\bar{x} - \sigma$) and ($\bar{x} + \sigma$)
High	Above ($\bar{x} + \sigma$)

3.4.1.8 Size of landholding under agriculture

The size of land holding under agriculture was operationalized as land area used by the respondents for agricultural production irrespective of owned or leased in by the respondents. Accordingly, the respondents were grouped into three categories as per the classification given by the Agriculture Census Division Department of Agriculture, Co-operation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India, 2018. The results were expressed in frequency and percentage for each category:

Categories	**Land under cultivation**	**Score**	**Frequency**	**Percentage**
Marginal farmers	< 2.5 acres	1		
Small farmers	2.51 – 5.0 acres	2		
Semi- medium farmers	5.01 – 10.0 acres	3		

3.4.1.9 Size of landholding under pineapple cultivation

The size of land holding under pineapple cultivation was classified into four intervals of class between the minimum and maximum obtainable range of score from 0.4 to 9. The results were expressed in frequency and percentage for each category:

Size of land	Frequency	Percentage
< 1 acre		
1 – 2 acres		
2 – 5 acres		
> 5 acres		

3.4.1.10 Annual income

Annual income was operationally defined as the total earnings in rupees of the farm family from all available income sources including farm, and non-farm activities in a year. The respondents' mean annual income was categorized based on size of land holding under agriculture as follows:

Category of farmers	Mokokchung	Dimapur	Peren	Mean income (Rs.)	Overall mean income (Rs.)
	Mean income (Rs.)	Mean income (Rs.)	Mean income (Rs.)		
Marginal (< 2.5 acres)					
Small (2.51 – 5.0 acres)					
Semi-medium (5.1 – 10.00 acres)					

Annual income from pineapple cultivation:

Annual income from pineapple cultivation was operationally defined as the total income earned by the respondents from pineapple cultivation. The annual income from pineapple cultivation was categorized based on size of land holding under pineapple cultivation as follows:

Category of farmers	**Mokokchung**	**Dimapur**	**Peren**	**Mean income (Rs.)**	**Overall mean income (Rs.)**
	Mean income (Rs.)	**Mean income (Rs.)**	**Mean income (Rs.)**		
Marginal (< 2.5 acres)					
Small (2.51 – 5.0 acres)					
Semi-medium (5.1 – 10.00 acres)					

3.4.1.11 Profitability from pineapple cultivation

Profitability is the ability to earn a return from a given investment (Nimalathasan, 2009).

Profitability was quantified by using the formula:

$$\text{Profitability} = \frac{\text{Total production of pineapple (q)x rate of sale per q}}{\text{Total area under pineapple cultivation}}$$

Profitability of the respondents was further tabulated and classified based on the category of farmers under pineapple cultivation, *viz.* marginal, small and semi-medium farmers. The profitability of the respondents was further categorized into the following based on land holding under pineapple cultivation:

Land under pineapple cultivation (acre)	**Profitability (Rupees)**
Less than 2.50	
2.5 – 5.00	
5.1 – 10.00	

3.4.1.12 Productivity of land under pineapple cultivation

Productivity was operationalised as the articulated measure that the ratio of a combined output to single input or combined input used in a production process, i.e., output per unit of input. cultivation in rupees. Productivity was measured by using the formula:

$$\text{Productivity} = \frac{\text{Total production of pineapple (q)}}{\text{Total area under cultivation (acre)}}$$

3.4.1.13 Sources of information utilization

Information source utilization was operationally defined as the frequency of contact or exposure of the respondents to different sources for obtaining farm information. This variable was quantified by using Ramchandran scale (1974). Information sources utilization was classified based on the use of mass-media sources, formal information sources and informal information sources.

a) Mass-media information sources:

Under mass-media sources, eight sources of information (radio, television, exhibition, printed media, newspaper, SMS based services, Agricultural apps/whatsapp/facebook/Instagram and videoconferencing) were included and their frequency of use was scored as Most often (2), Sometimes (1) and Never (0). Based on the total score obtained, respondents were classified into three categories using mean ($\bar{x}$) and standard deviation (σ) as follows:

Level of information sources utilization	Score range
Low	Below ($\bar{x} - \sigma$)
Medium	Between ($\bar{x} - \sigma$) and ($\bar{x} + \sigma$)
High	Above ($\bar{x} + \sigma$)

b) Formal information sources:

Formal information sources included the information received through the contact of six sources of information (AFA, AO/SDAO/HO, KVK, ATMA, NGOs and other sources) and their frequency of use was scored as Most often (2), Sometimes (1) and Never (0). Based on the total score obtained, respondents were classified into three categories using mean ($\bar{x}$) and standard deviation (σ) as follows:

Level of information sources utilization	Score range
Low	Below ($\bar{x} - \sigma$)
Medium	Between ($\bar{x} - \sigma$) and ($\bar{x} + \sigma$)
High	Above ($\bar{x} + \sigma$)

c) Informal information sources:

Informal information sources referred to the information obtained through contact with four sources of information, *viz*. friends, relatives, neighbours and progressive farmers for agricultural purposes. Their frequency of use was scored as Most often (2), Sometimes (1) and Never (0). The respondents were classified into three categories using mean ($\bar{x}$) and standard deviation (σ) as follows:

Level of information sources utilization	Score range
Low	Below ($\bar{x} - \sigma$)
Medium	Between ($\bar{x} - \sigma$) and ($\bar{x} + \sigma$)
High	Above ($\bar{x} + \sigma$)

The overall information sources utilization was further calculated based on the total scores obtained on all the three different sources of information and classified them into three categories using mean ($\bar{x}$) and standard deviation (σ):

Level of information sources utilization	Score range
Low	Below (x̄ – σ)
Medium	Between (x̄ – σ) and (x̄ + σ)
High	Above (x̄ + σ)

3.4.1.14 Extension contact

Extension contact referred to the frequency with which the respondents came in contact with the extension agency/workers. It was measured by using the procedure followed by Byrareddy (1971) with slight modifications. The scores assigned were listed as follows:

Extension workers	Frequency of contact		
	Regularly	Occasionally	Never
1. AFA/HEA	2	1	0
2. AO/SDAO/HO	2	1	0
3. KVK	2	1	0
4. ATMA	2	1	0
5. NGOs	2	1	0
6. Others	2	1	0

The data obtained was analysed by using frequency and percentage. Further, the respondents were categorized into three groups based on mean (x̄) and standard deviation (σ):

Level of extension contact	Score range
Low	Below (x̄ – σ)
Medium	Between (x̄ – σ) and (x̄ + σ)
High	Above (x̄ + σ)

3.4.15 Social participation

Social participation was operationalized as the degree of involvement of a respondent from mere membership to organizational positions and his/her active participation in the activities of local formal organizations. This was quantified by using the method followed by Trivedi and Pareek (1963) with due modifications. The respondents were provided with a list of seven organisations and were asked to delineate their extent of participation in each of them. The scoring procedure for each of the organization was as follows:

Membership/ Office Bearer	**Scores**
Member in any organization	1
Office bearer in any organization	2

Extent of participation	**Score**
Regular	2
Occasional	1
Never	0

The total possible score ranged from 0 to 28. By considering the total score obtained by each respondent, they were divided into three groups as low, medium and high using mean ($\bar{x}$) and standard deviation (σ) as:

Level of social participation	**Score range**
Low	Below ($\bar{x} - \sigma$)
Medium	Between ($\bar{x} - \sigma$) and ($\bar{x} + \sigma$)
High	Above ($\bar{x} + \sigma$)

3.4.1.16 Training exposure

It was operationalised number of days a respondent had undergone training on various topics on pineapple cultivation. A score of 1 was given to training attended and score of 0 for no trainings attended. The results were measured by frequency and percentage:

Training exposure	Score	Frequency	Percentage
No training attended	0		
Training attended	1		
Mean no. of days attended			

3.4.1.17 Input self sufficiency (ISS)

Input self sufficiency was operationalised as the extent to which farmer was able to meet the input requirement for pineapple cultivation from own resources than the purchased inputs. It was taken as the ratio of values of owned inputs to the total value of inputs used in pineapple cultivation.

Input self-sufficiency index (ISSI) was calculated by using the formula developed by Chandregowda (1996):

$$\text{ISSI} = \frac{\text{Value of owned input}}{\text{Total value of input used}} \times 100$$

Theoretically, an ISSI value of '0' indicates that the farmer was completely dependent on external inputs and a value of '100' would indicate that the farmer was completely dependent on owned inputs. The scored obtained was classified into 3 categories using mean ($\bar{x}$) and standard deviation (σ) as:

Level of input self sufficiency	Score range
Low	Below ($\bar{x} - \sigma$)
Medium	Between ($\bar{x} - \sigma$) and ($\bar{x} + \sigma$)
High	Above ($\bar{x} + \sigma$)

3.4.1.18 Household vulnerability

The term "vulnerability" has no definite particular universal definition due to the fact that all the different disciplines define vulnerability differently to explain the areas of concern.

The Livelihood Vulnerability Index (LVI) was operationalized to assess the vulnerability of farming households to climate change and variability. This scale based on the IPCC's (International Panel on Climate Change) definition of vulnerability developed by Hahn *et al.* (2009) with slight modifications was used in this study. The LVI includes seven major components: Socio-Demographic Profile, Livelihood Strategies, Social Networks, Health, Food, Water, and Natural Disasters and Climate Variability. Each is comprised of several indicators or sub-components. Each major component consisted of a number of different subcomponents, where each subcomponent is measured on a different scale and therefore, necessary to standardize each as an index.

$$\text{Index}_{shi} = \frac{-\,\mathrm{Smin}}{S_{\mathrm{max}} - S_{\mathrm{min}}}$$

Where,

S_h = observed sub-component of indicator for household

S_{min} = minimum value

S_{max} = maximum values

Each standardised subcomponents were averaged using the following formula to obtain the index of each major component:

$$M_h = \frac{\sum_{i=1}^{n} \mathrm{Index}_{shi}}{n}$$

Where,

M_h = one of the seven major components (Socio-Demographic Profile (SDP), Livelihood Strategies (LS), Social Network (SN), Health (H), Food (F), Water (W), or Natural Disaster and Climate Variability (NDCV) for household h

Index_{shi} = Subcomponents indexed by I

n = sub-components in each major component

The calculated seven major components were then averaged using the following formula to obtain the household level LVIM_{hi}

$$\mathrm{LVI} = \frac{\sum_{i=1}^{7} W_{Mi}\, M_{hi}}{\sum_{i=1}^{7} W_{Mi}}$$

Which can also be expressed as,

$$\mathrm{LVI} = \frac{W_{SDP}\, SDP_{h} + W_{LS}\, LS_{h} + W_{h} H_{h} + W_{SN} SN_{h} + W_{F} F_{h} + W_{W} W_{h} + W_{NDC} NDC_{h}}{W_{SDP} + W_{LS} + W_{H} + W_{SN} + W_{F} + W_{W} + W_{NDC}}$$

Where LVI_h, the Livelihood Vulnerability Index for household h, equals the weighted average of the seven major components. The weights of each major component, W_{Mi}, are determined by the number of sub-components that make up each major component and are included to ensure that all sub-components contribute equally to the overall LVI. In this study, the LVI was scaled from 0 (least vulnerable) to 0.5 (most vulnerable).

3.4.1.19 Employment generated

Employment is an activity in which a person of working age engages to produce goods or the act of giving a job to someone. In the present study, employment generated refers to the extent of employment generated (man days) for family members as well as hired labour during pineapple cultivation. The respondents were asked to indicate the employment generated per family (man days) as in how many labour days (family and hired labour) was generated through pineapple cultivation. Employment generated was classified into three intervals of class between the minimum and maximum obtainable range of score from 85 to 235. The results were expressed in frequency and percentage for each category as follows:

Level of Mandays generated	Frequency	Percentage
Low		
Medium		
High		

3.4.1.20 Integrated Nutrient Management

Integrated Nutrient management was operationalised as application of right quantity of organic and inorganic fertilizers and amendments to soil at a proper time, method and combination aimed at deriving maximum benefits and causing minimum damage to environment.

A list of questions related to Integrated Nutrient Management was prepared covering all aspects of nutrient management in pineapple cultivation. For each item, as against the recommended level, the farmers were assigned zero score for non-adoption and one score for adoption. Later the integrated nutrient management index developed by Chandregowda (1996) has been worked out by using the following formula:

$$\text{Integrated Nutrient Management Index} = \frac{\text{Actual score obtained}}{\text{Maximum possible score}} \times 100$$

The scored obtained was classified into 3 categories using mean ($\bar{x}$) and standard deviation (σ) as:

Level of Integrated Pest Management	Score range
Low	Below ($\bar{x} - \sigma$)
Medium	Between ($\bar{x} - \sigma$) and ($\bar{x} + \sigma$)
High	Above ($\bar{x} + \sigma$)

3.4.1.21 Integrated Pest Management

Integrated pest management was operationalised as the management of pests (insects, disease and weeds) by using preventive and curative measures through judicious combination of cultural, mechanical, biological and chemical means.

List of items were identified under insect, disease, nematode and weed management. For each item, as against the recommended level, the farmers were assigned one score for adoption and zero score for no adoption and the maximum possible scores were worked out. Later the integrated pest management index developed by Chandregowda (1996) has been worked out by using the following formula:

$$\text{Integrated Pest Management Index} = \frac{\text{Actual score obtained}}{\text{Maximum possible score}} \times 100$$

The scored obtained was classified into 3 categories using mean ($\bar{x}$) and standard deviation (σ) as:

Level of Integrated Pest Management	Score range
Low	Below ($\bar{x} - \sigma$)
Medium	Between ($\bar{x} - \sigma$) and ($\bar{x} + \sigma$)
High	Above ($\bar{x} + \sigma$)

3.4.1.22 Innovativeness

Innovativeness was operationalised as the socio-psychological orientation of an individual to get liked or closely associated with change, adopting innovative ideas and practices. The innovativeness scale developed by Saharkar (1995) was used with slight modifications. The scale consisted of five statements with a three point continuum. All the positive statements were assigned the score of 2, 1, 0 for Agree (A), Undecided (UD) and Disagree (DA) and vice versa for negative statements. The summated maximum score was 10 and minimum possible score was 0. Based on the mean ($\bar{x}$) and standard deviation (σ), the respondents were classified into three categories:

Level of innovativeness	Score range
Low	Below ($\bar{x} - \sigma$)
Medium	Between ($\bar{x} - \sigma$) and ($\bar{x} + \sigma$)
High	Above ($\bar{x} + \sigma$)

3.4.1.23 Risk taking ability

Risk taking ability was operationalized as the degree to which the farmers were oriented towards risk and uncertainty in facing problems in farming. It was measured by using the scale developed by Supe (1969) with slight modifications. The scale consisted of six statements with three point continuum. All the positive statements were assigned a score of 2, 1, 0 for Agree (A), Undecided (UD) and Disagree (DA) and vice versa for negative statements. The maximum possible score was 12 and minimum possible score was 0. Further, the respondents were classified into three categories using mean ($\bar{x}$) and standard deviation (σ):

Level of risk taking ability	Score range
Low	Below ($\bar{x} - \sigma$)
Medium	Between ($\bar{x} - \sigma$) and ($\bar{x} + \sigma$)
High	Above ($\bar{x} + \sigma$)

3.4.1.24 Market Innovativeness

Market innovativeness was operationalized as identification of new market opportunities and entry into new markets (Ali *et al*., 1995). Innovativeness is the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than members of a social system.

In the present study, method of summated rating scale suggested by Likert (1932) was followed to develop a scale to measure attitude of respondents towards market innovativeness. The steps followed are as follows:

Item collection

A set of items making up an attitude scale are called "Statements". A pool of statements consisting both favourable and unfavourable covering the area of market innovativeness were collected from various books, bulletins, journals, research papers and discussion with professors, subject matter specialists, researchers and extension officers, directly or indirectly exposed to a system of knowledge relevant to the study area. A preliminary list of 30 statements comprising of both positive and negative statements reflecting various dimensions towards market innovativeness were drafted.

Editing of items

The items collected were examined and carefully edited by following the criteria suggested by Edwards (1957). After rigorous scrutinizing with the help of subject experts, a total of 17 statements were retained out of the 30 statements. Efforts were made to compose each statement with minimum possible words with clarity in meaning as well as understanding.

Item Analysis

Item analysis is an important step as per the Likert's technique of attitude measurement in the construction of valid and reliable scale. The main objective of item analysis is to select items which can very well discriminate between two criterions. The 17 items selected were administered to a random sample of 20 farmers in a non-sample area. The response of the respondents was obtained on a five point continuum scale and score of strongly agree (5), agree (4), undecided (3), disagree (2) and strongly disagree (1). The scoring pattern was reversed for negative statements. The total score for each respondent was computed by summing the scores for all the individual items. The range of the score was 17-85.

Final selection of item

Based upon the scores, the respondents were arranged in ascending order. The top 27 per cent of the respondents with their total scores were considered as the high group and the bottom 27 per cent as the low group, as criterion groups for evaluating the individual items as suggested by Edwards (1957).

The critical ratio, 't' value, was calculated by using the formula suggested by Edwards (1957). After computing the 't' value for each items, the statements were arranged in descending order. 13 (9 positive and 4 negative) statements with 't' value equal or greater than 1.75 were selected final statements and included in the attitude scale as show in the table.

Table 3.4.1.24: Scale developed to measure the attitude of farmers towards market innovativeness

Sl. No.	Statements	t- value
1.	I always keep myself updated about new markets where I can get the best price of pineapple. (+)	11.000
2.	I am seeking opportunities so as to export pineapple outside my country. (+)	10.61446
3.	I am heavily dependent on the traders who approach me to take surplus pineapple right from my farm. (-)	4.490731
4.	I try to keep myself upto date with latest market price of Pineapple in market outside the state of Nagaland. (+)	4.264014
5.	I feel that packaging of pineapple may unnecessarily reduce my profit in marketing. (-)	3.674235
6.	I go for improved method of packaging pineapple so that it retains its quality during transportation so as to gain maximum profit. (+)	3.674235
7.	I usually want to see what results my fellow farmers obtained before I try out the new marketing channels. (-)	3.674235
8.	I try to keep myself upto date with highest market price of Pineapple in the local market. (+)	2.44949

9.	I prefer selling pineapple in local market for easy and assured profit. (-)	2.666667
10.	I am interested to develop value added products of Pineapple so as to maximize my profit from my pineapple enterprise. (+)	2.359071
11.	I always take a lead in supplying the best varieties of pineapple in the market to fetch high price. (+)	2.213594
12.	I grade pineapple before sending in market for getting premium price. (+)	2.064187
13.	I try to be the first in my area to supply the pineapple for marketing early in the market so as to fetch premium price. (+)	1.889822

Standardization of the scale

For standardization of the scale, validity and reliability of the scale was determined. Reliability of the scale was measured by split- half method.

Reliability of the scale

Reliability according to Goode and Hatt (1952) "is the extent to which repetition of the study would result in the same data and conclusions". This test was carried out to understand the consistency, stability and accuracy of the scale with the same instrument. Reliability of the scale was measured by split half method.

In split half method, the scale was divided into two halves based on odd and even number of statements. The two halves were then administered to a sample size of 20 respondents from non-sampled area. Karl Pearson product moment correlation coefficient was calculated between the two sets of scores obtained and the correlation coefficient value was found to be 0.74. This coefficient value indicates the split half reliability of the scale. The 'r' value was significant at one per cent level of significance which interpret that the scale has high reliability and can be administered to the farmers. To calculate the reliability coefficient (R) of the whole scale, Spearman- Brown (1910) prophecy formula was used. The reliability coefficient (R) was 0.85 and significant at one per cent level.

Cronbach's alpha coefficient or alpha coefficient is a test of reliability as internal consistency, which means how closely related a set of items are as a group (Cronbach, 1951). Unlike the split half method, Cronbach's alpha is not affected by how the items are arranged in the test. Therefore, Cronbach's alpha can be used to get more stability and accuracy. In this study, calculated value of Cronbach's alpha was 0.97 which indicated that the scale had excellent consistency measurement and hence, the scale was reliable.

Validity

Validity to refers to the efficiency with which it measured what it intended to measure. Validity and reliability increase transparency and decrease opportunities to insert research bias in qualitative research (Singh, 2014). The attribute of technology scale possesses face validity, content validity and intrinsic validity.

The scale developed was tested for content validity. According to Kerlinger (1987), content validity of scale is the representative or sampling adequacy of the content, the substance, the matter and the topics of a measuring instrument. The validity of the scale was examined for content validity by determining how well the content of the scale represented the domain subject under study. The items covering the subject under study were selected on consultation and discussion with subject matter specialists, researchers, reviewing the literature and with adherence to the judges' ratings. The scale was modified in light of their comments and feedback. Therefore, it may be said that the scale satisfied the content validity.

Administering of the scale

The final scale which consisted of 13 statements (9 positive and 4 negative) was administered to farmers and responses were collected in a five point continuum, *viz.* strongly agree, agree, undecided, disagree and strongly disagree. The scoring pattern was 4, 3, 2, 1 and 0 respectively and reverse for negative statements. The possible obtainable score of the respondent ranged from 0 to 52. Total attitude score of the respondents were calculated by summing all the scores of the statements.

Based on the mean ($\bar{x}$) and standard deviation (σ), the respondents were classified into three categories:

Level of market innovativeness	**Score range**
Low	Below ($\bar{x} - \sigma$)
Medium	Between ($\bar{x} - \sigma$) and ($\bar{x} + \sigma$)
High	Above ($\bar{x} + \sigma$)

3.4.1.25 Achievement motivation

It was operationalized as the desire to do well not so much for the sake of social recognition or prestige, but to realize the feeling of personal accomplishment. The achievement motivation scale developed by Supe (1969) with slight modifications was used in the present study. The scale had six statements with a three point continuum of Agree (A), Undecided (UD) and Disagree (DA). All the positive statements were assigned a score of 2, 1, 0 for Agree (A), Undecided (UD) and Disagree (DA) and vice versa f or negative statements. The maximum possible score was 12 and minimum possible score was 0. Based on the mean ($\bar{x}$) and standard deviation (σ), the respondents were classified into three categories:

Level of achievement motivation	**Score range**
Low	Below ($\bar{x} - \sigma$)
Medium	Between ($\bar{x} - \sigma$) and ($\bar{x} + \sigma$)
High	Above ($\bar{x} + \sigma$)

3.4.1.26 Decision making ability

The decision making ability of a farmer was operationally defined as the degree of judgement based on the available alternatives in terms of their desire and choosing the most appropriate option for achieving maximum profit on his farming. It was measured by using the scale developed by Supe (1969) with slight modifications. The scale consisted of six statements comprising of both positive and negative statements with a three point continuum. The continuum assigned were Agree (A), Undecided (UD) and Disagree (DA) and scored as 2, 1 and 0 for positive statements and vice-versa for negative statements. The maximum possible score was 12 and minimum possible score was 0. After obtaining the total scores, the respondents were classified into three categories based on mean ($\bar{x}$) and standard deviation (σ) as follows:

Level of decision making ability	**Score range**
Low	Below ($\bar{x} - \sigma$)
Medium	Between ($\bar{x} - \sigma$) and ($\bar{x} + \sigma$)
High	Above ($\bar{x} + \sigma$)

3.4.1.27 Management Orientation

Management orientation has been operationally defined as the degree to which a farmer is oriented towards scientific farm management comprising of planning, production and marketing functions of the farm. This variable was measured by adopting the scale developed by Samanta (1977) with slight modifications. The scale consists of totally 17 statements, six statements each for planning and production and 5 statements for marketing aspect. All the positive statements were assigned the score of 4, 3, 2, 1 and 0 for Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SDA) and vice versa for negative statements. Based on the mean ($\bar{x}$) and standard deviation (σ), the respondents were classified into three categories:

Level of management orientation	**Score range**
Low	Below ($\bar{x} - \sigma$)
Medium	Between ($\bar{x} - \sigma$) and ($\bar{x} + \sigma$)
High	Above ($\bar{x} + \sigma$)

3.4.1.28 Scientific orientation

It was operationalized as the degree to which a farmer is oriented to the use of scientific methods in agriculture. The variable was quantified by using the scientific orientation scale of Supe (1969) with slight modifications. The scale had twelve statements with five point continuum as Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SDA) and scored as 4, 3, 2, 1 and 0 for positive statements and vice-versa for negative statements. Based on the mean ($\bar{x}$) and standard deviation (σ), the respondents were classified into three categories:

Level of scientific orientation	**Score range**
Low	Below ($\bar{x} - \sigma$)
Medium	Between ($\bar{x} - \sigma$) and ($\bar{x} + \sigma$)
High	Above ($\bar{x} + \sigma$)

3.4.1.29 Economic motivation

Economic motivation was operationalized as the extent to which an individual is oriented towards achievement of the maximum economic ends such as maximization of profits. Economic motivation scale developed by Supe (1969) with slight modification was followed. The responses were obtained on a five point continuum scale of Strongly Agee (SA), Agree (A), Undecided (UD), Disagree (DA) and Strongly Disagree (SDA) and scored as 4, 3, 2, 1 and 0 for positive statements and vice-versa for negative statements. Based on the mean ($\bar{x}$) and standard deviation (σ), the respondents were classified into three categories:

Level of economic motivation	**Score range**
Low	Below ($\bar{x} - \sigma$)
Medium	Between ($\bar{x} - \sigma$) and ($\bar{x} + \sigma$)
High	Above ($\bar{x} + \sigma$)

3.4.1.30 Market Orientation

It refers to the degree to which farmer is oriented towards marketing functions on his farm. Market orientation scale developed by Samanta (1977) was followed in the present study.

The positive statements were given scores of 4, 3, 2, 1 and 0 for ‘strongly agree’, ‘agree’, ‘undecided’, ‘disagree’ and ‘strongly disagree’. The scoring was reversed in case of negative statements. Thus, the maximum and minimum scores that could be obtained by each respondent were in range of 20 and 0 respectively. Based on the mean ($\bar{x}$) and standard deviation (σ), the respondents were classified into three categories:

Level of market orientation	**Score range**
Low	Below ($\bar{x} – \sigma$)
Medium	Between ($\bar{x} – \sigma$) and ($\bar{x} + \sigma$)
High	Above ($\bar{x} + \sigma$)

3.4.2 Dependent variables

3.4.2.1 Knowledge of sustainable pineapple cultivation practices

Knowledge referred to the farmers’ understanding of the recommended sustainable cultivation practices of pineapple and the information retained by the farmers.

For the present study, operational measure for knowledge was developed to know the knowledge level of the pineapple farmers towards sustainable pineapple cultivation. The knowledge questions were constructed based on the package of practices developed for pineapple cultivation by Central Institute of Horticulture and KVK, Dimapur after discussing with subject experts. Lists of 18 practices were developed for the purpose and each practice was administered in the form of questions to respondents to obtain the response from respondents. The answers were quantified by giving one score to the correct answer and zero to the incorrect one. The knowledge index was calculated by using the formula:

$$\text{Knowledge Index (KI)} = \frac{\text{Total score obtained by the respondents}}{\text{Maximum obtainable score}} \text{ X } 100$$

As a result, the maximum score that one could get was 74 and the minimum was zero. Based on the mean ($\bar{x}$) and standard deviation (σ) obtained, the respondents were classified as follows:

Level of knowledge	**Score range**
Low	Below ($\bar{x} - \sigma$)
Medium	Between ($\bar{x} - \sigma$) and ($\bar{x} + \sigma$)
High	Above ($\bar{x} + \sigma$)

3.4.2.2 Extent of Adoption of sustainable pineapple cultivation practices

According to Rogers (1962), adoption is a decision to make full use of an innovation as the best course of action available. In this study, adoption level referred to the level of adoption of sustainable cultivation practices of pineapple by the respondents. The extend of adoption of sustainable cultivation practices of pineapple was measured by referring the recommended sustainable cultivation practices of pineapple for studying adoption of 18 practices selected. A score of two for full adoption, one for partial adoption and zero for non-adoption were accorded. The following formula was applied to measure the adoption level of respondents towards sustainable cultivation practices of pineapple.

$$\text{Adoption Index} = \frac{\begin{array}{c}\text{Actual score obtained for adopting sustainable cultivation} \\ \text{practices of pineapple by the respondents}\end{array}}{\begin{array}{c}\text{Total possible score for sustainable cultivation practices} \\ \text{of pineapple}\end{array}} \text{ X } 100$$

The total possible score ranged from zero to 86. The respondents were grouped into three categories based on mean ($\bar{x}$) and standard deviation (σ) as follows:

Level of adoption	Score range
Low	Below ($\bar{x}$ – σ)
Medium	Between ($\bar{x}$ – σ) and ($\bar{x}$ + σ)
High	Above ($\bar{x}$ + σ)

Technological gap

Technological gap has been defined as the proportion of gap in the adoption of practices recommended and it is expressed in percentage (Ray *et al.*, 1995). The responses collected from the respondents were quantified as fully, partially and not adopted of the recommended practices. Any remarkable deviation from the adoption of normal recommendation was treated as partial adoption. The technological gap for sustainable cultivation practices of pineapple was calculated by using the following formula:

$$\text{Technological Gap Index} = \frac{R-A}{R} \times 100$$

Where,

R = maximum possible adoption score that a respondent could be awarded in respect of a given component of the technology

A = Score obtained by a respondent by virtue of his adoption of a given component of technology

$$\text{Mean technological gap} = \frac{\text{Total gap for all practices}}{\text{Number of practices recommended}}$$

The maximum score that a respondent could obtain was 86 and minimum score was zero. On the basis of their overall technological gap, the respondents were grouped into three categories considering the mean($\bar{x}$) and standard deviation (σ) as measure of check.

Level of technological gap	Score range
Low	Below $(\bar{x} - \sigma)$
Medium	Between $(\bar{x} - \sigma)$ and $(\bar{x} + \sigma)$
High	Above $(\bar{x} + \sigma)$

3.4.2.3 Attitude towards adoption of sustainable pineapple cultivation practices

Attitude refers to the degree of positive or negative affect associated with some psychological object (Thurstone, 1946).

In the present study, Likert's technique (1932) was followed to develop a scale to measure the attitude of respondents towards sustainable cultivation practices of pineapple. The procedure followed is presented below:

Item collection

A set of items, covering the area of sustainable cultivation practices of pineapple reflecting various dimensions of attitude were collected based upon review of previous research studies, books, bulletins, magazines and discussion with academicians, subject matter specialists, researchers in the field of extension, horticulture, entomology and pathology. A tentative list of 92 statements (50 positive and 42 negative statements) were drafted keeping in view of the applicability of statements suited to the study area.

Editing of items

By following the criteria suggested by Edwards (1957), the items collected were examined and each item was carefully edited. Out of the 92 statements, a total of 50 statements were retained after rigorous scrutinizing. Each statement comprised of minimum possible words as well as clarity in meaning and understanding. Efforts were also made to include both positive and negative statements.

Item analysis

Item analysis is an important step of attitude measurement in the construction of a valid and reliable scale. The purpose of item analysis is to select those items which form an internally consistent scale and eliminate those items that do not (Spector, 1992). The 50 statements selected were subjected to item analysis to delineate the items that discriminate between persons having favourable and unfavourable attitudes. The response of respondents for each statement were obtained on a five point continuum ranging from, "strongly agree", "agree", "undecided", "disagree" and "strongly disagree" with the weighted scores of 5, 4, 3, 2, and 1 respectively for positive statements and reverse scoring pattern for negative statements. The total score for each individual was computed by summing up the scores for all the individual items.

Computation of t value and final selection of item

For computation of t-value, all the 50 scale items were administered to a random sample of 20 farmers in a non- sampled area. Based upon the total scores, the respondents were arranged in ascending order. The top 27 per cent of the respondents with their total scores were considered as the high group and the bottom 27 per cent as the low group, and used as two criterion groups to evaluate the individual items as suggested by Edwards (1957). Thus, out of 20 farmers to whom the items were administered for the item analysis, 5 farmers with lowest, 5 with highest scores were used as criterion groups to evaluate individual items.

The critical ratio, that is the 't' value which is a measure of the extent to which a given statement differentiates between the high and low groups of the respondents for each statement was calculated by using the formula suggested by Edwards (1957). After computing the 't' value for each item, the statements were arranged in rank order according to their 't' values. 14 (6 positive and 8 negative) statements with ‘t’ value equal to or greater than 1.75 were finally selected and included in the attitude scale (Edwards, 1957).

Table 3.4.2.3: Scale developed to measure the attitude of farmers towards sustainable cultivation practices of pineapple

Sl. No.	Statements	‘t’ value
1.	In order to sustainably manage a pineapple farm, a farmer should essentially go for curing of suckers and slips. (+)	4.000
2.	A farmer must practice mulching the pineapple plantation with black polysheet to conserve the soil moisture and check soil erosion. (+)	2.667
3.	Using black polythene film as mulch is a sustainable method of controlling weed growth and conserving soil moisture in sustainable pineapple cultivation. (+)	2.272
4.	A farmer should prepare compost from the farm waste in sustainable cultivation practices. (+)	2.142
5.	Desuckering practice in pineapple population is not advisable for sustainable cultivation. (-)	2.132
6.	Soil and water resources belong to only the present generation and so maximum resources must be used to make it sustainable. (-)	2.127
7.	Sustainable pineapple cultivation practices benefits only the producers and not the environment. (-)	2.000
8.	A farmer should not be aware that drip irrigation help in maintaining optimum growth of the plant in sustainable pineapple cultivation. (-)	2.000
9.	One should opt for adopting biological pest control practices in sustainable cultivation practices. (+)	2.000
10.	More pesticide and weedicide are required for controlling pests and weeds in sustainable cultivation practices. (-)	2.000
11.	One should go for adopting sustainable pineapple cultivation practices as it is beneficial to farmers. (+)	1.898
12.	Biocontrol is not a sustainable practice to control the insect-pest population in pineapple field. (-)	1.898
13.	Sustainable pineapple cultivation practices can be practiced only by small farmers. (-)	1.890
14.	Maintaining good drainage system is not a sustainable practice in pineapple cultivation. (-)	1.789

Standardization of the scale

The validity and reliability were determined for standardization of the scale. Reliability was measured by administering the split- half technique.

Reliability of the scale

Reliability was carried out to know the consistency, stability and accuracy of the scale. According to Ray and Mondal (1999), reliability refers to the precision or accuracy of measurement or score. Reliability is the ability of a 'test instrument' to yield consistent results from one set of measures to another. A good instrument should evoke responses that are valid and yield nearly same results if administered twice to the same respondents (Goode and Hatt, 1952).

Split half method

Reliability was tested by using the split-half method where the scale of 14 statements was divided into two halves based on odd and even number of statements and administered to respondents in a non- sampled area. The correlation coefficient value between the two sets of score was 0.74 and the calculated value of reliability coefficient for the test was 0.85, the 'r' value significant at one per cent level of significance. The result indicated that the attitude scale has high reliability and suitable for administration to the farmers as the scale was consistent and dependable in its measurement. It may be said that, the test is reliable to measure the attitude of farmers towards sustainable cultivation practices of pineapple.

Validity

Validity is often defined as the extent to which an instrument measures what it asserts to measure (Blumberg *et al*., 2005). A scale is said to be valid if it stands for one's reasoning. The scale developed was tested for content validity. The content validity of the developed scale was examined by determining how well the content of the scale represented the domain subject matter under study.

The items were subjected to scrutiny, criticism and discussion with specialists, extension academicians and with adherence to the judges' ratings. The scale was modified accordingly and thus, it may be said that the scale possessed content validity.

Administering the scale

The final scale consisting of 14 statements (6 positive and 8 negative statements) were administered to farmers and asked to respond on a five point continuum, *viz*. strongly agree, agree, undecided, disagree and strongly disagree. The scoring pattern for the response were 4, 3, 2,1 and 0 respectively for positive statements and reverse scoring for negative statements. The maximum obtainable score by the respondent may be 56 and minimum obtainable score 0. All the statements of the respondent were summed up to get the final attitude score.

The respondents were further groped into three categories based on the mean($\bar{x}$) and standard deviation (σ) as follows:

Degree of attitude	Score range
Less favourable	Below ($\bar{x} - \sigma$)
Favourable	Between ($\bar{x} - \sigma$) and ($\bar{x} + \sigma$)
More favourable	Above ($\bar{x} + \sigma$)

3.4.3 Constraints perceived by the pineapple growers in adopting sustainable pineapple cultivation practices and suggest strategies to overcome

Constraint is defined as a limiting factor that prevents a system from moving closer to achieve its goal. In this study, constraint referred to the problems, hindrances or limitation that restrict the farmers from performing to its full potential in sustainable cultivation practices of pineapple. Garrett ranking technique was followed to analyse the problems perceived by the respondents. This technique provides the change of orders of constraints and advantages into numerical scores.

The prime advantage of this technique over simple frequency distribution is that the constraints are arranged based on their severity from the point of view of respondents (Zalkuwi *et al*., 2015). Major problems faced in sustainable cultivation practices of pineapple were identified. The respondents were then asked to rank the identified problems for all factors based on the severity of the constraints faced. Constraints faced by the respondents were categorized under main heads such as labour, economic, technological, marketing, extension contact, input, infrastructural, IPM, environmental and other constraints. The rank assigned to different constraints were then transformed into percentage by using the formula:

$$\text{Percent Position} = \frac{100(R_{ij} - 0.5)}{N_j}$$

Where,

R_{ij} = Rank given for the i^{th} constraint by the j^{th} respondent and

N_j = Number of constraints ranked by j^{th} respondent

The percent position is converted into scores by referring to the table given by Garett and Woodworth (1969). Then for each factor, the scores of each individual were added and then total value of scores and mean values of score were calculated. These mean scores for all the factors were arranged in descending order and the most influencing factors were identified through the ranks assigned. The factors having highest mean value was considered to be the most important factor.

Suggestions are the ideas, proposals, plan or an approach by an individual or a group of people for tackling a problem for further improvement of a situation. In the present study, suggestions were given by the respondents for sustainable cultivation practices of pineapple.

3.5 Formulation of Hypothesis

Keeping in view the importance of factors selected with reference to the objectives of the present study, the following set of research hypotheses were framed and presented in null form (Ho) as:

H_o1: There is no association between the selected socio- economic, personal and psychological variables with *knowledge* of sustainable pineapple cultivation practices.

H_o2: There is no association between the selected socio- economic, personal and psychological variables with *extent of adoption* of sustainable pineapple cultivation practices.

H_o3: There is no association between the selected socio- economic, personal and psychological variables with *attitude* towards adoption of sustainable pineapple cultivation practices.

3.6 Tools and techniques used for data collection

An interview schedule directed towards the objectives of the study was developed for data collection. The schedule was prepared with references from similar research materials from within and outside the institution.

3.6.1 Development of interview schedule

A structured interview schedule was prepared based on the objectives and scope of the study by including the items related to the dependent and independent variables with all the relevant scales, indices, schedule items, etc for measuring the variables included in the study. Pre-testing of the interview schedule was made. Based on pretested results, few difficult and ambiguous questions were deleted from the drafted schedule and few changes were incorporated in the formation of items and their sequence. The final version of the interview schedule has been appended in the Appendix.

3.6.2 Collection of data

Primary data were collected through personal interview and group discussions. The secondary data was collected from various publications, magazines, journals, relevant text books and other sources.

3.7 Analysis of data

The data collected were coded, tabulated and analysed. The data were subjected to different statistical tests as per the objectives of the study. These tests include mean, standard deviation, frequency and percentage grouping which were used in simple comparison of different categories. The other statistical tools like correlation coefficient, multiple regression, z- test, path analysis and factor analysis using SPSS were analysed. A brief description of these tools is given below:

3.7.1 Mean

Mean is the sum of the observed values of a set divided by the number of observations in the set is called a mean or an average. The calculated mean was used for grouping the respondents.

3.7.2 Standard Deviation

The positive square root of the variance is called standard deviation. It explains the average amount of variation on either side of the mean. The mean and standard deviation were used to classify the farmers into three following categories:

Category	**Criteria**
Low	Below $(\bar{x} - \sigma)$
Medium	Between $(\bar{x} - \sigma)$ and $(\bar{x} + \sigma)$
High	Above $(\bar{x} + \sigma)$

3.7.3 Frequency

A frequency distribution was used to quantify the different personal, social, psychological and economical characteristics of the farmers. It was also used in the response analysis of knowledge and adoption statements.

3.7.4 Percentage

Percentage was used to make the simple comparison of different groups where ever needed.

3.7.5 Karl Pearson correlation coefficient/Half-test reliability ($r_{1/2}$)

This was used to calculate the degree of relationship between odd numbered scored judges and even numbered scored judges.

$$r = \frac{N(\Sigma XY) - (\Sigma X)(\Sigma Y)}{\sqrt{[N\Sigma X^2 - (\Sigma X)^2]}\sqrt{[N\Sigma Y^2 - (\Sigma Y)^2]}}$$

Where,

r = corelation coefficient

X = sum of the scores of odd numbered responses of respondents

Y = sum of the scores of even numbered responses of respondents

ΣX = sum of the scores of all odd numbered responses of respondents

ΣY = sum of the scores of all even numbered responses of respondents

X^2 = sum of squares obtained from odd numbered responses of respondents

Y^2 = sum of squares obtained from even numbered responses of respondents

N = Total number of paired odd and even numbered responses of respondents

3.7.6 Spearman- Brown Formula (r_{11})

This tool was used to determine the reliability co-efficient of scores obtained from odd and even numbered responses obtained from the respondents for scale development of the attitude of the respondents.

$$R = \frac{2r}{1+ r}$$

Where,

R= Reliability coefficient of the whole scale.

r = Estimated correlation between two halves (Pearson r)

3.7.7 Cronbach's alpha coefficient

Cronbach's alpha coefficient which measures the internal consistency or reliability of a set of survey items was used to check the consistency and reliability of the scale developed for the present study.

$$\alpha_{St} = \frac{Kr}{[1+(K-1)r]}$$

Where,

K = Number of items in scale

r = mean of the K (K-1)/2 non-redundant correlation coefficients

3.7.8 Correlation Coefficient

This was used to find out the relationship between the independent and dependent variables.

3.7.9 Multiple Regression Analysis

Multiple regression analysis was used mainly to find out the significant contributions made by the independent variables on the dependent variable.

3.7.10 Z test

A statistical test used to determine whether two population means are different when the variances are known and the sample size is large. It is denoted as,

$$z = \frac{\bar{X} - \mu}{\frac{\sigma}{\sqrt{n}}}$$

Where $\bar{X}$= sample mean

μ= population mean

σ = standard deviation

n= sample size

3.7.11 Path Analysis

In finding a quantitative interpretation of direct and indirect effects of factors (independent variables) on knowledge level of sustainable cultivation practices and for developing the operational model, the path analysis was employed. According to Miller (1977) the technique of path analysis is not a method for discovering causal laws but a procedure for giving quantitative interpretation of an assumed causal system as it operates within a given population. Path co-efficients reflect the amount of direct contribution to a given variable on other variable when effects of other related variables are taken into account. The direct path co-efficients follows the order of magnitude of partial regression co-efficients of the variables. The direct co-efficients are comparable. Path analysis also denotes the extent to which the variance in a dependent variable is determined by the variance of the independent variable.

3.7.12 Factor Analysis

Factor analysis is a technique that is used to reduce a larger variable into smaller variable factor. Principle Component Analysis method of factor analysis was used in this study. This analyses the data in order to reduce the data using smaller set of components through grouping factor based on intercorrelation between factors (Pallant, 2002). The component model is expressed as follows:

$$Z_i = a_{i1} X_1 + a_{i2} X_2 + a_{i3} X_3 + \ldots\ldots\ldots\ldots\ldots a_{ip} X_p$$

Where Z_i - Magnitude of the variable

a_{ip} - The factor loading of variable i on factor p

X_p-The amount of association in magnitude of indicators, the uncorrelated trait measured by factor ‘p’ which is possessed by variable.

i - Factor loading with reference to indicators 1, 2, 3 . . . p

p - A set of common factors (1, 2 . . . p)

$a_{ip}X_p$ - Factor co-efficient or loading of variables i on factor p

Those principal components whose Eigen values are greater than or equal to one are retained to determine the number of components in the study. During the selection of variables from the extracted dimensions, greater and positive values from rotated component matrix (Varimax rotation method) from respective dimensions are selected.

CHAPTER IV

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

This chapter deals with the results and discussion of the research study. The results and discussion obtained after subjecting data to statistical analysis and interpretation are presented in this chapter under the following heads:

4.1. Profile characteristics of the pineapple growers
4.2. Knowledge level of pineapple growers about sustainable cultivation practices
4.3. Extent of adoption of sustainable cultivation practices among pineapple growers
4.4. Technological gap in adoption of sustainable cultivation practices among the pineapple growers
4.5. Attitude of pineapple growers towards adoption of sustainable cultivation practices of pineapple
4.6. Determinants of knowledge and adoption in relation to sustainable cultivation practices of pineapple
4.7. Constraints perceived by the pineapple growers in adopting sustainable pineapple cultivation practices and suggest strategies to overcome.

4.1. Profile characteristics of the pineapple growers

4.1.1 Personal and socio-economic characteristics of the pineapple growers

4.1.1.1 Age

Table 4.1.1.1and Fig 4.1.1.1 highlighted that 63.43 per cent of the respondents from Dimapur district belonged to 35- 55 years category followed by 25.71 per cent under more than 55 years and less than 35 years (10.86%). It was found that 54.29 per cent and 50.00 per cent of the respondents from Peren and Mokokchung district belonged to 35- 55 years of age category. Under more than 55 years of age category, 24.28 per cent and 36.67 per cent of the respondents from districts Peren and Mokokchung belonged to this category. Furthermore, 21.43 per cent and 13.33 per cent of them from districts Peren and Mokokchung were categorised under less than 35 years of age category.

Overall, majority (59.64%) of the respondents were found in the 35- 55 years of age category followed by more than 55 years (26.54%) and less than 35 years (13.82%) age category.

Farmers of middle age tend to be more energetic, efficient and responsible. They may have more involvement and commitment in sustainable cultivation practices of pineapple. Similar findings were reported by Akter *et al.* (2018), Alam and Usmani (2019), Das *et al.* (2019), Deb *et al.* (2021) and Moumita and Mazhar (2022).

Table 4.1.1.1: Distribution of the respondents based on their age

Category	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Young (< 35 years)	19 (10.86)	15 (21.43)	04 (13.33)	38 (13.82)
Middle Aged (35 – 55 years)	**111 (63.43)**	**38 (54.29)**	**15 (50.00)**	**164 (59.64)**
Old (> 55 years)	45 (25.71)	17 (24.28)	11 (36.67)	73 (26.54)
Mean	48.27	46.29	50.27	47.98
SD	10.55	12.26	10.71	11.05

Figures in parentheses indicate the percentage (%) of the respondents

4.1.1.2 Gender

From Table 4.1.1.2 and Fig 4.1.1.2, it was observed that majority of the respondents were male in case of Dimapur district (73.71%) and Mokokchung district (63.27%) whereas majority (64.29%) were female among the respondents from Peren district.

Overall, 63. 27 per cent of the respondents were male. This implied that both men and women actively take part in farming activities. These findings were in line with the findings of Mondal *et al.* (2014), Akhilomen *et al.* (2015), Suhaimi and Fatah (2019), Nahar *et al.* (2020) and Rhonben *et al.* (2021).

Table 4.1.1.2: Distribution of the respondents based on their gender

Category	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Male	**129 (73.71)**	25 (35.71)	**20 (66.67)**	**174 (63.27)**
Female	46 (26.29)	**45 (64.29)**	10 (33.33)	101 (36.73)

Figures in parentheses indicate the percentage (%) of the respondents

4.1.1.3 Marital status

It was found from Table 4.1.1.3 and Fig 4.1.1.3 that 97.14 per cent, 97.14 per cent and 96.67 per cent of the respondents were married among Dimapur, Peren and Mokokchung respectively. Overall, 97.09 per cent of the respondents were found to be married. This imply that farmers who are married have a higher tendency to participate in sustainable farming activities than those farmers who are not married. Similar findings were observed by Akhilomen *et al.* (2015), Krishnamurthy (2015), Datta *et al.* (2020), Kehinde *et al.* (2021) and Sodjinou *et al.* (2022).

Table 4.1.1.3: Distribution of the respondents based on their marital status

Category	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Married	**170 (97.14)**	**68 (97.14)**	**29 (96.67)**	**267 (97.09)**
Unmarried	05 (2.86)	02 (2.86)	01 (03.33)	08 (2.91)

Figures in parentheses indicate the percentage (%) of the respondents

4.1.1.4 Family size

Table 4.1.1.4 and Fig 4.1.1.4 revealed that more than half (59.43) of the respondents belonged to medium family followed by large family (21.71%) and (18.86%) among the respondents from Dimapur district. Under Peren district, 41.43 per cent of the respondents belonged to medium family, 31.43 per cent and 27.14 per cent of the respondents belonged to small family and large family. Among the respondents Mokokchung district, half (50.00%) of the respondents belonged to middle family, followed by small family (36.67%) and large family (13.33%).

Overall, more than half (53.82%) belonged to medium family followed by small family (24.36%) and large family (21.82%).

The importance to make better economic progress, management and quality of life might be the possible reason behind most of the respondents belonging to medium family. More number of members in a household offer the possibility of readily available labour work especially during the peak harvesting time. These findings are in tune with the findings of Jha (2012), Boruah *et al.* (2015), Das *et al.* (2019), Rhonben *et al.* (2021).

Table 4.1.1.4: Distribution of the respondents based on their family size

Category	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Small (1 – 4 members)	33 (18.86)	22 (31.43)	11 (36.67)	67 (24.36)
Medium (5 – 6 members)	**104 (59.43)**	**29 (41.43)**	**15 (50.00)**	**148 (53.82)**
Large (7 & aboveMembers)	38 (21.71)	19 (27.14)	04 (13.33)	60 (21.82)
Mean	5.63	5.56	5	5.55
SD	1.38	1.85	1.2	1.5

Figures in parentheses indicate the percentage (%) of the respondents

4.1.1.5 Education

Table 4.1.1.5 and Fig 4.1.1.5 revealed that among the respondents from Dimapur district, close to half (46.86%) had education upto middle school, 21.71 per cent of them were educated upto highschool level, followed by 14.86 per cent upto primary level and 9.14 per cent of them were illiterate. Only 2.86 per cent and 0.57 per cent of the respondents were educated up to matric and graduate level respectively.

In case of Peren district, Table 4.1.1.5 and Fig 4.1.1.5 further revealed that 35.71 per cent of the respondents were educated upto middle school level followed by 32.86 per cent, 24.29 per cent and 1.43 per cent up to primary, highschool level and graduate level respectively. 5.47 per cent of the respondents were found to be illiterate.

It was also observed from Table 4.1.1.5 and Fig 4.1.1.5 that more than half (56.67%) of the respondents under Mokokchung district were educated upto highschool level, 23.33 per cent,16.67 per cent, 3.33 per cent had education upto middle school, matric and primary level respectively. Further, none (0.00%) of the respondents were illiterate and educated upto graduate level.

Based on the pooled data from all the three districts it was found that (41.45%) of the respondents were educated upto middle level, followed by highschool (28.73%), primary (18.18%), matric (3.64%) and graduate (0.73%) level. However, 7.27 per cent of the respondents were found to be illiterate. Education plays a key important role in developing and bringing desirable changes in a human being. Most of the respondents were relatively educated which may have helped the respondents in gaining agricultural knowledge and helped in increasing the ability of information dissemination among the farmers. Education significantly impacts the farmers in productivities and field management.

These findings were in conformity with the findings of Nanda *et al.* (2012), Das *et al.* (2019) and Rashid *et al.* (2021).

Table 4.1.1.5: Distribution of the respondents based on their education

Category	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Illiterate	16 (9.14)	04 (5.71)	00 (0.00)	20 (7.27)
Primary	26 (14.86)	23 (32.86)	01 (3.33)	50 (18.18)
Middle	**82 (46.86)**	**25 (35.71)**	07 (23.33)	114 **(41.45)**
Highschool	45 (25.71)	17 (24.29)	**17 (56.67)**	79 (28.73)
Matriculate	5 (2.86)	00 (0.00)	5 (16.67)	10 (3.64)
Graduate	01 (0.57)	01 (1.43)	00 (0.00)	02 (0.73)

Figures in parentheses indicate the percentage (%) of the respondents

4.1.1.6 Occupation

As revealed in Table 4.1.1.6 and Fig 4.1.1.6, majority of the respondents (88.00%, 67.14% and 76.67%) from all the three districts; Dimapur, Peren and Mokokchung respectively were engaged only in farming.

In case of Dimapur district, 9.71 per cent of the respondents were engaged in both farming and business followed by farming and service (2.29%) sector.

A considerable number of the respondents (30.00%) under Peren district were engaged in both farming and business and 2.86 per cent were engaged in farming and service.

It was also found that 13.33 per cent of the respondents from Mokokchung district were engaged in both farming and service sector followed by 10.00 per cent engaged in both farming and business. This might be due to the fact that a greater number of respondents from this district were educated compared to the other two districts.

Overall, the study revealed that most of the respondents (81.45%) were engaged only in farming activity while 14.91 per cent and 3.64 per cent of the respondents were engaged in both farming and business and farming and service respectively. The findings reveal that majority of the respondents were dependent on agriculture for their livelihood and some of the respondents were engaged in other activities besides farming to gain additional income. Similar findings were also reported by Rabina *et al.* (2021), Rashid *et al.* (2021), Kakki *et al.* (2022) and Moumita and Mazhar (2022).

Table 4.1.1.6: Distribution of the respondents based on their occupation

Category	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Farming	**154 (88.00)**	**47 (67.14)**	**23 (76.67)**	**224 (81.45)**
Farming + Business	17 (9.71)	21 (30.00)	03 (10.00)	41 (14.91)
Farming + Service	04	02	04	10

	(2.29)	(2.86)	(13.33)	(3.64)

Figures in parentheses indicate the percentage (%) of the respondents

4.1.1.7 Experience

Table 4.1.1.7 and Fig 4.1.1.7 showed that under Dimapur district, majority (68.57%) of the respondents had medium level (5.57 – 14.91 years) of experience, followed by 23.43 per cent high level of experience and 8.00 per cent low level of experience in pineapple cultivation. In case of Peren district, more than half (65.71%) of the respondents were found to be in the medium level of experience, whereas 22.86 per cent had low medium level of experience followed by only 11.43 per cent of the respondents under high level of experience. Further, Mokokchung district had majority (73.33%) of the respondents under medium level of experience while 20.00 per cent and 6.67 per cent of the respondents had high and medium level of experience respectively.

The comprehensive data of the three districts revealed that majority (68.36%) of the respondents had medium level of experience followed by high (20.00%) and low (11.64%) level of experience. The mean and standard deviation was 10.24 and 4.67 respectively. The findings indicate that most of the farmers have been involved in pineapple cultivation for quite a long time and have enough experience to manage well their pineapple farms. Similar findings were observed by Jha (2010), Patra and Kense (2021), Rashid *et al.* (2021) and Kakki *et al.* (2022).

Table 4.1.1.7: Distribution of the respondents based on their experience in pineapple cultivation

Category	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Low (< 5.57)	14 (8.00)	16 (22.86)	02 (6.67)	32 (11.64)
Medium (5.57 – 14.91)	**120 (68.57)**	**46 (65.71)**	**22 (73.33)**	**188 (68.36)**
High (> 14.91)	41 (23.43)	08 (11.43)	06 (20.00)	55 (20.00)
Mean	10.86	8.74	10.1	10.24

SD	4.64	3.99	5.57	4.67

Figures in parentheses indicate the percentage (%) of the respondents

4.1.1.8 Size of land holding under agriculture

Table 4.1.1.8 and Fig 4.1.1.8 indicated that more than half of the respondents from Dimapur district (74.28%) belonged to the category of small farmers (2.5 – 5.0 acres) while, 14.86 per cent belonged to marginal category (less than 2.5 acres) and 10.86 per cent belonged to the semi- medium category (5.01 – 10.00 acres).

Under Peren district, 72.86 per cent of the respondents belonged to small farmers followed by 17.14 per cent of the respondents belonging to marginal category and semi – medium farmers (10.00%). It was also found that among the respondents from Mokokchung district, half (53.34%) of the respondents belonged to small category and a considerable level of respondents (33.33%) belonged to marginal category followed by semi – medium category of farmers (13.33).

Overall, 71.64 per cent of the respondents belonged to small farmers followed by marginal farmers (17.45%) and semi – medium farmers (10.91%). Majority of the respondents fall under the category of small farmers. This could be due to the fact that agricultural land is inherited from their ancestors among the families and as a result of fragmentation of land, the land gets reduced. Similar findings were observed in the works of Phukan *et al.* (2017), Rashid *et al.* (2021) and Lotha and Jha (2022).

Table 4.1.1.8: Distribution of the respondents based on their size of landholding under agriculture

Category (in acres)	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Marginal (< 2.5)	26 (14.86)	12 (17.14)	10 (33.33)	48 (17.45)
Small (2.5- 5.0)	**130 (74.28)**	**51 (72.86)**	**16 (53.34)**	**197 (71.64)**
Semi- medium (5.01- 10.00)	19 (10.86)	07 (10.00)	04 (13.33)	30 (10.91)

Mean	3.61	3.60	3.59	3.48
SD	1.33	1.53	1.49	2.2

Figures in parentheses indicate the percentage (%) of the respondents

4.1.1.9 Size of land holding under pineapple cultivation

An overview of Table 4.1.1.9 and Fig 4.1.1.9 revealed that under Dimapur district, majority (59.43%) of the respondents had a size of landholding 2-5 acres while 38.28 per cent had landholding size of 1-2 acres and 2.29 per cent of them had more than 5 acres of landholding under pineapple cultivation.

With respect to respondents from Peren district, Table 4.1.1.9 and Fig 4.1.1.9 showed that majority (65.71%) of the respondents owned 1-2 acres size of landholding under pineapple cultivation, 24.29 per cent of them owned 2-5 acres and 10.00 per cent owned less than 1 acre of landholding under pineapple cultivation. Similarly, it was found that half (50.00%) of the respondents owned 1-2 acres size of landholding under pineapple cultivation followed by 30.00 per cent, 16.67 per cent and 3.33 per cent of them owning 2-5 acres, less than 1 acre and more than 5 acres respectively.

The consolidated data of the three districts revealed that majority (47.27%) of the respondents possessed 2-5 acres of landholding under pineapple cultivation while 46.55 per cent owned 1-2 acres, 4.36 per cent possessed less than 1 acre and only 1.82 per cent possessed landholding of more than 5 acres.

These findings are in line with the findings of Alam and Usmani (2019), Rabina *et al*. (2021) and Jadhav *et al.* (2023).

Table 4.1.1.9: Distribution of the respondents based on their size of landholding under pineapple cultivation

Size of land	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
< 1 acre	00 (0.00)	07 (10.00)	05 (16.67)	12 (4.36)
1 – 2 acres	67 (38.28)	**46 (65.71)**	**15 (50.00)**	128 (46.55)
2 – 5 acres	**104 (59.43)**	17 (24.29)	09 (30.00)	**130 (47.27)**
> 5 acres	04 (2.29)	00 (0.00)	01 (3.33)	05 (1.82)
Mean	2.89	1.85	2.11	2.55
SD	1.29	0.96	1.9	1.37

Figures in parentheses indicate the percentage (%) of the respondents

4.1.1.10 Input self - sufficiency

Table 4.1.1.10 and Fig 4.1.1.10 showed that under Dimapur district, majority (86.86%) of the respondents had medium level of input self-sufficiency followed by low level (8.57%) and high (4.57%) level of input self-sufficiency.

In case of Peren district, it was found that 70.00 per cent of the respondents had medium level of input self-sufficiency followed by high (24.29%) level of input self-sufficiency and low (5.71%) level of input self-sufficiency. This indicated that the respondents were self-sufficient with their own inputs and rely lesser on external inputs and are sustainable in their livelihood. Whereas, Table 4.1.1.10 and Fig 4.1.1.10 further revealed that half (50.00%) of the respondents under district Mokokchung had low level of input self-sufficiency followed by medium level (46.67%) and low (3.33%) level of input self-sufficiency. This implied that district Mokokchung were less self-sufficient compared to the other two districts.

Overall, 78.18 per cent of the respondents had medium level of input self-sufficiency and 12.36 per cent 9.46 per cent of the respondents had high and low level of input self-sufficiency respectively. An increased input self-sufficiency may form a key aspect in improving sustainability of farming systems.

Table 4.1.1.10: Distribution of the respondents based on their level of input self-sufficiency

Level of input self sufficiency	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Low (< 81.39)	15 (8.57)	04 (5.71)	**15 (50.00)**	34 (12.36)
Medium (81.39 – 92.29)	**152 (86.86)**	**49 (70.00)**	14 (46.67)	**215 (78.18)**
High (> 92.29)	08 (4.57)	17 (24.29)	01 (3.33)	26 (9.46)
Mean	86.89	89.14	81.16	86.84
SD	4.29	5.21	7.68	5.45

Figures in parentheses indicate the percentage (%) of the respondents

4.1.1.11 Employment generated

Table 4.1.1.11 and Fig 4.1.1.11 revealed that majority (95.43%) of the respondents from Dimapur district had 100–200 days of mandays generated followed by 3.43 per cent with more than 200 mandays generated and 1.14 per cent with less than 100 mandays generated. In case of respondents from Peren district, it was found that 68.57 per cent had mandays generated between 100–200 days while 31.43 per cent had less than 100 days mandays generated. With reference to respondents from Mokokchung district, half (50.00%) of them had mandays generated between 100–200 days, 46.67 per cent had less than 100 mandays generated and only 3.33 per cent more than 200 mandays generated. This variation maybe due to less landholdings under pineapple cultivation.

The consolidated data of the respondents from the three districts found that majority (83.64%) of them had mandays generated between 100–200 days followed by 13.82 per cent with less than 100 mandays generated and 2.54 per cent more than 200 mandays generated. It was found that the respondents employed both family labour, hired labour and exchanged labour. The rate of labour charge for both man and woman varied from district to district and village to village. These findings are supported by Beck (2015), Mahesh *et al.* (2017) and Sahoo (2019).

Table 4.1.1.11: Distribution of the respondents based on mandays generated

Level of mandays generated	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
< 100	02 (1.14)	22 (31.43)	14 (46.67)	38 (13.82)
100 – 200	**167 (95.43)**	**48 (68.57)**	**15 (50.00)**	**230 (83.64)**
> 200	06 (3.43)	00 (0.00)	01 (3.33)	07 (2.54)
Mean	145.83	120.87	123.13	137
SD	29.12	25.34	38.43	31.53

Figures in parentheses indicate the percentage (%) of the respondents

4.1.1.12 Integrated Nutrient Management

Table 4.1.1.12 and Fig 4.1.1.12 clearly stated that majority (71.43%) of the respondents under Dimapur district had medium level of integrated nutrient management followed by high (28.57%) level of integrated nutrient management. In case of respondents from Peren district, it was found that 92.86 per cent had medium level of integrated nutrient management followed by high (7.14%) level of integrated nutrient management. Under Mokokchung district, majority (70.00%) of the respondents had medium level of integrated nutrient management and high level (30.00%) of integrated nutrient management.

In the pooled data, 76.73 per cent of the respondents had medium level of integrated nutrient management followed by 23.27 per cent of high level of integrated nutrient management. It was found from the study that the respondents were involved in managing the soil nutrient content with practices such as preparation of vermicompost, compost pit, Farm Yard Manure (FYM), use of poultry litter, green leaf manuring and recycling of pineapple leaves, dry leaves as mulches. However, it was found that very few or none of them used neem cakes, biofertilizers and fertilizers. The farmers were encouraged to be organic and so minimal or no use of fertilizers were observed. Some of these findings were supported by findings of Ju *et al.* (2009), Selim and Owied (2017) and Selim (2020).

Table 4.1.1.12: Distribution of the respondents based on their Integrated Nutrient Management

Category	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Low (< 59.01)	00 (0.00)	00 (0.00)	00 (0.00)	00 (0.00)
Medium (59.01 – 68.33)	**125 (71.43)**	**65 (92.86)**	**21 (70.00)**	**211 (76.73)**
High (> 68.33)	50 (28.57)	05 (7.14)	09 (30.00)	64 (23.27)
Mean	64.14	62.07	64.67	63.67
SD	5.04	3.13	4.54	4.66

4.1.1.13 Integrated Pest Management

Table 4.1.1.13 and Fig 4.1.1.13 stated that majority (93.14%) of the respondents under Dimapur district had medium level of integrated pest management followed by low (5.72%) and high (1.14%) level of pest management. The respondents from Peren district also had medium (98.57%) and low (1.14%) level of integrated pest management. Table 4.1.1.13 further revealed that majority (96.67%) of the respondents from Mokokchung district had medium level and low (3.33%) level of integrated pest management.

Collectively, it was found that almost all (94.91%) the respondents had medium level of integrated pest management whereas only 4.36 per cent and 0.73 per cent practised low and high level of integrated pest management respectively. It was found that the respondents practised more of cultural, mechanical and biological method of IPM. Methods such as proper weed management, drainage system and cover crops were adopted by the respondents. However, the study revealed that the respondents had little or no knowledge regarding traps crops, fungicides and cowdung slurry.

Table 4.1.1.13: Distribution of the respondents based on their level of Integrated Pest Management

Category	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Low (< 63.36)	10 (5.72)	01 (1.43)	01 (3.33)	12 (4.36)
Medium (63.36 – 68.74)	**163 (93.14)**	**69 (98.57)**	**29 (96.67)**	**261 (94.91)**
High (> 68.74)	02 (1.14)	00 (0.00)	00 (0.00)	02 (0.73)
Mean	65.77	66.23	67.27	66.05
SD	2.83	2.39	2.20	2.69

Figures in parentheses indicate the percentage (%) of the respondents

4.1.1.14 Annual Income

4.1.1.14(a) Income from all sources

Under Dimapur district, Table 4.1.1.14(a) and Fig 4.1.1.14(a) showed that for respondents having less than 2.5 acres of landholding under agriculture, the mean annual income was ₹.2,11,738.5 while the respondents owning 2.5 – 5.00 acres and 5.1 – 10.00 acres of landholding under agriculture had a mean annual income of ₹.2,55,580.8 and ₹.3,74,315.8 respectively with a mean of 261158.3.

In case of Peren district, it was found that the mean annual income for respondents owning less than 2.5 acres was ₹.2,26958.3 and ₹.247994.1 under 2.5 – 5.00 acres followed by ₹.3,42,000 under 5.1 – 10.00 acres. Mean was 253788.6.

However, in case of Mokokchung district, the respondents under less than 2.5 acres had an annual mean income of ₹.80182.45. For respondents under 2.5 – 5.00 acres and 5.1 – 10.00 acres, the annual income was found to be ₹.2,77826.7 and ₹.3,27,500 respectively with a mean of 254196.7 and standard deviation 111966.6. This variation in income maybe due to the fact that income generation for respondents from Dimapur and Peren district were inclusive of business, service and agri and allied sectors. It was found that Dimapur district had more marketing avenues comparatively.

In the pooled data, it was found that respondents under less than 2.5 acres had an annual mean income of ₹.2,11504.2, followed by ₹.2,55155.3 under 2.5 – 5.0 acres and ₹.3,60533.3 under 5.1 – 10.00 acres.

Table 4.1.1.14(a): Distribution of the respondents based on their annual income from all sources

Category of farmers	Dimapur district (n_1= 175)	Peren district (n_2 = 70)	Mokokchung district (n_3 = 30)	Overall respondents (N = 275)	Overall mean annual income (Rs.)
	Mean annual income (Rs.)	Mean annual income (Rs.)	Mean annual income (Rs.)	Mean annual income (Rs.)	
Marginal (< 2.5 acres)	211738.5	226958.3	80182.45	211504.2	259032
Small (2.50 – 5.0 acres)	255580.8	247994.1	277826.7	255155.3	
Semi- medium (5.1 – 10.00 acres)	374315.8	342000	327500	360533.3	
Mean	261158.3	253788.6	254196.7	259032	
SD	92431.14	84344.02	111966.6	92478.28	

4.1.1.14(b) Income from pineapple cultivation

Table 4.1.1.14(b) and Fig 4.1.1.14(b) revealed that the respondents under Dimapur district owning less than 2.5 acres of land holding under pineapple cultivation had an annual mean income from pineapple cultivation of ₹.1,16,284.60, followed by ₹.2,10,215.10 under 2.51 – 5.00 acres followed by ₹.3,45,000 under 5.1 – 10.00 acres. In case of Peren district, the respondents under less than 2.5 acres had an annual mean income of ₹. 79,126.42, followed by ₹. 1,67,705.90 under 2.51 – 5.00 acres of pineapple cultivation. The respondents from Mokokchung district had an annual mean of ₹.68,970 from pineapple cultivation in area less than 2.5 acres, followed by ₹.1,89,111.10 under 2.51 – 5.0 acres and ₹.4, 20,000 under 5.1 – 10.00 acres.

Overall, it was found that the annual mean income from pineapple cultivation for respondents under less than 2.5 acres was ₹.96,975.50, followed by ₹.2,02,546.20 under 2.51 – 5.0 acres of land holding and ₹.3,60,000.00 under 5.1 – 10.00 acres. The possible variation might be due to the fact that some of the respondents cultivate pineapple focused more on home consumption rather than commercial purpose. Another possible reason might be due to the fact for more accessibility to marketing linkages.

Table 4.1.1.14(b): Distribution of the respondents based on their income from pineapple cultivation

Category of farmers	Dimapur	Peren	Mokokchung	Overall respondents	Overall mean annual income from pineapple cultivation (Rs.)
	Mean annual income (Rs.)	Mean annual income (Rs.)	Mean annual income (Rs.)	Mean annual income (Rs.)	
Marginal (< 2.5 acres)	116284.60	79126.42	68970.00	96975.50	147441.1
Small (2.51 – 5.0 acres)	210215.10	167705.90	189111.10	202546.20	
Semi-medium (5.1 – 10.00 acres)	345000	0.00	420000.00	360000.00	
Mean	171429.70	100638.60	116713.30	147441.1	
SD	85539.06	56697.69	99680.21	86822.82	

4.1.1.14(c) Contribution of income from pineapple cultivation to the total income

Table 4.1.1.14(c) and Fig 4.1.1.14(c) revealed that the total contribution of income from pineapple cultivation to the total income under Dimapur district was 65.44 per cent followed by 45.91 per cent under Mokokchung district and 39.65 under pineapple cultivation. Overall, the contribution of income from pineapple cultivation to the total income was 56.92 per cent. Thus, pineapple cultivation among the respondents were found to be beneficial in generating income and helped in improving their livelihood.

Table 4.1.1.14(c): Contribution of income from pineapple cultivation to the total income

Districts	Overall annual mean income (Rs.)	Mean income from pineapple cultivation (Rs.)	Contribution of pineapple cultivation income to the total income (%)
Dimapur	261958.30	171429.70	65.44
Peren	253788.60	100638.60	39.65
Mokokchung	254196.70	116713.30	45.91
Overall	259032.00	147441.10	56.92

4.1.1.15 Profitability

Table 4.1.1.15 and Fig 4.1.1.15 indicated the profitability of pineapple among the 3 selected district. It was found that Dimapur district had the highest profitability in all categories of farmers followed by Peren and Mokokchung district. On average profitability, Dimapur district had the highest profitability with an amount of ₹.53,888.91/acre followed by Peren district with profitability of ₹.46,225.56/acre followed by Mokokchung district with ₹.38,298.61/acre profitability. In the pooled data, the overall average profitability was ₹.50,237.48/acre. It was found that due to non-availability of proper market and storage facilities, the pineapple growers sometimes had to distribute their harvested fruits to their relatives, friends and neighbours.

Table 4.1.1.15: Profitability of pineapple cultivation

Category	Profitability (Rs. / acre)	Average profitability (Rs. / acre)	Overall average profitability (Rs. / acre)
Dimapur		53,888.91	50,237.48
Marginal (less than 2.5 acres)	46,827.16		
Small (2.5 – 5.00 acres)	59,212.11		
Semi – medium (5.01 – 10.00 acres)	67,828.77		
Peren		46,225.56	
Marginal (less than 2.5 acres)	42,699.28		
Small (2.5 – 5.00 acres)	57,219.28		
Mokokchung		38,298.61	
Marginal (less than 2.5 acres)	29,189.35		
Small (2.5 – 5.00 acres)	56,362.87		
Semi – medium (5.01 – 10.00 acres)	57,905.56		

4.1.1.16 Productivity

Table 4.1.1.16 and Fig 4.1.1.16 depicted the productivity of the three selected districts from the year 2016-17 to 2020-21. According to the Statistical Handbook of Nagaland, tt was found that Dimapur district had the highest average area (2987.5 ha) under pineapple cultivation. It was found that Peren district had the highest productivity during the year 2016-17 (13.58 mt/ha) and 2017-18 (13.5 mt/ha) while Mokokchung district observed the highest productivity during the year 2018-19 (13.89%) and 2020-21 (16.85%). The trend observed was fluctuation in its productivity over the years. This may be due to several factors such as climatic change, decrease in soil fertility, inadequate knowledge on farm management techniques and inefficient utilisation of available input resources (Afzal *et al.,* 2018).

Table 4.1.1.16: Area and productivity of pineapple cultivation

Districts	**Average area (hectare)**	**Average productivity (metric tonnes/hectare)**				**Average productivity (mt/ha) Pooled**
		2016-17	**2017-18**	**2018-19**	**2020-21**	
Dimapur	2987.5	12.11	12.14	11.67	10.61	11.63
Peren	1626.25	**13.58**	**13.5**	13.51	13.49	13.52
Mokokchung	792.5	13.33	11.65	**13.89**	**16.85**	**13.93**
Average		13.01	12.43	13.02	13.65	

4.1.1.17 Household Vulnerability

The results of the study showing the indexed Sub-components, its corresponding major components and the overall Livelihood Vulnerability Index (LVI) values for the study area are presented in Table 4.1.1.17 and Fig 4.1.1.17. The estimated LVI for the study revealed that Dimapur district may be more vulnerable to climate change and its variability followed by Peren and Mokokchung districts. The corresponding values were 0.374, 0.363 and 0.345 respectively.

The first major component was the sociodemographic profile which consisted of five sub- components. Peren showed greater vulnerability (0.202) compared to Dimapur (0.2) and Mokokchung (0.147) districts. The dependency ratio for Mokokchung (0.132) was higher than Dimapur (0.122) and Peren (0.108) which indicates that there were more households from Dimapur and Peren which have larger working population than minors and people above the age of 65 compared to Mokokchung district. Higher dependency ratio could mean that lesser number of members from a family can engage in the farm and other livelihood activities. It was found that only 7.27 per cent of the respondents have not attended school. An individual with some level of education tends to have more access to information, comprehend and respond effectively to issues and looks for solutions to overcome it. Those individuals with education are able to adopt new technologies and strategies in solving climatic stress than those deprived of education.

The second major component was the livelihood strategies consisting of three subcomponents. The three subcomponents were family members working in a different community, household dependent solely on agriculture as a source of income and agricultural livelihood diversification index. The subcomponents combined showed greater vulnerability in case of Dimapur district (0.409) followed by Peren district (0.338) and Mokokchung district (0.333). Dimapur had greater vulnerability (0.251), followed by Mokokchung

(0.2) and Peren districts (0.143) in case of family members working in a different community. This may be due to the fact that some members of the respondents were employed in other sectors besides agriculture and thus migrated to other towns and cities for employment. Similar findings were reported by Joshua *et al*. (2018). It was found that 88 per cent of respondents under Dimapur district was solely dependent on agriculture followed by Mokokchung (76.67%) and Peren district (67.1%). This showed that the households were heavily dependent on agriculture for their livelihood. Peren district showed greater vulnerability (0.2) based on average agricultural livelihood diversification index than Dimapur (0.97) and Mokokchung districts (0.33). Agricultural livelihood diversification index included growing crops, raising livestock and collecting resources from natural resources. This finding implies that the households practised diversified activities and helped in responding better to crop failure and other livelihood misfortunes. Their engagement in diversified activities helped in increasing their income and build better resilience to climate change.

The third major component social network comprised of three subcomponents. 32.6 per cent of the respondents from Dimapur district followed by 35.7 per cent and 36.7 per cent of the respondents from Peren and Dimapur districts respectively had not approached their local government for assistance in the past twelve months. This may imply that they were comfortable seeking assistance from family and friends rather than from their local government authorities. All the three districts showed similar result in case of percentage of household that are member of a group; 34.7 per cent 33.3 and 34.4 percent for Dimapur, Peren and Mokokchung districts respectively. The participation of an individual in a group like self-help groups, community groups, church groups and other groups give more exposure to knowledge and technologies. This output knowledge helps in mitigating climate change and variabilities. The respondents from Dimapur district (0.171) were found to be receiving more help than giving it to others compared to Peren (0.159) and Mokokchung (0.085) districts. Overall, Peren households were more vulnerable on social network component compared to Dimapur and Mokokchung districts (2.81 and 2.65 respectively).

Major component health had three sub-components. The overall health vulnerability score showed lesser vulnerability in case of Peren district (0.257) compared to Dimapur (0.263) and Mokokchung (0.303) districts. Peren district had greater vulnerability (0.358) for the average time a household took to reach nearest health facility compared to Mokokchung (0.343) and Dimapur (0.324) districts. Inadequate and poor access to health services tend to decrease the health condition of famers which in turn increases their vulnerability to extreme climatic situations. 33.3 per cent under Mokokchung district had households with family members suffering from chronic illness whereas Dimapur and Peren districts had 28.6 per cent and 22.8 per cent respectively.

Under food component, it had five subcomponents. Households solely dependent on agriculture was reported to be highest in Peren (0.657) followed by Dimapur (0.549) and Mokokchung (0.367) districts. The average number of months households struggle to find food was highest in Dimapur district (0.276). Food security increases household’s resilience to external stresses like extreme climatic conditions. The average crop diversity index showed that Dimapur was more vulnerable (0.468) than Peren (0.389) and Mokokchung (0.278) districts. Crop diversity index considered the different crops the households cultivated. Cultivating more variety of crops tends to be less vulnerable as it responds better in case of crop failure. Households from Mokokchung district were found to be least vulnerable (0.033) when it came to households that do not save crops without saving some for some other time. The value of this subcomponent was found to be 0.188 and 0.271 in case of Dimapur and Peren districts respectively. The households that do not save seeds for new season was highest in case of Mokokchung (0.167) followed by

Dimapur (0.137) and Peren districts (0.1). The overall food vulnerability score was 0.324, 0.336 and 0.219 for Dimapur, Peren and Mokokchung districts respectively.

The sixth major component was water, made up of four subcomponents. Peren district had the highest water vulnerability (0.545) followed by Dimapur (0.532) and Mokokchung (0.483) districts. Households from Peren district had lower vulnerability (0.586) in facing shortage of water due to climate change than Dimapur (0.68) and Mokokchung (0.767). In Dimapur and Peren, 58.6 and 51.7 per cent of the households used natural water as source of water while only 20 per cent of the households from Mokokchung district used natural water as source of water. The average time taken to reach the water source was found to be highest in case of Dimapur (0.342) followed by Mokokchung (0.331) and Peren (0.238). It was observed that the highest vulnerability in non-availability of consistent water supply was in Peren (0.771) compared to Mokokchung (0.633) and Dimapur (0.588). When water supply is irregular and non-reliable, more time is spent in travelling over long distances. This resultsin affecting the performance of the households especially women and children in their livelihood activities.

The seventh major component was natural disasters and climate variability. It consisted of eight subcomponents. The highest average number of flood/cyclone/drought/ landslides events in the past 6 years was observed among the households from Peren district (0.162). 56.7 per cent of the households from Mokokchung did not receive a warning about the pending natural disasters while 35.4 and 24.3 per cent of the households from Dimapur and Peren did not receive the warning. More than half of the respondents from all the districts reported increase in temperature in the past 10 years. 72.3, 72.2 and 66.5 per cent, of households from Peren, Dimapur and Mokokchung districts reported less rain than average of rainy seasons. Mokokchung district was found to have the highest vulnerability (0.767) in case of adaptation measures to check climate/weather problems. The indices recorded for mean standard deviation of monthly average of average maximum daily temperature from 2014-18 for Dimapur, Peren and Mokokchung districts were 0.549, 0.541 and 0.512 respectively. In case of mean standard deviation of monthly average of average minimum daily temperature from 2014-18, the indices recorded were 0.513, 0.607 and 0.567 for Dimapur, Peren and Mokokchung districts respectively. Mean standard deviation of monthly average precipitation from 2014-18 was found to be 0.277 (Dimapur), 0.216 (Peren) and 0.311 (Mokokchung). When the subcomponents of natural disasters and climate variability component was added, Mokokchung district was found to have highest vulnerability (0.522) followed by Peren (0.465) and Dimapur (0.451) districts. The overall Livelihood Vulnerability Index (LVI) values as shown in Table 4.1.1.17 and Figure 4.1.1.17 formed by the aggregated value of all the major components showed that Dimapur district recorded the highest (0.364) vulnerability which was followed by Peren (0.362) and Mokokchung (0.343).

Table 4.1.1.17: Indexed sub-components, major components, and overall LVI for Dimapur, Peren and Mokokchung districts

Sub- component	Dimapur	Peren	Mokokchung	Major component	Dimapur	Peren	Mokokchung
a. Dependency ratio	0.122	0.108	0.132	**Socio-demographic profile**	0.2	0.202	0.147
b. Percentage of female headed household	0.268	0.343	0.133				
c. Average age of head of household	0.303	0.347	0.271				
d. Percent of household where head of household has not attended school	0.091	0.057	0.00				
e. Percentage of household with orphans	0.217	0.157	0.2				
a. Percentage of household with family members working in different community	0.251	0.143	0.2	**Livelihood strategies**	0.409	0.338	0.333
b. Percentage of household dependent solely on agriculture as source of income	0.88	0.671	0.767				
c. Average agricultural livelihood diversification index	0.097	0.2	0.033				
a. Average receive: give ratio	0.171	0.159	0.085	**Social Network**	0.281	0.283	0.265
b. Percentage of household that are a member of a group	0.347	0.333	0.344				
c. Percentage of household that have not gone to their local government for assistance in the last 12 months	0.326	0.357	0.367				
a. Average time to health facility	0.324	0.358	0.343	**Health**	0.291	0.257	0.303
b. Percentage of household with family members with chronic illness	0.286	0.228	0.333				
c. Percentage of household where a family member had to miss work or school in the last 2 weeks due to illness	0.263	0.186	0.233				
a. Percentage of household dependent solely on family food for food	0.549	0.657	0.367	**Food**	0.324	0.336	0.219
b. Average number of months households struggle to find food	0.276	0.264	0.253				
c. Average crop diversity index	0.468	0.389	0.278				
d. Percentage of household that do not save crops	0.188	0.271	0.033				
e. Percentage of household that do not save seeds	0.137	0.1	0.167				

a. Percentage of household facing shortage of water due to climate change. b. Percentage of household that utilize a natural water source c. Average time to water source d. Percentage of household that do not have consistent water supply	0.68 0.517 0.342 0.588	0.586 0.586 0.238 0.771	0.767 0.2 0.331 0.633	**Water**	0.532	0.545	0.483
a. Average number of flood/cyclone/drought/ landslides events in the past 6 years b. Percentage of the households that did not receive a warning about the pending natural disasters c. Percentage of households reporting temperature increase in the past 10 years d. Percentage of households reporting less rain than average of rainy seasons e. Percentage of households adaptation measures to check climate/weather problems f. Mean standard deviation of monthly average of average maximum daily temperature (2014 – 2018) g. Mean standard deviation of monthly average of average minimum daily temperature (2014 – 2018) h. Mean standard deviation of monthly average precipitation (2014 – 2018)	0.057 0.354 0.674 0.615 0.571 0.549 0.513 0.277	0.162 0.243 0.672 0.733 0.543 0.541 0.607 0.216	0.099 0.567 0.633 0.722 0.767 0.512 0.567 0.311	**Natural disasters and climate variability**	0.451	0.465	0.522
Livelihood Vulnerability Index (LVI): 0. 335 Dimapur district **LVI_1:** 0. 364 Peren district **LVI_2:** 0. 362 Mokokchung district **LVI_3:** 0. 343							

4.1.2 Communication characteristics of the pineapple growers

4.1.2.1 Sources of information utilized

Table 4.1.2.1(a) and Fig 4.1.2.1(a) revealed the sources of information utilized by the pineapple growers in Dimapur district. It was found that informal sources of information was utilized most by the respondents followed by formal information sources and mass-media. Under mass-media, it was found that 58.29 per cent of the respondents used SMS based services sometimes and 31.43 per cent of them never used it. It was also found that 26.29 per cent, 13.14 per cent and 12.57 per cent acquired information through newspaper, printed media and radio sometimes respectively. Further, 83.43 per cent, 92.00 per cent, 92.00 per cent, 86.86 per cent, 73.71 per cent and 93.14 per cent never used radio, television, exhibition, printed media, newspaper and apps/WhatsApp/Facebook for information sources respectively. Similar findings were observed by Das *et al.* (2022). In case of formal information sources, majority (60.00% and 56.00%) of the respondents contacted KVK and ATMA respectively sometimes for information. While, 68.00 per cent, 60.57 per cent 99.43 per cent and 56.00 per cent of them never contacted AFA/HEA, AO/SDAO, NGOs and CIH respectively for information. These findings were in line with the findings of Das *et al.* (2022). Under informal information sources, it was revealed that majority (88.57%) of the respondents acquired information from friends most often. Less than half (46.86%) and more than half (61.71%) acquired information from relatives and neighbours whereas, 50.86 per cent of the respondents never acquired information from progressive farmers. Similar observations were reported by Patra and Kense (2021) and Das *et al.* (2022).

Table 4.1.2.1(a): Distribution of the respondents based on their utilization of information sources in Dimapur **N= 175**

Information sources	Most often		Sometimes		Never		Mean score	Rank
	F	%	F	%	F	%		
a. Mass media								
1.Radio	07	4.00	22	12.57	**146**	**83.43**	1.63	III
2. Television	02	1.14	12	6.86	**161**	**92.00**		
3. Exhibition	00	0.00	14	8.00	**161**	**92.00**		
4. Printed media	00	0.00	23	13.14	**152**	**86.86**		
5. Newspaper	00	0.00	46	26.29	**129**	**73.71**		
6. SMS	18	10.28	**102**	**58.29**	55	31.43		
7. Apps/Whatsapp/Facebook	00	0.00	12	6.86	**163**	**93.14**		
b. Formal information sources								
1. AFA/HEA	00	0.00	56	32.00	**119**	**68.00**	2.52	II
2. AO/SDAO	01	0.57	68	38.86	**106**	**60.57**		
3. KVK	06	3.43	**105**	**60.00**	64	36.57		
4. ATMA	03	1.71	**98**	**56.00**	74	42.29		
5. NGOs	00	0.00	01	0.57	**174**	**99.43**		
6. CIH	17	9.71	60	34.29	**98**	**56.00**		
c. Informal information sources								
1. Friends	**155**	**88.57**	15	8.57	05	2.86	4.87	I
2. Relatives	78	44.57	**82**	**46.86**	15	8.57		
3. Neighbours	47	26.86	**108**	**61.71**	20	11.43		
4. Progressive farmers	01	0.57	85	48.57	**89**	**50.86**		

Table 4.1.2.1(b) and Fig 4.1.2.1(b) revealed the utilization of information sources by the respondents from Peren district. Among the three different sources of information utilised, informal information sources was ranked first followed by formal information and mass media. Under mass media sources of information,10.00 per cent of the respondents utilized SMS most often as information sources, 25.71 per cent, 30.00 per cent, 40.00 per cent utilized radio, newspaper and SMS sometimes respectively. While majority (98.57%, 92.86%, 94.29%) never utilized television, printed media and apps/ Whatsapp/ Facebook as information source respectively. It was also found that none (100.00%) of the respondents acquired information through exhibition. Under formal information sources, 2.86 per cent, 1.43 per cent, 1.43 per cent of the respondents acquired information most often from KVK, ATMA and NGOs

respectively. Further, 27.14 per cent and 20.00 per cent acquired information sometimes from ATMA and CIH respectively. While majority (90.00%, 87.14%, 81.43%, 71.43%, 80.00% and 80.00%) of the respondents never acquired information from AFA/HEA, AO/SDAO, KVK, ATMA, NGOs and CIH respectively. These findings were in accordance with the findings of Patra and Kense (2021) and Das *et al.* (2022).

Table 4.1.2.1(b): Distribution of the respondents according to their utilization of information sources in Peren N= 70

Information sources	Most often		Sometimes		Never		Mean score	Rank
	F	%	F	%	F	%		
a. Mass media								
1. Radio	00	0.00	18	25.71	**52**	**74.29**	1.31	III
2. Television	01	1.43	00	0.00	**69**	**98.57**		
3. Exhibition	00	0.00	00	0.00	**70**	**100.00**		
4. Printed media	00	0.00	05	7.14	**65**	**92.86**		
5. Newspaper	00	0.00	21	30.00	**49**	**70.00**		
6. SMS	07	10.00	28	40.00	**35**	**50.00**		
7.Apps/Whatsapp/ Facebook	00	0.00	04	5.71	**66**	**94.29**		
b. Formal information sources								
1. AFA/HEA	00	0.00	07	10.00	**63**	**90.00**	1.16	II
2. AO/SDAO	00	0.00	09	12.86	**61**	**87.14**		
3. KVK	01	1.43	12	17.14	**57**	**81.43**		
4. ATMA	01	1.43	19	27.14	**50**	**71.43**		
5. NGOs	02	2.86	12	17.14	**56**	**80.00**		
6. CIH	00	0.00	14	20.00	**56**	**80.00**		
c. Informal information sources								
1. Friends	**50**	**71.43**	17	24.29	03	4.29	3.94	I
2. Relatives	18	25.71	23	32.86	**29**	**41.43**		
3. Neighbours	17	24.29	**40**	**57.14**	13	18.57		
4. Progressive farmers	03	4.29	20	28.57	**47**	**67.14**		

Table 4.1.2.1(c) and Fig 4.1.2.1(c) showed the distribution of respondents from Mokokchung district according to their utilization of information sources. Informal information sources was most used among the three types of information sources followed by formal information sources and mass media respectively. Under mass media sources, 6.67 per cent and 3.33 per cent of the respondents used radio and exhibition most often respectively as a medium of information sources. 20.00 per cent and 53. 33 per cent of them utilized radio and exhibition sometimes respectively. In case of formal information sources, it was found that 3.33 per cent and 6.67 per cent of the respondents received information from the functionaries of AO/SDAO and ATMA most often. More than half (76.66%) of the respondents acquired information from ATMA functionaries sometimes, 40.00 per cent from the functionaries of AFA/HEA followed by 16.67 per cent from AO/SDAO and 13.33 per cent from KVK functionaries. In case of informal information sources, majority (86.67% and 76.67%) of the respondents received information most often from friends and neighbours respectively. 50.00 per cent and 43.33 per cent of them received information sometimes from relatives and progressive farmers. While 16.67 per cent, 3.33 per cent and 20 per cent acquired information from relatives, neighbours and progressive farmers respectively. These findings were supported by the findings of Patra and Kense (2021) and Das *et al.* (2022).

Table 4.1.2.1(c): Distribution of the respondents according to their utilization of information sources in Mokokchung N= 30

Information sources	Most often		Sometimes		Never		Mean score	Rank
	F	%	F	%	F	%		
a. Mass media								
1.Radio	02	6.67	06	20.00	**22**	**73.33**	1.03	III
2. Television	00	0.00	01	3.33	**29**	**96.67**		
3. Exhibition	01	3.33	**16**	**53.33**	13	43.34		
4. Printed media	00	0.00	01	3.33	**29**	**96.67**		
5. Newspaper	00	0.00	01	3.33	**29**	**96.67**		
6. SMS	00	0.00	00	0.00	**30**	**100.00**		
7. Apps/ Whatsapp/ Facebook	00	0.00	00	0.00	**30**	**100.00**		

b. Formal information sources								
1. AFA/HEA	00	0.00	12	40.00	**18**	**60.00**		
2. AO/SDAO	01	3.33	05	16.67	**24**	**80.00**		
3. KVK	00	0.00	04	13.33	**26**	**86.67**	1.67	II
4. ATMA	02	6.67	**23**	**76.66**	05	16.67		
5. NGOs	00	0.00	00	0.00	30	100.00		
6. CIH	00	0.00	00	0.00	30	100.00		
c. Informal information sources								
1. Friends	**26**	**86.67**	04	13.33	00	0.00		
2. Relatives	10	33.33	**15**	**50.00**	05	16.67	5.93	I
3. Neighbours	**23**	**76.67**	06	20.00	01	3.33		
4. Progressive farmers	11	36.67	**13**	**43.33**	06	20.00		

Table 4.1.2.1(d) and Fig 4.1.2.1(d) revealed that 68.00 per cent of the respondents from Dimapur district had medium level of overall information sources utilization while 27. 83 per cent and 4.57 per cent had high level and low-level overall information sources utilization respectively. It was also evident that majority (67.14%) of the respondents under Peren district had medium level overall information sources utilization followed by low level (30.00%) and high level (2.86%) overall information sources utilization. In case of Mokokchung district, it was found that majority (80.00%) of the respondents had medium level followed by high level (16.67%) and low level (3.33%) of overall information sources utilization. In the pooled data, 69.09 per cent of them had medium level followed by high level (20.00%) and low level (10.91%) of overall information sources utilization. Better social and economic status allow the farmers to have better access to modern types of media and communication which in turn benefit them in achieving better yields. Similar findings were observed by Karangami *et al.* (2021), Kharlukhi and Jha (2021), Rabina *et al.* (2021), Das *et al.* (2022) and Hiwarale *et al.* (2023).

Table 4.1.2.1(d): Distribution of the respondents based on the overall information sources utilization

Level of information sources utilization	Frequency (Percentage) Dimapur (n_1 = 175)	Frequency (Percentage) Peren (n_2 = 70)	Frequency (Percentage) Mokokchung (n_3 = 30)	Frequency (Percentage) Overall (N = 275)
Low (< 5.91)	08 (4.57)	21 (30.00)	01 (3.33)	30 (10.91)
Medium (5.91 - 10.73)	**119 (68.00)**	**47 (67.14)**	**24 (80.00)**	**190 (69.09)**
High (> 10.73)	48 (27.43)	02 (2.86)	05 (16.67)	55 (20.00)
Mean	9.02	6.41	8.63	8.31
SD	2.17	2.04	2.24	2.41

Figures in parentheses indicate the percentage (%) of the respondents

4.1.2.2 Extension contact

Table 4.1.2.2 exhibited that 66.29 per cent of the respondents under Dimapur district never had extension contact with AFA/HEA. Less than half (40.57%) had occasional extension contact with AO/SDAO. More than half (61.71%) had occasional contact with KVK, 57.71 per cent had occasional contact with ATMA whereas, 98. 86 per cent and 5.71 per cent of the respondents had no extension contact with NGOs and CIH.

Table 4.1.2.2(a): Distribution of the respondents based on their extension contact

Dimapur district						
Extension contact sources	Regular		Occasional		Never	
	F	%	F	%	F	%
1. AFA/HEA	01	0.57	58	33.14	**116**	**66.29**
2. AO/SDAO	00	0.00	71	40.57	**104**	**59.43**
3. KVK	05	2.86	**108**	**61.71**	62	35.43
4. ATMA	01	0.57	**101**	**57.71**	73	41.72
5. NGOs	00	0.00	02	1.14	**173**	**98.86**
6. CIH	03	1.71	57	32.57	**115**	**65.71**
Peren district						
Extension contact sources	Regular		Occasional		Never	
	F	%	F	%	F	%
1. AFA/HEA	00	0.00	08	11.43	**62**	**88.57**
2. AO/SDAO	00	0.00	09	12.86	**61**	**87.14**
3. KVK	00	0.00	10	14.29	**60**	**85.71**
4. ATMA	00	0.00	19	27.14	**51**	**72.86**
5. NGOs	02	2.86	11	15.71	**57**	**81.43**

6. CIH	00	0.00	13	18.57	**57**	**81.43**
Mokokchung district						
Extension contact sources	**Regular**		**Occasional**		**Never**	
	F	**%**	**F**	**%**	**F**	**%**
1. AFA/HEA	00	0.00	10	33.33	20	**66.67**
2. AO/SDAO	00	0.00	03	10.00	27	**90.00**
3. KVK	00	0.00	04	13.33	26	**86.67**
4. ATMA	07	23.33	23	76.67	00	0.00
5. NGOs	00	0.00	00	0.00	30	**100.00**
6. CIH	00	0.00	00	0.00	30	**100.00**
Overall						
Extension contact sources	**Regular**		**Occasionally**		**Never**	
	F	**%**	**F**	**%**	**F**	**%**
1. AFA/HEA	01	0.36	76	27.64	**198**	**72.00**
2. AO/SDAO	00	0.00	83	30.18	**192**	**69.82**
3. KVK	05	1.82	122	44.36	**148**	**53.82**
4. ATMA	01	0.36	**143**	**52.00**	131	47.64
5. NGOs	02	0.73	13	4.73	**260**	**94.54**
6. CIH	03	1.09	70	25.46	**202**	**73.45**

Table 4.1.2.2(b) and Fig 4.1.2.2(b) indicated that more than half (77.71%) of the respondents under Dimapur district had medium level of extension contact followed by high (16.57%) and low (5.72%) level of extension contact.

In Peren district, Table 4.1.2.2(b) revealed that 68.57 per cent had medium level and 30 per cent had low and 1.43 per cent of the respondents had high level of extension contact.

In case of Mokokchung district, it was found that more than half (76.67%) of the respondents had medium level followed by low (23.33%) and high (10.00%) level of extension contact.

Similar trend was observed in the aggregated data where majority (75.27%) had medium level, 13. 82 per cent and 10.91 per cent of the respondents had low and medium level of extension contact respectively. The possible reason might be that majority of the respondents were middle and old aged and they found it inconvenient and difficult to contact with the extension agents. These findings were in conformity with the findings of Wani *et al*. (2019) and Hiwarale *et al.* (2023).

Table 4.1.2.2(b): Distribution of the respondents based on their overall level of extension contact

Level of extension contact	Frequency (Percentage) Dimapur (n_1 = 175)	Frequency (Percentage) Peren (n_2 = 70)	Frequency (Percentage) Mokokchung (n_3 = 30)	Frequency (Percentage) Overall (N = 275)
Low (< 0.67)	10 (5.72)	21 (30.00)	07 (23.33)	38 (13.82)
Medium (0.67 – 3.19)	**136 (77.71)**	**48 (68.57)**	**23 (76.67)**	**207 (75.27)**
High (>3.19)	29 (16.57)	01 (1.43)	00 (10.00)	30 (10.91)
Mean	2.29	1.06	1.33	1.93
SD	1.19	0.92	0.96	1.26

Figures in parentheses indicate the percentage (%) of the respondents

4.1.2.3 Social participation

Table 4.1.2.3 and Fig 4.1.2.3 revealed that under Dimapur district, more than half (60.00%) of the respondents had medium level of social participation while 24 per cent and 16 per cent had low and high level of social participation respectively. In case of respondents from Peren district, 68.57 per cent of them had medium level of social participation followed by low (17.14%) and high (14.29%) level of social participation. Further, it was also found that majority (80.00%) of the respondents from Mokokchung district had medium level of social participation while 10.00 per cent of them apiece had low and high level of social participation.

It was found that pineapple growers from Molvom village and Bungsang village under Dimapur district have formed a farmer producer company called 'Molsang Organic Pineapples Producer Company Limited' registered in the year 2018. This company was formed for marketing their produce. During the year 2021, the company in partnership with Agriculture and Horticulture Department, Government of Nagaland send 600kgs of their pineapple produce to Big Basket, Kolkata.

In the pooled data, 64.36 per cent of the respondents had medium level of social participation followed by low (20.73%) and high (14.91%) level of social participation. The findings can be explained by the fact that majority of the respondents were a member/office bearer in social organizations like Village Council/Village Panchayat, Village Development Board, SHGs and so on and have participated in the activities of their organizations. Similar findings were observed by Dharmanand *et al.* (2020), Saryamand and Jirli (2020), Kharlukhi and Jha (2021) and Hiwarale *et al.* (2023).

Table 4.1.2.3: Distribution of the respondents based on their level of social participation

Level of social participation	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Low (< 0.97)	42 (24.00)	12 (17.14)	03 (10.00)	57 (20.73)
Medium (0.97 – 5.33)	**105 (60.00)**	**48 (68.57)**	**24 (80.00)**	**177 (64.36)**
High (> 5.33)	28 (16.00)	10 (14.29)	03 (10.00)	41 (14.91)
Mean	3.14	3.16	3.13	3.15
SD	2.36	1.95	1.59	2.18

Figures in parentheses indicate the percentage (%) of the respondents

4.1.2.4 Training exposure

Table 4.1.2.4 and Fig 4.1.2.4 revealed that under Dimapur district 66.86 per cent of the respondents attended trainings and 33.14 per cent had not attended trainings on sustainable cultivation practices of pineapple.

In case of Peren district, it was found that 58.57 per cent of the respondents did not attend trainings while 41.43 per cent attended trainings on pineapple cultivation.

Further, the data indicated that less than half (36.67%) of the respondents attended trainings whereas more than half (63.33%) did not attend trainings.

It can be observed from the pooled data that more than half (57.09%) of the respondents have attended trainings while 42.91 per cent did not attend trainings on pineapple cultivation. The number of days the respondents attended training ranged from 1-7 days. It was found that the respondents attended trainings organised by ATMA, KVK, state horticulture department and CIH. Adikhari *et al.* (2021), Rhonben *et al.* (2021) and Kakki *et al.* (2022) also reported similar findings.

Table 4.1.2.4: Distribution of the respondents based on their training exposure

Training exposure	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Not attended	58 (33.14)	**41 (58.57)**	**19 (63.33)**	122 (42.91)
Attended	**117 (66.86)**	29 (41.43)	11 (36.67)	**157 (57.09)**
Mean no. of days of training attended	0.99	1	1	0.77

Figures in parentheses indicate the percentage (%) of the respondents

4.1.3 Psychological characteristics of the pineapple growers

4.1.3.1 Innovativeness

Table 4.1.3.1and Fig 4.1.3.1 revealed that more than half (61.14%) under Dimapur district had medium level of innovativeness followed by high (27.43%) and low (11.43%) level of innovativeness.

In the context of Peren district, majority (74.29%) had medium level of innovativeness while 15.71 per cent had high level and 10.00 per cent of the respondents had low level of innovativeness.

The respondents under Mokokchung district had medium (83.33) level of innovativeness while 10.00 per cent had high level followed by low level (6.67%) of innovativeness.

The aggregated data of the three districts showed that majority (66.91%) of the respondents had medium level followed by 22.55 per cent and 10.54 per cent belonging to high and low level of innovativeness. The reason behind most of the respondents possessing medium of innovativeness might be due to their moderate level of participation in social organization, extension activities and education level. This was supported by the findings of Amaladeepan and Pushpa (2018), Sunitha (2019) and Dharmanand *et al.* (2020).

Table 4.1.3.1: Distribution of the respondents based on their innovativeness

Category	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Low (< 3.97)	20 (11.43)	07 (10.00)	02 (06.67)	29 (10.54)
Medium (3.97 – 8.73)	**107 (61.14)**	**52 (74.29)**	**25 (83.33)**	**184 (66.91)**
High (> 8.73)	48 (27.43)	11 (15.71)	03 (10.00)	62 (22.55)
Mean	6.50	6.23	5.77	6.35
SD	2.50	2.07	2.28	2.38

Figures in parentheses indicate the percentage (%) of the respondents

4.1.3.2 Risk taking ability

It was found from table 4.1.3.2 and Fig 4.1.3.2 that 57.71 per cent of the respondents under Dimapur district had medium level of risk-taking ability followed by high (22.29%) and low (20.00%) level.

The respondents under Peren district had majority (88.57%) under medium level followed by low (7.14%) and high (4.29%) level of risk-taking ability.

The table further revealed that respondents under Mokokchung district had 43.33 per cent under medium level followed by high (36. 67%) and low (20.00) level of risk-taking ability.

The pooled data of the three districts indicated that majority (64.00%) of the respondents were under medium level followed by 19.27 per cent and 16.73 per cent under high and low level of risk taking ability respectively. The reason may be due to their fear of failure in adopting new farm practices. They generally wait for their farmer friends to adopt the new practice first and adopt the practice later only if it is successful. These findings were in conformity with the findings of Amaladeepan and Pushpa (2018), Shwetha and Shivalingaih (2018), Sunitha (2019), Kumar *et al*. (2021) and Kakki *et al*. (2022)

Table 4.1.3.2: Distribution of the respondents based on their risk taking ability

Level	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Low (< 8.55)	35 (20.00)	05 (7.14)	06 (20.00)	46 (16.73)
Medium (8.55 – 11.47)	**101 (57.71)**	**62 (88.57)**	**13 (43.33)**	**176 (64.00)**
High (> 11.47)	39 (22.29)	03 (04.29)	11 (36.67)	53 (19.27)
Mean	9.92	10.13	10.23	10.01
SD	1.56	1.02	1.72	1.46

Figures in parentheses indicate the percentage (%) of the respondents

4.1.3.3 Market innovativeness

Table 4.1.3.3 and Fig 4.1.3.3 revealed that majority (70.86%) of the respondents under Dimapur district had medium level of market innovativeness followed by high (17.71%) and low (11.43%) level of market innovativeness.

In case of Peren district, it was observed that 80.00 per cent of the respondents had medium level whereas only 11.43 per cent and 8.57 per cent were under high and low level of market innovativeness.

It could be seen further from the table that the respondents under Mokokchung district had more than half of them under middle (56.67%) followed by 33.33 per cent and 10.00 per cent under low and high level of market innovativeness respectively.

Similar trends could be observed in the pooled data wherein majority (71.64%) of the respondents were under middle level, 15.27 per cent and 13.09 under high and low level of market innovativeness respectively. This might be due to the fact that most of the respondents had medium level of innovativeness and market orientation.

Table 4.1.3.3: Distribution of the respondents based on their market innovativeness

Level	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Low (< 24.43)	20 (11.43)	06 (8.57)	10 (33.33)	36 (13.09)
Medium (24.43 – 35.39)	**124 (70.86)**	**56 (80.00)**	**17 (56.67)**	**197 (71.64)**
High (> 35.39)	31 (17.71)	08 (11.43)	03 (10.00)	42 (15.27)
Mean	31.06	30.2	27.13	30.41
SD	4.97	4.25	5.39	4.98

Figures in parentheses indicate the percentage (%) of the respondents

4.1.3.4 Achievement motivation

Table 4.1.3.4 and Fig 4.1.3.4 revealed that majority (80.57%) of the respondents under Dimapur district had medium level and low (19.43%) level of achievement motivation.

The study indicated that in case of respondents under Peren district, majority (87.14%) followed by 12.86 per cent under low level of achievement motivation.

In case of Mokokchung district, it was found that more than half (53.33%) of the respondents were under low level and 46.67 per cent under middle level of achievement motivation.

In the pooled data of the three districts, it can be observed that majority (78.55%) of the respondents were under middle level followed by low (21.45%) level of achievement motivation. Achievement motivation drives the individual to reach their goals. The reason might behind low and medium level of achievement may be due to their socio-economic status and education these findings were in line with the findings of Ramesh and Singh (2016) and Kumar *et al.* (2022).

Table 4.1.3.4: Distribution of the respondents based on their achievement motivation

Level	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Low (< 8.20)	34 (19.43)	09 (12.86)	**16 (53.33)**	59 (21.45)
Medium (8.20 – 12.14)	**141 (80.57)**	**61 (87.14)**	14 (46.67)	**216 (78.55)**
High (> 12.14)	00 (0.00)	00 (0.00)	00 (0.00)	00 (0.00)
Mean	10.28	10.69	8.33	10.07
SD	1.81	1.72	2.38	1.97

Figures in parentheses indicate the percentage (%) of the respondents

4.1.3.5 Decision making ability

It could be inferred from Table 4.1.3.5 and Fig 4.1.3.5 that more than half (66.28%) of the respondents under Dimapur district had medium level of decision making ability followed by low (22.86%) and high (10.86%) level of decision making ability.

It also revealed that more than half (65.71%) of the respondents under Peren district had medium level of decision making ability while 30 per cent and 4.29 per cent of the respondents had high and low level of decision making ability respectively.

Further, it was found from the table that half (53.33%) of the respondents under Mokokchung district had medium level followed by high (43.34%) and low (3.33%) of decision making ability.

From the cumulative data, it was evident that more than half (64.73%) of the respondents had medium level while 19.27 per cent and 16 per cent of the respondents had high and low level of decision making ability. The reason for majority of the respondents possessing medium level of decision making ability is due to their medium level of experience in pineapple cultivation which helps them to take appropriate decisions at the right time. Another possible reason could be their moderate social participation and extension contact which helped them in gaining ideas and information and enhanced their capacity in taking decisions related to various farm activities. These findings are in concurrence with the findings of Gaware (2019) and Ali (2022).

Table 4.1.3.5: Distribution of the respondents based on their decision making ability

Level	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Low (< 5.49)	40 (22.86)	03 (04.29)	01 (03.33)	44 (16.00)
Medium (5.49 – 8.89)	**116 (66.28)**	**46 (65.71)**	**16 (53.33)**	**178 (64.73)**
High (> 8.89)	19 (10.86)	21 (30.00)	13 (43.34)	53 (19.27)
Mean	6.76	7.8	8.33	7.19
SD	1.67	1.43	1.58	1.7

Figures in parentheses indicate the percentage (%) of the respondents

4.1.3.6 Management orientation

Table 4.1.3.6 and Fig 4.1.3.6highlighted that under Dimapur district, majority (76.00%) of the respondents had medium level followed by high (16.57%) and low (7.43%) level of management orientation.

In case of Peren district, the study revealed that majority (71.43%) of the respondents had medium level whereas 27.14 per cent had low level and only 1.43 per cent of the respondents had high level of management orientation.

Under Mokokchung district, the result from the table further indicated that majority (70.00%) had medium level while 26.67 per cent and 3.33 per cent of the respondents had high and low level of management orientation respectively.

Similar trend was observed in the pooled data where, majority (74.18%) had medium level, followed by 13.82 per cent under high and 12 per cent of the respondents under low level of management orientation. The plausible reason could be their many years of experience in agriculture, exposure to mass media and participation in social activities, frequent contacts with extension agents and their land holdings which might have influenced the farmers for proper planning before the onset of season, grab market opportunities and learn about new technologies and practices for better management of their farms. Similar findings were observed by Shwetha and Shivalingaih (2018), Jamir and Jha (2020) and Khan *et al.* (2021).

Table 4.1.3.6: Distribution of the respondents based on their management orientation

Level	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Low (< 50.74)	13 (7.43)	19 (27.14)	01 (03.33)	33 (12.00)
Medium (50.74 – 56.38)	**133 (76.00)**	**50 (71.43)**	**21 (70.00)**	**204 (74.18)**
High (> 56.38)	29 (16.57)	01 (1.43)	08 (26.67)	38 (13.82)
Mean	53.93	52.06	54.9	53.56
SD	2.71	2.63	2.51	2.82

Figures in parentheses indicate the percentage (%) of the respondents

4.1.3.7 Scientific orientation

Under Dimapur district, Table 4.1.3.7 and Fig 4.1.3.7 showed that majority (77.71%) of the respondents had medium level followed by high (16. 57%) and low (5.72%) level of scientific orientation.

It was also found that respondents from Peren district had almost all the respondents (90%) under medium level followed by low (5.71%) and high (4.29%) level of scientific orientation.

In case of Mokokchung district, the table further depicted that half (53.33%) of the respondents had medium level, while 36 per cent had low level followed by high (10.00 %) level of scientific orientation.

The aggregated data from the table revealed that majority (78.18%) of the respondents had medium level followed by high (12.73%) and low (9.09%) of scientific orientation. The medium level of scientific orientation was substantiated by their medium level of education, farm experience, risk taking ability, information sources utilization, extension contact and social participation which help in improving their scientific knowledge on farm practices. These findings were in concurrence with the findings of Ahmed (2019), Bidve *et al*. (2021) and Kharlukhi and Jha (2021).

Table 4.1.3.7: Distribution of the respondents based on their scientific orientation

Category	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Low (< 31.80)	10 (5.72)	04 (5.71)	11 (36.67)	25 (9.09)
Medium (31.80 – 37.82)	**136 (77.71)**	**63 (90.00)**	**16 (53.33)**	**215 (78.18)**
High (> 37.82)	29 (16.57)	03 (4.29)	03 (10.00)	35 (12.73)
Mean	35.29	34.56	32.57	34.81
SD	2.73	2.07	4.89	3.01

Figures in parentheses indicate the percentage (%) of the respondents

4.1.3.8 Economic motivation

It was found from Table 4.1.3.8 and Figure 4.1.3.8 that more than half (63.43%) of the respondents under Dimapur district had medium level followed by low (20.00%) and high (16.57%) level of economic motivation.

Under Peren district, it was revealed that majority (87.14%) of the respondents had medium level, 7.15 per cent had high level and 5.71 per cent of the respondents had low level of economic motivation.

Whereas in case of Mokokchung district, the study further revealed that more than half (63.33%) had medium followed by medium (30.00%) and low (6.67%) level of economic motivation.

Under the pooled data, it was observed that more than half (65.82%) of the respondents had medium level while 19. 27 per cent and 14.91 per cent of them had high and low level of economic motivation respectively. The possible reason for the findings may be due to their aspiration for high returns from their income generating farming activities. Another reason could be their medium level of education, social participation, extension contact, information utilization and market orientation that boost them to possess moderate and high economic motivation. These findings were in accordance with findings of Amaladeepan and Pushpa (2018), Farooq *et al.* (2020), Jamir and Jha (2020) and Gayathri and Sahana (2022).

Table 4.1.3.8: Distribution of the respondents based on their economic motivation

Category	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Low (< 15.41)	35 (20.00)	04 (5.71)	02 (06.67)	41 (14.91)
Medium (15.41 – 18.71)	**111 (63.43)**	**61 (87.14)**	09 (30.00)	**181 (65.82)**
High (> 18.71)	29 (16.57)	05 (7.15)	**19 (63.33)**	53 (19.27)
Mean	16.88	16.86	18.57	17.06
SD	1.72	0.99	1.69	1.65

Figures in parentheses indicate the percentage (%) of the respondents

4.1.3.9 Market orientation

Table 4.1.3.9and Fig 4.1.3.9 depicted that majority (72.00%) of the respondents under Dimapur district had medium followed by high (18.29%) and low (9.71%) level of market orientation.

In case of Peren district, it was found that majority (84.29%) of the respondents had medium level whereas 10 per cent and 5.71 per cent of the respondents had low and high level of market orientation respectively.

Furthermore, it was observed from the table that majority (86.66%) of the respondents under Mokokchung district had medium level followed by 6.67 per cent for both high and low level of market orientation.

From the aggregated data, it was evident that majority (776.73%) of the respondents had medium level followed by high (76.73%) and low (9.45%) of market orientation. The probable reason for this trend might be that majority of the respondents had moderate land holdings with medium sources of information utilization, extension contact, economic motivation ad their primary motive was to gain more profit from their produce. This finding was supported by the findings of Jamir and Jha (2020) and Hiwarale *et al.* (2023).

Table 4.1.3.9: Distribution of the respondents based on their market orientation

Category	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Low (< 14.95)	17 (9.71)	07 (10.00)	02 (06.67)	29 (9.45)
Medium (14.95 – 17.63)	**126 (72.00)**	**59 (84.29)**	**26 (86.66)**	**211 (76.73)**
High (> 17.63)	32 (18.29)	04 (5.71)	02 (06.67)	38 (13.82)
Mean	16.39	16.16	16.1	16.29
SD	1.44	1.15	1.09	1.34

Figures in parentheses indicate the percentage (%) of the respondents

4.2. Knowledge level of pineapple growers about sustainable cultivation practices

4.2.1 (a) Practise-wise knowledge level of pineapple growers under Dimapur district

Table 4.2.1(a) exhibited the knowledge level of sustainable cultivation practices of pineapple growers under Dimapur district with a mean knowledge index and standard deviation of 64.29 and 6.24 respectively. The respondents had 100.00 per cent mean knowledge level on practices such as varieties, propagation method, planting time, cropping pattern, harvesting, ratooning, storage and post harvest management. The respondents had 96.38 per cent mean knowledge level for land preparation, 91.71 per cent for weed management, 91.24 per cent for intercultural operations, 89.71 per cent for rodent management, 67.24 per cent for mealy bug, heart rot and leaf and fruit rot management and 63.43 per cent for leaf spot management. It was also found that the respondents had 61.57 per cent mean knowledge level under planting dimension and was ranked VIII. In case of irrigation dimension, the respondents had 57.71 per cent mean knowledge level as the respondents generally practised rainfed pineapple cultivation and were hardly bothered to know the frequency of irrigation required. The respondents were found to have 50.09 per cent, 41.33 per cent, 35.71 per cent mean knowledge level for heart rot disease, leaf and fruit rot and mealy bug ranked Xth, XIth and XIIth respectively. The pineapple fields were infested by these pests and diseases minimally and so this might be the reason that the respondents had less knowledge on this aspect. Further, the respondents had 33.14 per cent mean knowledge level in value addition dimension followed by 32.76 per cent mean knowledge in manuring. This might be due to ignorance on importance of manure supplement in their pineapple fields. It was also found that the respondents had 23.43 per cent, 26.79 per cent and 5.43 per cent mean knowledge level on black/soft rot and its management and leaf spot respectively. Lastly, the respondents had 0.00 per cent knowledge level on treatment of suckers and growth regulators.

Table 4.2.1(a): Practise-wise knowledge level of pineapple growers under Dimapur district

Sl. No.	Practices	Knowledge level (N = 175) F	%	Mean knowledge level (%)	Rank	Mean knowledge Index	SD
1.	**Recommended varieties** Queen, Kew and Giant Kew	175	100.00	100.00	I	65.29	6.24
2.	**Propagation** Suckers and slips	175	100.00	100.00	I		
3.	**Land preparation** 1. Initial land clearing 2. Pit digging and solarization 3. Filling of pits with manure	175 156 175	100.00 89.14 100.00	96.38	II		
4.	**Treatment of suckers** Cow pat pit and neem oil solution	00	0.00	0.00	XVIII		
5.	**Planting** 1. Single row 2. Double row 3. Plant population for single row 4. Plant population for double row	161 104 98 68	92.00 59.43 56.00 38.86	61.57	VIII		
6.	**Planting time** May – July and November – December	175	100.00	100.00	I		
7.	**Manuring** 1. Compost/ cattle manure 2. Green leaf + compost/manure + soil 3. Azotobacter/Azospirrilum + Phosphotika + manure	75 97 00	42.86 55.43 00.00	32.76	XIV		
8.	**Intercultural operations** 1. Use of paddy straw 2. Black polythene mulching 3. Protection from scorching sun	173 129 175	98.29 73.71 100.00	91.24	IV		
9.	**Cropping pattern** 1. Mix cropping with colocassia, yam, chillies, sweet potato, cabbage, cauliflower, soybean 2. Intercropping with turmeric, ginger, cowpea, colocassia, coconut and arecanut, mango.	175 175	100.00 100.00	100.00	I		
10.	**Irrigation** 1. Generally dependent on rainwater	175	100.00				

	2. Types of irrigation used 3. Ideal way of maintaining soil moisture during extreme dry conditions 4. Requirement of irrigation during dry months	96 14 119	54.86 8.00 68.00	57.71	IX		
11.	**Weed management** 1. Weed control methods 2. Weeding practiced throughoutthe year 3. Uprooted weeds used as organic compost and mulch 4. Use of black polythene to control weeds	 166 175 175 117	 94.86 100.00 100.00 66.86	91.71	III		
12.	**Growth regulator** Use of planofix & celemone @ 10-20ppm to induce flowering	00	00.00	0.00	XVIII		
13.	**Pest and disease management** 1. Mealy bug 1. Symptoms appear on roots 2. The roots cease to grow, collapse and rot 3. Infected plants show stunted growth 4. Wilting at the tip develop a reddish yellow colour	 60 63 63 63	 34.29 36.00 36.00 36.00	35.71	XII		
	Management 1. Cultivate uninfected plant material 2. Ants removed 3. *Bacillus gordonae* applied	 175 175 04	 100.00 100.00 2.26	67.24	VI		
	2. Rodents 1. Controlled by setting up traps 2. Rodents fed poison bait	 175 140	 100.00 80.00	89.71	V		
	3. Heart rot 1.Disease causes complete rotting 2. The top leaves turn brown 3. The basal portion of the leaves rot with foul smell	 87 88 88	 49.71 50.29 50.29	50.09	X		
	Management 1. Good drainage maintained 2. Use healthy planting material 3. Controlled by applying *Trichoderma*	 163 175 03	 93.14 100.00 1.71	67.24	VI		
	4. Leaf and fruit rot 1. Occurs when the plants are not dried 2. Other plants also destroyed by entering through wounds 3. In severe conditions, the entire plant turn dark and die	 95 43 79	 54.29 24.57 45.14	41.33	XI		

	Management 1. Diseased plant must be destroyed 2. Suckers for propagation must be free from uninfested areas 3. Controlled by applying *Trichoderma*	175 175 03	100.00 100.00 1.71	67.24	VI		
	5. Leaf spot 1. First symptom is water-soaked lesions on the leaves 2. The spots enlarge in size	08 11	04.57 6.29	5.43	XVII		
	Management 1. Good soil drainage should be maintained 2. Healthy planting material should be used 3. Controlled by applying *Trichoderma*	155 175 03	88.57 100.00 1.71	63.43	VII		
	6. Black/Soft rot 1. Small, circular, water soaked spots appear at the stalk end of the fruit 2. Fruit rot and emit foul smell 3. Delay between harvest and utilization leads to development of disease	41 41 41	23.43 23.43 23.43	23.43	XVI		
	Management 1. Avoid injury to the fruit during harvest and transit 2. Controlled by applying *Trichoderma*	90 03	51.43 1.71	26.79	XV		
14.	**Harvesting** 1. Fruit takes about 15-20 months to mature 2. Change in colour determine the maturity of the fruit 3. Fruit harvested by breaking/cutting the stalk few cm below the fruit 4. Size, colour of fruit and brix content determine ripe fruits	175 175 175 175	100.00 100.00 100.00 100.00	100.00	I		
15.	**Ratooning** 1. 1-2 suckers are left in the mother plant after harvesting 2. Fertilization and proper earthing up of the ratoon crop for good anchorage	175 175	100.00 100.00	100.00	I		
16.	**Storage** 1. Harvested fruits well ventilated and kept in shade/cool placefor long storage	175	100.00	100.00	I		

	2. Proper care of the harvested fruit for protection against pest infestation	175	100.00				
17.	**Post harvest management** 1.Cleaning Harvested fruits cleaned by removing the stalk and leaves from one end 2. Cooling Harvested fruits kept in shade for cooling 3. Grading and packaging 1. Harvested fruits separated and graded according to shape and size 2. Clean bamboo baskets used for packaging	 175 175 175 175	 100.00 100.00 100.00 100.00	100	I		
	4. Value addition 1. Pineapple juice 2. Pineapple squash 3. Pineapple jam	 59 59 56	 33.71 33.71 32.00	33.14	XIII		

4.2.1 (b) Practise-wise knowledge level of pineapple growers under Peren district

Table 4.2.1(b) showed the knowledge level of pineapple growers under Peren district. The average mean knowledge index of the pineapple growers from Peren district was 55.89 and 5.35 standard deviation. The respondents had 100.00 per cent mean knowledge level for dimensions such as varieties, propagation, planting time, cropping pattern, harvesting, ratooning, storage and post harvest management. The respondents had 97.14 per cent mean knowledge level on land preparation, 78.57 per cent mean knowledge level on weed management, 68.09 per cent on intercultural operations, 66.67 per cent on mealy bug management, 64.76 per cent on heart rot management, 64.29 per cent on leaf spot management and 56.43 per cent mean knowledge level on rodent management. The respondents had only 48.57 per cent mean knowledge level on irrigation dimension and ranked IXth. This lack of knowledge might be due to the same reason as the respondents from Dimapur district as their pineapple cultivation was also rainfed. Further, it was found that the respondents had 40.36 per cent mean knowledge on planting, 34.76 per cent on heart rot, 26.19 per cent on leaf and fruit rot and its management, 23.43 and 22.86 per cent on black/soft rot and its management. The table envisaged that the respondents had 19.52 per cent men knowledge level on manuring followed by 14.76 per cent mean knowledge level on value addition. Also, the respondents were found to have 0.00 per cent knowledge level on dimensions such as treatment of suckers, growth regulators and leaf spot and were ranked XIXth in mean knowledge level.

Table 4.2.1(b): Practise-wise knowledge level of pineapple growers under Peren district

Sl. No.	Practices	Knowledge level (N = 70) F	Knowledge level (N = 70) %	Mean knowledge level (%)	Rank	Mean knowledge Index	SD
1.	**Recommended varieties** Queen, Kew and Giant Kew	70	100.00	100.00	I		
2.	**Propagation** Suckers and slips	70	100.00	100.00	I		
3.	**Land preparation** 1. Initial land clearing 2. Pit digging and solarization 3. Filling of pits with manure	70 64 70	100.00 91.43 100.00	97.14	II		
4.	**Treatment of suckers** Cow pat pit and neem oil solution	00	0.00	0.00	XIX		
5.	**Planting** 1. Single row 2. Double row 3. Plant population for single row 4. Plant population for double row	63 15 27 08	90.00 21.43 38.57 11.43	40.36	X		
6.	**Planting time** May – July and November – December	70	100.00	100.00	I		
7.	**Manuring** 1. Compost/ cattle manure 2. Green leaf + compost/manure + soil 3. Azotobacter/Azospirrilum + Phosphotika + manure	26 15 00	37.14 21.43 00.00	19.52	XVI	55.89	5.35
8.	**Intercultural operations** 1. Use of paddy straw 2. Black polythene mulching 3. Protection from scorching sun	62 11 70	88.57 15.71 100.00	68.09	IV		
9.	**Cropping pattern** 1. Mix cropping with colocassia,						

	yam, chillies, sweet potato, cabbage, cauliflower, soybean 2. Intercropping with turmeric, ginger, cowpea, colocassia, coconut and arecanut, mango.	70 70	100.00 100.00	100.00	I		
10.	**Irrigation** 1. Generally dependent on rainwater 2. Types of irrigation used 3. Ideal way of maintaining soil moisture during extreme dry conditions 4. Requirement of irrigation during dry months	70 28 06 32	100.00 40.00 8.57 45.71	48.57	IX		
11.	**Weed management** 1. Weed control methods 2. Weeding practiced throughout the year 3. Uprooted weeds used as organic compost and mulch 4. Use of black polythene to control weeds	60 70 70 20	85.71 100.00 100.00 28.57	78.57	III		
12.	**Growth regulator** Use of planofix & celemone @ 10-20ppm to induce flowering	00	00.00	0.00	XIX		
13.	**Pest and disease management** 1. Mealy bug 1. Symptoms appear on roots 2. The roots cease to grow, collapse and rot 3. Infected plants show stunted growth 4. Wilting at the tip develop a reddish yellow colour	04 07 08 08	5.71 10.00 11.43 11.43	9.64	XVIII		
	Management 1. Cultivate uninfected plant material 2. Ants removed 3. *Bacillus gordonae* applied	70 70 00	100.00 100.00 0.00	66.67	V		
	2. Rodents 1. Controlled by setting up traps 2. Rodents fed poison bait	70 09	100.00 12.86	56.43	VIII		
	3. Heart rot 1. Disease causes complete rotting 2. The top leaves turn brown 3. The basal portion of the leaves rot with foul smell	24 24 25	34.29 34.29 35.71	34.76	XI		

	Management 1. Good drainage maintained 2. Use healthy planting material 3. Controlled by applying *Trichoderma*	 66 70 00	 94.29 100.00 0.00	64.76	VI		
	4. Leaf and fruit rot 1. Occurs when the plants are not dried 2. Other plants also destroyed by entering through wounds 3. In severe conditions, the entire plant turn dark and die	 20 16 19	 28.57 22.86 27.14	26.19	XII		
	Management 1. Diseased plant must be destroyed 2. Suckers for propagation must be free from uninfested areas 3. Controlled by applying *Trichoderma*.	 70 70 00	 100.00 100.00 0.00	26.19	XIII		
	5. Leaf spot 1. First symptom is water-soaked lesions on the leaves 2. The spots enlarge in size	 00 00	 0.00 0.00	0.00	XIX		
	Management 1. Good soil drainage should be maintained 2. Healthy planting material should be used 3. Controlled by applying *Trichoderma*	 65 70 00	 92.86 100.00 0.00	64.29	VII		
	6. Black/Soft rot 1. Small, circular, water soaked spots appear at the stalk end of the fruit 2. Fruit rot and emit foul smell 3. Delay between harvest and utilization leads to development of disease	 00 00 00	 0.00 0.00 0.00	23.43	XIV		
	Management 1. Avoid injury to the fruit during harvest and transit 2. Controlled by applying *Trichoderma*	 32 00	 45.71 0.00	22.86	XV		
14.	**Harvesting** 1. Fruit takes about 15-20 months to mature 2. Change in colour determine the maturity of the fruit 3. Fruit harvested by breaking/cutting the stalk few cm below the fruit	 70 70 70	 100.00 100.00 100.00	100.00	I		

	4. Size, colour of fruit and brix content determine ripe fruits	70	100.00				
15.	**Ratooning** 1. 1-2 suckers are left in the mother plant after harvesting 2. Fertilization and proper earthing up of the ratoon crop for good anchorage	70 70	100.00 100.00	100.00	I		
16.	**Storage** 1. Harvested fruits well ventilated and kept in shade/cool placeor long storage 2. Proper care of the harvested fruit for protection against pest infestation	70 70	100.00 100.00	100.00	I		
17.	**Post harvest management** 1.Cleaning Harvested fruits cleaned by removing the stalk and leaves from one end 2. Cooling Harvested fruits kept in shade for cooling 3. Grading and packaging 1. Harvested fruits separated and graded according to shape and size 2. Clean bamboo baskets used for packaging	70 70 70 70	100.00 100.00 100.00 100.00	100.00	I		
	4. Value addition 1. Pineapple juice 2. Pineapple squash 3. Pineapple jam	11 10 10	15.71 14.29 14.29	14.76	XVII		

4.2.1(c): Practise-wise knowledge level of pineapple growers under Mokokchung district

Table 4.2.1(c) accounted for the knowledge level of pineapple growers under Mokokchung district. The mean knowledge index and standard deviation were 64.91 and 7.69 respectively. The respondents had 100.00 per cent mean knowledge level for practices such as varieties, propagation, land preparation, planting time, cropping pattern, harvesting, ratooning, storage and post harvest management. The respondents had mean knowledge level of 85.00 per cent followed by 82.22 per cent in intercultural operations, 80.00 per cent in rodent management, 67.78 per cent in black/soft rot, 66.67 per cent in leaf spot management and 50.00 per cent in heart rot disease. It was also found that management of black/soft rot, irrigation, planting, leaf and fruit rot were ranked VIII[th], IX[th], X[th] and XI[th] with mean knowledge per cent of 43.33, 40.83, 40.00 and 35.56 respectively. The table further revealed that the respondents had 24.44 per cent mean knowledge level in value addition and 20.00 per cent mean knowledge level in leaf spot. Finally, in case of treatment of suckers and growth regulators practices, the respondents had 0.00 per cent mean knowledge level and were ranked XIV[th].

Table 4.2.1(c): Practise-wise knowledge level of pineapple growers under Mokokchung district

Sl. No.	Practices	Knowledge level (N = 30) F	Knowledge level (N = 30) %	Mean knowledge level (%)	Rank	Mean Knowledge Index	SD
1.	**Recommended varieties** Queen, Kew and Giant Kew	30	100.00	100.00	I		
2.	**Propagation** Suckers and slips	30	100.00	100.00	I		
3.	**Land preparation** 1. Initial land clearing 2. Pit digging and solarization 3. Filling of pits with manure	30 30 30	100.00 100.00 100.00	100.00	I		
4.	**Treatment of suckers** Cow pat pit and neem oil solution	00	0.00	0.00	XIV		
5.	**Planting** 1. Single row 2. Double row 3. Plant population for single row 4. Plant population for double row	27 05 12 04	90.00 16.67 40.00 13.33	40.00	X		
6.	**Planting time** May – July and November – December	30	100.00	100.00	I		
7.	**Manuring** 1. Compost/ cattle manure 2. Green leaf + compost/manure + soil 3. Azotobacter/Azospirrilum + Phosphotika + manure	08 14 00	26.67 46.67 00.00	24.44	XII	64.91	7.69
8.	**Intercultural operations** 1. Use of paddy straw 2. Black polythene mulching 3. Protection from scorching sun	30 14 30	100.00 46.67 100.00	82.22	III		
9.	**Cropping pattern** 1. Mix cropping with colocassia,						

	yam, chillies, sweet potato, cabbage, cauliflower, soybean 2. Intercropping with turmeric, ginger, cowpea, colocassia, coconut and arecanut, mango.	30 30	100.00 100.00	100.00	I		
10.	**Irrigation** 1. Generally dependent on rainwater 2. Types of irrigation used 3. Ideal way of maintaining soil moisture during extreme dry conditions 4. Requirement of irrigation during dry months	30 3 02 14	100.00 10.00 06.67 46.67	40.83	IX		
11.	**Weed management** 1. Weed control methods 2. Weeding practiced throughout the year 3. Uprooted weeds used as organic compost and mulch 4. Use of black polythene to control weeds	30 30 30 12	100.00 100.00 100.00 40.00	85.00	II		
12.	**Growth regulator** Use of planofix & celemone @ 10-20ppm to induce flowering	00	00.00	0.00	XIV		
13.	**Pest and disease management** 1. Mealy bug 1. Symptoms appear on roots 2. The roots cease to grow, collapse and rot 3. Infected plants show stunted growth 4. Wilting at the tip develop a reddish yellow colour	15 15 15 15	50.00 50.00 50.00 50.00	50.00	VII		
	Management 1. Cultivate uninfected plant material 2. Ants removed 3. *Bacillus gordonae* applied	30 30 00	100.00 100.00 0.00	66.67	VI		
	2. Rodents 1. Controlled by setting up traps 2. Rodents fed poison bait	30 18	100.00 60.00	80.00	IV		
	3. Heart rot 1. Disease causes complete rotting 2. The top leaves turn brown 3. The basal portion of the leaves rot with foul smell	15 15 15	50.00 50.00 50.00	50.00	VII		

	Management 1. Good drainage maintained 2. Use healthy planting material 3. Controlled by applying *Trichoderma*	30 30 00	100.00 100.00 0.00	66.67	VI		
	4. Leaf and fruit rot 1. Occurs when the plants are not dried 2. Other plants also destroyed by entering through wounds 3. In severe conditions, the entire plant turn dark and die	15 06 11	50.00 20.00 36.67	35.56	XI		
	Management 1. Diseased plant must be destroyed 2. Suckers for propagation must be free from uninfested areas 3. Controlled by applying *Trichoderma*	30 30 00	100.00 100.00 0.00	66.67	VI		
	5. Leaf spot 1. First symptom is water-soaked lesions on the leaves 2. The spots enlarge in size	05 07	16.67 23.33	20.00	XIII		
	Management 1. Good soil drainage should be maintained 2. Healthy planting material should be used 3. Controlled by applying *Trichoderma*	30 30 00	100.00 100.00 0.00	66.67	VI		
	6. Black/Soft rot 1. Small, circular, water soaked spots appear at the stalk end of the fruit 2. Fruit rot and emit foul smell 3. Delay between harvest and utilization leads to development of disease	19 21 21	63.33 70.00 70.00	67.78	V		
	Management 1. Avoid injury to the fruit during harvest and transit 2. Controlled by applying *Trichoderma*	26 00	86.67 0.00	43.33	VIII		
14.	**Harvesting** 1. Fruit takes about 15-20 months to mature 2. Change in colour determine the maturity of the fruit 3. Fruit harvested by breaking/cutting the stalk few cm below the fruit	30 30 30	100.00 100.00 100.00	100.00	I		

	4. Size, colour of fruit and brix content determine ripe fruits	30	100.00				
15.	**Ratooning** 1. 1-2 suckers are left in the mother plant after harvesting 2. Fertilization and proper earthing up of the ratoon crop for good anchorage	30 30	100.00 100.00	100.00	I		
16.	**Storage** 1. Harvested fruits well ventilated and kept in shade/cool place for long storage 2. Proper care of the harvested fruit for protection against pest infestation	275 275	100.00 100.00	100.00	I		
17.	**Post harvest management** 1. Cleaning Harvested fruits cleaned by removing the stalk and leaves from one end 2. Cooling Harvested fruits kept in shade for cooling 3. Grading and packaging 1. Harvested fruits separated and graded according to shape and size 2. Clean bamboo baskets used for packaging	30 30 30 30	100.00 100.00 100.00 100.00	100.00	I		
	4. Value addition 1. Pineapple juice 2. Pineapple squash 3. Pineapple jam	08 07 07	26.67 23.33 23.33	24.44	XII		

4.2.1 (d) Overall knowledge level of the respondents

Table 4.2.1(d) and Fig 4.2.1(d) envisaged the overall knowledge level of the respondents. Under Dimapur district, majority (70.28%) of the respondents had medium overall knowledge level followed by high (22.86%) and low (6.86%) overall knowledge level. In case of Peren district, it was found that majority (58.57%) of the respondents had low overall knowledge level while 40.00 per cent and only 1.43 per cent of them had medium and high overall knowledge level respectively. Possible reason could be that majority of the respondents were educated only upto middle school, few of them were illiterate and majority of them had no training exposure. It was further revealed that more than half (60.00%) of the respondents from Mokokchung district had medium overall knowledge level while only 26.67 per cent had high level and 13.33 per cent of them had low overall knowledge level.

In the consolidated data, it was observed that 61.45 per cent of the respondents had medium overall knowledge level while 20.73 per cent and 17.82 per cent of them had low and high overall knowledge level respectively. The findings were supported by the findings of Kaur *et al.* (2020), Deb *et al*. (2021), Kumar *et al.* (2021), Rabina *et al*. (2021) and Moumita and Mazhar (2022).

Table 4.2.1(d): Distribution of the respondents based on their overall knowledge

Level of knowledge	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Low (< 55.45)	12 (6.86)	**41 (58.57)**	04 (13.33)	57 (20.73)
Medium (55.45 – 70.25)	**123 (70.28)**	28 (40.00)	**18 (60.00)**	**169 (61.45)**
High (> 70.25)	40 (22.86)	01 (1.43)	08 (26.67)	49 (17.82)
Mean Knowledge Index	**65.12**	**55.89**	**64.91**	**62.85**
SD	6.24	5.35	7.69	7.40

Figures in parentheses indicate the percentage (%) of the respondents

4.2.1 (e) Comparative account of knowledge of farmers on sustainable pineapple cultivation among the districts

A quick view of Table 4.2.1(e) showed the comparative study on knowledge of farmers on sustainable pineapple cultivation among the three districts on study. The z value between Dimapur and Peren district was 11.598 which indicated a large deviation from the mean being analyzed. The p value was found to be less than 0.01 which suggested that the observed difference between the two districts is statistically significant at 0.01 (1%) significance level. In case of comparison between district Dimapur and Mokokchung, the z value was 0.141 and p value was 0.89 which was found to be not statistically significant. This result may be due to the sample and effect size.

With reference to comparison between Peren and Mokokchung districts, the z value was -5.938 which indicated that the difference was in favour of Mokokchung district. The p value was less than 0.01 which could be interpreted that there was a statistically significant difference between the two districts.

Table 4.2.1(e): Comparative account of knowledge of farmers on sustainable pineapple cultivation among the districts

Sl. No.	Name of the district	Mean Knowledge Index	Z value	P value
1.	Dimapur	65.12	11.598*	< 0.01
	Peren	55.89		
2.	Dimapur	65.12	0.141	0.89
	Mokokchung	64.91		
3.	Peren	55.89	- 5.938*	< 0.01
	Mokokchung	64.91		

* - Significant at 1 %

4.2.2 Relationship between independent variables and knowledge level of the pineapple growers

A glance at Table 4.2.2 revealed the relationship of independent variables with the knowledge level of the respondents. Variables education, social participation, sources of information utilization, size of landholding under pineapple cultivation, annual income, profitability, productivity, employment generated, economic motivation, market orientation, management orientation, integrated nutrient management, extension contact, training exposure, experience and scientific orientation had positive and significant relationship with the knowledge level of the respondents. While the variables input self sufficiency and decision making ability were found to have negative and significant relationship with the knowledge level of the respondents.

Education: It was found to have a positive and significant relationship with the knowledge level of the respondents. Education not only helps in acquisition of knowledge but also help in understanding and deciding better on new ideas and practices. Educated farmers have more access to farm information sources and more exposure to extension agents and research stations. The finding was in agreement with the finding of Prashanth *et al.* (2018), Patra and Kense (2020), Deb *et al*. (2021), Kumar (2021) and Kumar *et al.* (2021).

Social participation: This variable had positive and significant relationship with the knowledge level of the respondents. Farmers who actively participate in social activities through social organizations come across different types of people with different understanding and experiences. They exchange their ideas, views and experiences through such interactions and are thus, able to gain new knowledge. Similar finding was observed by Patra and Kense (2020) and Kumar (2021).

Sources of information utilization: The relationship between sources of information utilizationand knowledge level of the respondents were positive and highly significant. Respondents possessing higher level of sources of information utilized had more knowledge about the cultivation practices of pineapple. This may be inferred that with higher utilization of the information sources, more is acquisition of the latest and relevant information on the various practices of pineapple cultivation. This finding was supported by Rabina *et al*. (2021).

Size of landholding under pineapple cultivation: It had positive and significant relationship with the knowledge level of the respondents. Respondents possessing bigger landholding under pineapple cultivation had relatively higher knowledge level on sustainable cultivation practices of pineapple. This may imply that an increased landholding under farming for a farmer act as an impetus to search for and learn new sustainable cultivation practices of pineapple which in turn motivate the farmer to invest commercially in the pineapple cultivation. This finding was in conformity with the findings of Prashanth *et al.* (2018), Patra and Kense (2020) and Rabina *et al*. (2021).

Annual income and profitability: These variableswere also found to have a positive and significant relationship with the knowledge level of the respondents. Farmers with higher income tend to take more risk to try new practices and purchase machineries and planting materials. This finding was in accordance with the findings of Prashanth *et al.* (2018), Patra and Kense (2020), Deb *et al*. (2021) and Rabina *et al*. (2021).

Productivity and employment generated: It was found that variables productivity and employment generated had also positive and significant relationship with the knowledge of the respondents. The possible reason maybe that with increase in productivity and employment generation, the farmers are motivated to farm better leading to look for improved practices and technologies.

Economic motivation: This variable also had positive and significant relationship with the knowledge level of the respondents. The respondents with higher economic motivation tend to have higher knowledge. This might be due to the fact that farmers are oriented towards maximum economic returns from their farm produce and hence to get the best return, economic motivation act as a defining factor to acquire the new and best sustainable cultivation practices of pineapple cultivation. This finding was in accordance with the findings of Wani *et al.* (2020) and Kumar *et al.* (2021).

Market orientation: The relationship between market orientation and knowledge level of the respondents was positive and significant. Respondents with higher level of market orientation possessed higher knowledge of sustainable cultivation practices of pineapple. The plausible reason could be farmers with higher market orientation tend to seek more information on the best, latest and most reliable markets and marketing channels.

Management orientation: The table exhibited that management orientation had positive and significant relationship with the knowledge level of the respondents. Respondents with higher level of management orientation had higher knowledge level. Farmers with good managerial skills tend to be well educated and have considerable exposure to social participation, mass-media and other sources of information.

Integrated Nutrient Management: It was also found to have positive and significant relationship with the knowledge level of the respondents.

Extension contact: This variable exhibited positive and significant relationship with the knowledge level of the respondents. Respondents possessing higher frequency of extension contact possessed more knowledge level of the sustainable cultivation practices of pineapple. The possible reason could be that, with more contact of the respondents with the extension personnel, more is their exposure to diversified knowledge on sustainable practices of farming. These interactions might have motivated the respondents and acquired higher knowledge. Similar finding was supported by the findings of Wani *et al.* (2020), Deb *et al*. (2021), Kumar (2021) and Rabina *et al*. (2021).

Training exposure: It was observed that training exposure had positive and significant relationship with the knowledge level of the respondents. Respondents have more training exposure tend to have higher knowledge level of sustainable cultivation practices of pineapple. During training programme, the trainees are exposed to relevant and updated information, innovation and skills. The trainees feel boosted to incorporate those practices learned in their farms. These factors could be the reason for a positive and significant effect of trainings received on the knowledge level of the respondents. Similar findings were on par with the findings of Patra and Kense (2020).

Experience: It was further found that experience in pineapple cultivation had a positive and significant relationship with the knowledge level of the respondents. It could imply that with the increase in years of experience in pineapple cultivation, the pineapple growers gain all round proficiency in the various cultivation activities and also help them in realising the importance of sustainable cultivation practices of pineapple. This finding was in conformity with the findings of Prashanth *et al.* (2018) and Deb *et al.* (2021).

Scientific orientation:The relationship between scientific orientation and knowledge level of the respondents was positive and significant. This might be due to the fact that the respondents with more scientific orientationassess the feasibility and relevancy of the sustainable cultivation practices objectively in their farm situation. This finding was in accordance with the findings of Wani *et al.* (2020).

Input self-sufficiency: It was observed that this variable had negative and significant relationship with the knowledge level of the respondents.

Decision making ability: Decision making ability had a negative and significant relationship with the knowledge level of the respondents. This inferred that with increase in knowledge, decision making ability decreases. This might be due to factors such as being too cautious or overthinking due to the information they posses or being too focussed on what they possess that lead to low decision making.

Table 4.2.2: Relationship between independent variables and knowledge level of the respondents

Sl. No.	Independent variables	Pearson correlation	p - value
1.	Age	0.051	0.395
2.	Family size	0.043	0.482
3.	Occupation	-0.09	0.137
4.	Education	0.294**	< 0.001
5.	Input self sufficiency	-0.133*	0.028
6.	Social participation	0.136*	0.024
7.	Sources of information utilization	0.438**	< 0.001
8.	Innovativeness	0.098	0.104
9.	Risk bearing ability	0.027	0.652

10.	Market innovativeness	0.058	0.336
11.	Decision making ability	-0.222**	< 0.001
12.	Achievement motivation	-0.031	0.614
13.	Size of land holding under agriculture	0.094	0.119
14.	Size of land holding under pineapple	0.313**	< 0.001
15.	Annual income	0.160**	0.008
16.	Profitability	0.203**	0.001
17.	Productivity	0.357**	< 0.001
18.	Employment generated	0.318**	< 0.001
19.	Economic motivation	0.182**	0.002
20.	Market orientation	0.169**	0.005
21.	Management orientation	0.355**	< 0.001
22.	IPM	0.087	0.149
23.	INM	0.273**	< 0.001
24.	Extension contact	0.283**	< 0.001
25.	Training exposure	0.255**	< 0.001
26.	Experience	0.165**	0.006
27.	Scientific orientation	0.223**	< 0.001

**Correlation is significant at the 0.01 level (2- tailed)
*Correlation is significant at the 0.05 level (2- tailed)

Variables, *viz.* education, social participation, sources of information utilization, size of landholding under pineapple cultivation, annual income, profitability, productivity, employment generated, economic motivation, market orientation, management orientation, integrated nutrient management, extension contact, training exposure, experience, scientific orientation, input self sufficiency and decision making ability were significant with the knowledge level of the respondents. Therefore,

H_o1: There is no association between education, social participation, sources of information utilization, size of landholding under pineapple cultivation, annual income, profitability, productivity, employment generated, economic motivation, market orientation, management orientation, integrated nutrient management, extension contact, training exposure, experience, scientific orientation, input self sufficiency and decision making ability with *knowledge* of sustainable pineapple cultivation practices was rejected.

Variables, *viz.* age, family size, occupation, innovativeness, risk bearing ability, market innovativeness, achievement motivation, size of land holding under agriculture and IPM were found non significant. Therefore,

H_o1_a: There is no association between age, family size, occupation, innovativeness, risk bearing ability, market innovativeness, achievement motivation, size of land holding under agriculture and IPM with *knowledge* of sustainable pineapple cultivation practices was accepted.

4.2.3 Multiple linear regression of the independent variables with the knowledge level of the pineapple growers

Table 4.2.3 presented the multiple linear regression analysis between the independent variables and knowledge level of the respondents. It was found that variables education, input self sufficiency, sources of information utilization, risk bearing ability, decision making ability, size of land holding under agriculture, employment generated, management orientation, integrated nutrient management, experience and scientific orientation substantially contributed to the knowledge level of the farmers. The R^2 value (0.437) of the model indicated that these variables jointly contributed about 43.7 per cent of the variation in the knowledge level of the respondents towards sustainable cultivation practices of pineapple. Thus, it may be inferred that significant predictor variables were found important in explaining the knowledge level of the respondents.

Table 4.2.3: Multiple linear regression of independent variables with knowledge

Sl. No.	Variables	Regression coefficient	't' value	'p' value
1.	Education	1.843	4.841	< 0.01
2.	Input self sufficiency	-0.131*	-2.002	0.046
3.	Sources of information utilization	0.658	3.925	< 0.01
4.	Risk bearing ability	-0.552*	-2.125	0.035
5.	Decision making ability	-0.691**	-3.331	< 0.01
6.	Size of land holding under agriculture	-1.354**	-3.49	< 0.01
7.	Employment generated	0.09**	4.748	< 0.01
8.	Management orientation	0.314*	2.228	0.027
9.	Integrated Nutrient Management	0.263**	3.431	< 0.01
10.	Experience	0.184	2.371	0.018
11.	Scientific orientation	0.275*	2.155	0.032

R^2 value = 0.437 F = 18.57** (p value = < 0.001)

** Significant at 1% level * Significant at 5% level

4.3. Extent of adoption of sustainable cultivation practices among pineapple growers

4.3.1 Practise-wise extent of adoption of sustainable cultivation practices of pineapple

Table 4.3.1 revealed the adoption status of the sustainable cultivation practices of pineapple followed by the respondents from Dimapur, Peren and Mokokchung districts.

It was found that majority (88.00%, 88.57% and 83.33%) of the respondents from Dimapur, Peren and Mokokchung districts fully adopted digging of pits and solarizing the soil and the pooled data of the three districts showed that majority (87.64%) of the respondents.While only 9.72 per cent, 5.72 per cent and 3.33 per cent of the respondents from Dimapur, Peren and Mokokchung districts respectivelyfully adopted the filling of pits with manure. Overall, 87.64 per cent of the respondents fully adopted digging of pits and solarizing the field and 16.73 per cent partially adopted filling of pits with manure.

In case of varieties, cent per cent of the respondents from all the three districts were found to have fully adopted the cultivation of Giant Kew and Kew varieties. While only 5.71 per cent from Dimapur, 15.72 per cent from Peren and 6.67 per cent from Mokokchung fully adopted the cultivation of Queen variety. Overall, 8.36 per cent and 7.64 per cent of the respondents fully and partially used Queen variety. This may be due to the fact that Giant Kew and Kew varieties are fibreless, very juicy, the fruits are big in size and spineless leaves. However, Queen varieties are less juicy, fibrous, fruits are smaller in size and the leaves are spiny which pose as injurious during intercultural operations.

100.00 per cent of the respondents from all the districts of Dimapur, Peren and Mokokchung districts fully used suckers and slips as the planting material. This may be due to the fact that suckers and slips as planting material take lesser time to bear fruit than crowns.

It was found that none (0.00%) of the respondents from Dimapur, Peren and Mokokchung districts practised treatment of planting material before planting. This may be due to lack of knowledge on importance of treatment of planting material.

In case of single row spacing, 21.71 per cent of the respondents from Dimapur district fully adopted it while 40.00 per cent of the respondents from Peren and Mokokchung districts fully adopted it. It was from the cumulative data that 28.37 per cent of the respondents fully adopted single row spacing. In case of double row spacing, more than half (59.43%) of the respondents from Dimapur district fully adopted it followed by half (50.00%) and 30.00 per cent of the respondents from Mokokchung and Peren districts fully adopted it. The consolidated data revealed that half (50.91%) of the respondents fully adopted double row spacing. It was found that the respondents also followed triangle type of spacing (P-P 1 feet) and (R-R 4-5 feet) for easier intercultural operations and to avoid overcrowding of the pineapple plants.

Less than half (48.00%), majority (74.28%) and less than half (40.00%) of the respondents from Dimapur, Peren and Mokokchung districts partially adopted the single row population of 44,500 plants/ha while half of the respondents from Dimapur district partially adopted double row population of 60,000 plants/ha, followed by 42.86 per cent and 23.33 per cent from Peren and Mokokchung districts partially adopting it respectively. The cumulative data revealed that 20.36 per cent and 26.18 per cent of the respondents fully adopted single row population and double row spacing respectively.

The table further revealed that majority (97.14%, 95.71% and 96.67%) of the respondents from Dimapur, Peren and Mokokchung districts fully adopted that planting time of March – May and September – November. The consolidated data showed that majority (96.73%) of the respondents fully adopted the recommended planting time.

In case of manuring, it was found that only 3.43 per cent, 5.71 per cent and 33.33 per cent of the respondents from Dimapur, Peren and Mokokchung districts fully adopted the application of FYM (compost/cattle manure) as manure. In the overall data, 7.27 per cent of the respondents fully adopted it, 21.09 per cent partially adopted it and 71.64 per cent did not adopt it. 23.43 per cent, 4.29 per cent and 36.67 per cent of the respondents from Dimapur, Peren and Mokokchung districts partially adopted green leaf+ compost/manure + soil. It was found that the pineapple growers usually used green leaf as manure without mixing with soil and manure. Overall, 12.73 per cent partially adopted this practice. However, none (0.00%) of the respondents used azotobacter/azospirillum and phosphotika for manuring purposes. This may be due to lack of awareness. It was found that low use of manures was due to non-availability, lack of finance or inability to manage application of manure in larger landholding.

It was found that 4.57 per cent, 4.29 and 10.00 per cent of the respondents from Dimapur, Peren and Mokokchung districts fully adopted irrigating of their pineapple fields. In the pooled data, 5.09 per cent of the respondents fully adopted irrigation practices. The pineapple cultivation practised by the respondents are generally rainfed and therefore, the irrigation practised is quite low.

Under cropping pattern, 35.43 per cent of the respondents from Dimapur district, 22.86 per cent from Peren and 80.00 per cent from Mokokchung partially practised intercropping of pineapple with mango, arecanut, coconut, ginger, turmeric, cowpea, colocassia, etc. Overall, 37.09 per cent of the respondents partially adopted it. Further, 34.29 per cent of the respondents from Dimapur, 22.86 per cent from Peren and 76.67 per cent from Mokokchung district partially adopted intercropping of pineapple with colocassia, yam, chillies, sweet potato, cabbage, cauliflower, soybean, etc. In the pooled data, 36.00 per cent of the respondents partially adopted intercropping with these crops. It was found that the respondents adopted intercropping and mixed cropping in the initial 1-2 years of pineapple cultivation with various crops such as banana, maize, paddy, xanthophyllum, and sesame.

In case of intercultural operations, 44.57 per cent of the respondents from Dimapur practised mulching of the pineapple plants with straw to prevent sunburn followed by 31.43 per cent and 93.34 per cent from Peren and Mokokchung districts respectively fully adopting it. Overall, 46.55 per cent of the respondents fully adopted it. This was practised depending upon the cultivation of paddy and availability of paddy straws. It was also found that the fruits get sunburn due to extreme heat during peak summer and therefore to avoid sunburn, the pineapple farmers plant trees like yongchak, neem and banana bordering the pineapple field to provide shade, tie up the pineapple leaves in the middle to give protection to the fruits and also provide shade to the fruits by placing big leaves on top of the fruits.

Only 1.71 per cent from Dimapur district fully adopted using of black polythene for mulching purpose, 3.33 per of the respondents from Mokokchung district partially adopted it while none (0.00%) of the respondents from Peren district practised black polythene mulching. The pooled data showed that only 1.09 of the respondents fully adopted black polythene mulching. This may be due to lack of knowledge on black polythene mulching and lack of financial resources to procure the black polythene.

It was also found that cent per cent (100.00%) of the respondents fully adopted using of uprooted weeds as organic compost and mulch and uprooting of weeds atleast twice in a year.

In case of growth regulators, none (0.00%) of the respondents adopted application of planofix and celemone as growth regulators to induce flowering. This may be due to lack of knowledge and awareness of application of growth regulators.

In case of mealy bug management, cent per cent (100.00%) of the respondents controlled by cultivating unaffected planting material, 22.29 per cent from Dimapur, 22.86 per cent from Peren and 3.33 per cent from Mokokchung district fully adopted removing of ants harbouring in the field. Overall, 20.36 per cent of them fully adopted it. In terms of application of *Bacillus gordonae*, none of the (0.00%) respondents practised it. They may be due to lack of awareness.

In case of rodent management, 64.57 per cent, 57.14 per cent 90.00 per cent of the respondents from Dimapur, Peren and Mokokchung respectively fully adopted trapping of the rodents with attractive baits. 6.29 per cent, 1.43

per cent and 6.67 per cent fully adopted application of poison baits for rodent management. The pooled data showed that 5.09 per cent of the respondents fully adopted application of poison baits. Another practised observed which was adopted by the respondents were the non-removal of the already half eaten ripened pineapple fruit from the mother plant so that the rodents, birds, ants, honeybee or squirrels will continue to consume the same fruit and prevent loss of another healthy, ripened fruit. Insecticide DDT (dichloro-diphenyl-trichloroethane) was applied around the border of the pineapple field on extreme cases in order to prevent entry animals into the field.

In case of heart rot, leaf rot and fruit rot management, 84.57 per cent, 78.57 per cent, and 90.00 per cent of the respondents from Dimapur, Peren and Mokokchung district fully adopted maintaining good soil drainage in the field. Overall, 83.64 per cent of them fully adopted it. Cent per cent (100.00%) of the respondents fully adopted usage of healthy planting material. None (0.00%) of the respondents were found to have adopted the treatment of suckers with Trichoderma and spraying of neem oil mixed with detergent powder. This zero adopted may be due to lack of knowledge.

In case of harvesting, cent (100.00%) of the respondents from Dimapur fully adopted harvesting of fruits 15-20 months after planting followed by 64.29 per cent and 96.67 per cent of the respondents from Peren and Mokokchung districts fully adopting the practice. The pooled data showed that 65.82 per cent fully adopted it. It was also found that cent per cent (0.00%) of the respondents fully adopted harvesting of fruits when the fruits turned yellow and matured fruits harvested by breaking/cutting the stalk a few cm below the fruit.

For ratooning, cent pr cent (100.00%) of the respondents fully adopted desuckering immediately after harvest leaving 1-2 suckers on the mother plant. 72.00 per cent, 78.57 per cent and 50.00 per cent of the respondents from

Dimapur, Peren and Mokokchung districts partially adopted proper fertilization and earthing up for good anchorage of the ratoon crop. The consolidated data showed that 71.27 per cent of the respondents partially adopted it. This may be due to non-availability of manures.

It was also found that cent per cent (100.00%) of the respondents fully adopted well ventilating of the harvested fruits and kept it in shade/cool place for longer storage. Harvested fruits were protected against pest and disease infestation during storage.

The respondents (100.00%) were found to fully adopt post-harvest management practices.

In case of value addition, 14.86 per cent, 11.43 per cent and 6.67 per cent of the respondents from Dimapur, Peren and Mokokchung fully adopted the practice of using KMS, sugar and citric acid as preservatives during pineapple squash, juice and jam preparation. The pooled data showed that 13.09 per cent of the respondents fully adopted the practice. Further, 17.14 per cent, 15.71 per cent and 6.67 per cent of the respondents from Dimapur, Peren and Mokokchung districts fully adopted the practice of storing the finished product in sterilized bottles. 15.64 per cent of the total respondents fully adopted this practice. It was found that the respondents had less knowledge on value addition process while some of the respondents could not practice value addition due to time constraint and labour constraint during peak harvest season.

Table 4.3.1: Practise-wise extent of adoption of sustainable cultivation practices of pineapple by the respondents

Sl. No.	Practices	Dimapur (n_1 = 175)			Peren (n_2 = 70)			Mokokchung (n_3 = 30)			Overall (N = 275)		
		FA (F & %)	PA (F & %)	NA (F & %)	FA (F & %)	PA (F & %)	NA (F & %)	FA (F & %)	PA (F & %)	NA (F & %)	FA (F & %)	PA (F & %)	NA (F & %)
1.	**Land preparation** a. Digging of pits and solarizing the soil.	**154 (88.00)**	21 (12.00)	00 (0.00)	**62 (88.57)**	08 (11.43)	00 (0.00)	**25 (83.33)**	05 (16.67)	00 (0.00)	**241 (87.64)**	34 (12.36)	00.00 (00.00)
	b. Pits filled with manure.	17 (9.72)	15 (8.57)	143 (81.71)	4 (5.72)	13 (18.57)	53 (75.71)	01 (3.33)	18 (60.00)	11 (36.67)	22 (8.00)	46 (16.73)	207 (75.27)
2.	**Varieties** a. Giant Kew and Kew	175 (100.00)	00 (0.00)	00 (0.00)	70 (100.00)	00 (0.00)	00 (0.00)	30 (100.00)	00 (0.00)	00 (0.00)	275 (100.00)	00.00 (00.00)	00.00 (00.00)
	b. Queen	10 (5.71)	10 (5.71)	155 (88.58)	11 (15.72)	05 (7.14)	54 (77.14)	02 (6.67)	06 (20.00)	22 (73.33)	23 (8.36)	21 (7.64)	231 (84.00)
3.	**Propagation** Suckers and slips are used as planting material.	175 (100.00)	00 (0.00)	00 (0.00)	70 (100.00)	00 (0.00)	00 (0.00)	30 (100.00)	00 (0.00)	00 (0.00)	275 (100.00)	00 (00.00)	00 (00.00)
4.	**Treatment of planting material** a. Suckers/ slips are dipped in a mixture of cow pat pit and dried for 6-10 hours before planting.	00 (0.00)	00 (0.00)	175 (100.00)	00 (0.00)	00 (0.00)	70 (100.00)	00 (0.00)	00 (0.00)	30 (100.00)	00 (00.00)	00 (00.00)	275 (100.00)
	b. Suckers/slips treated in neem oil solution @ 5ml/l before planting.	00 (0.00)	00 (0.00)	175 (100.00)	00 (0.00)	00 (0.00)	70 (100.00)	00 (0.00)	00 (0.00)	30 (100.00)	00 (00.00)	00 (00.00)	275 (100.00)
5.	**Spacing** a. Single row system: 30cm x 60cm x 75cm.	38 (21.71)	81 (46.29)	56 (32.00)	28 (40.00)	23 (32.86)	09 (12.86)	12 (40.00)	13 (43.33)	05 (16.67)	78 (28.37)	127 (46.18)	70 (25.45)

	b. Double row system: 30cm x 60cm x 90cm.	104 (59.43)	51 (29.14)	20 (11.43)	21 (30.00)	15 (21.43)	34 (48.57)	15 (50.00)	00 (0.00)	15 (050.00)	140 (50.91)	66 (24.00)	69 (25.09)
6.	**Plant population** a. Single row: 44,500 plants/ha.	35 (20.00)	84 (48.00)	56 (32.00)	09 (12.86)	52 (74.28)	09 (12.86)	12 (40.00)	12 (40.00)	06 (20.00)	56 (20.36)	148 (53.82)	71 (25.82)
	b. Double row: 60,000 plants/ha.	56 (32.00)	98 (56.00)	21 (12.00)	08 (11.43)	30 (42.86)	32 (45.71)	08 (26.67)	07 (23.33)	15 (50.00)	72 (26.18)	135 (49.09)	68 (24.73)
7.	**Planting time** March- May and September-November	170 (97.14)	05 (2.86)	00 (0.00)	67 (95.71)	03 (4.29)	00 (0.00)	29 (96.67)	01 (3.33)	00 (0.00)	266 (96.73)	9 (3.27)	00.00 (00.00)
8.	**Manuring** a. A dose of 18t/ha of FYM (compost/cattle manure) as basal dressing.	06 (3.43)	41 (23.43)	128 (73.14)	04 (5.71)	09 (12.86)	57 (81.43)	10 (33.33)	08 26.67)	12 (40.00)	20 (7.27)	58 (21.09)	197 (71.64)
	b. Green leaf + compost/manure + soil	06 (3.43)	41 (23.43)	128 (73.14)	00 (0.00)	03 (4.29)	67 (95.71)	00 (0.00)	11 (36.67)	19 (63.33)	00 (00.0)	35 (12.73)	240 (87.27)
	c. Azotobacter/Azospirillum + Phosphotika.	00 (0.00)	00 (0.00)	175 (100.00)	00 (0.00)	00 (0.00)	70 (100.00)	00 (0.00)	00 (0.00)	30 (100.00)	00 (00.0)	00 (00.0)	00 (00.0)
9.	**Irrigation** The field is irrigated 5-6 times at an interval of 20-25 days during the dry period.	08 (4.57)	24 (13.71)	143 (81.72)	03 (4.29)	06 (8.57)	61 (87.14)	03 (10.00)	02 (6.67)	25 (83.33)	14 (5.09)	32 (11.64)	229 (83.27)
10.	**Cropping pattern** a. Intercropped with mango, arecanut, coconut, ginger, turmeric, cowpea, colocassia, etc.	03 (1.71)	62 (35.43)	110 (62.86)	02 (2.86)	16 (22.86)	52 (74.28)	03 (10.00)	24 (80.00)	03 (10.00)	8 (2.91)	102 (37.09)	165 (60.00)
	b. Intercropped with colocassia, yam, chillies, sweet potato, cabbage, cauliflower, soybean, etc.	03 (1.71)	60 (34.29)	112 (64.00)	03 (4.29)	16 (22.86)	51 (72.86)	03 (10.00)	23 (76.67)	04 (13.33)	09 (3.27)	99 (36.00)	167 (60.73)

11.	**Intercultural operations** 1. Mulching a.Pineapple plants are covered with straw to prevent sunburn.	78 (44.57)	09 (5.14)	88 (50.29)	22 (31.43)	00 (0.00)	48 (68.57)	28 (93.34)	01 (3.33)	01 (3.33)	128 (46.55)	10 (3.63)	137 (49.82)
	b. Black polythene is used to cover the plants as mulches	03 (1.71)	00 (0.00)	172 (98.29)	00 (0.00)	00 (0.00)	70 (100.00)	00 (0.00)	01 (3.33)	29 (96.67)	3 (1.09)	1 (0.36)	271 (98.55)
	c. Uprooted weeds are used as organic compost and mulch	175 (100.00)	00 (0.00)	00 (0.00)	70 (100.00)	00 (0.00)	00 (0.00)	30 (100.00)	00 (0.00)	00 (0.00)	275 (100.00)	00 (00.00)	00 (00.00)
	2.Weed management Weeds are uprooted atleast twice in year.	175 (100.00)	00 (0.00)	00 (0.00)	70 (100.00)	00 (0.00)	00 (0.00)	30 (100.00)	00 (0.00)	00 (0.00)	275 (100.00)	00 (00.00)	00 (00.00)
12.	**Growth regulators** Application of planofix and celemone @10-20ppm to induce flowering	00 (0.00)	00 (0.00)	175 (100.00)	00 (0.00)	00 (0.00)	70 (100.00)	00 (0.00)	00 (0.00)	30 (100.00)	00 (00.00)	00 (00.00)	275 (100.00)
13.	**IPM and DM:** 1. Mealy bug a. Controlled by cultivating unaffected plant material	175 (100.00)	00 (0.00)	00 (0.00)	70 (100.00)	00 (0.00)	00 (0.00)	30 (100.00)	00 (0.00)	00 (0.00)	275 (100.00)	00 (00.00)	00 (00.00)
	b. Ants harbouring in the field are removed	39 (22.29)	50 (28.57)	86 (49.14)	16 (22.86)	12 (17.14)	42 (60.00)	01 (3.33)	18 (60.00)	11 (36.67)	56 (20.36)	80 (29.09)	139 (50.55)
	c. Application of *Bacillus gordonae*	00 (0.00)	00 (0.00)	175 (100.00)	00 (0.00)	00 (0.00)	70 (100.00)	00 (0.00)	00 (0.00)	30 (100.00)	00 (00.00)	00 (00.00)	275 (100.00)
	2. Rodent a. Cage trap with attractive baits.	113 (64.57)	13 (7.43)	49 (28.00)	40 (57.14)	22 (31.43)	08 (11.43)	27 (90.00)	03 (10.00)	00 (0.00)	180 (65.45)	38 (13.82)	57 (20.73)
	b. Poison bait (Crushed rice/maize grains with	11	59	105	01	04	65	02	14	14	14	77	184

	vegetable oil & zinc phosphide/sodium fluoro acetate) is fed.	(6.29)	(33.71)	(60.00)	(1.43)	(5.71)	(92.86)	(6.67)	(46.67)	(46.66)	(5.09)	(28.00)	(66.91)
	3. Heart rot, leaf rot & fruit rot a. Good soil drainage is maintained	148 (84.57)	07 (4.00)	20 (11.43)	55 (78.57)	05 (7.14)	10 (14.29)	27 (90.00)	02 (6.67)	01 (3.33)	230 (83.64)	14 (5.09)	31 (11.27)
	b. Healthy planting material is used	175 (100.00)	00 (0.00)	00 (0.00)	70 (100.00)	00 (0.00)	00 (0.00)	30 (100.00)	00 (0.00)	00 (0.00)	275 (100.00)	00 (00.00)	00 (00.00)
	c. Suckers are treated with *Trichoderma* @200 gm in 15-20l water for 10 minutes before planting	00 (0.00)	00 (0.00)	175 (100.00)	00 (0.00)	00 (0.00)	70 (100.00)	00 (0.00)	00 (0.00)	30 (100.00)	00 (00.00)	00 (00.00)	275 (100.00)
	a. 2% neem oil mixed with any detergent powder @40-50g/100l is sprayed.	00 (0.00)	00 (0.00)	175 (100.00)	00 (0.00)	00 (0.00)	70 (100.00)	00 (0.00)	00 (0.00)	30 (100.00)	00 (00.00)	00 (00.00)	275 (100.00)
14.	**Harvesting** a. The fruits are harvested 15-20 months after planting	175 (100.00)	00 (0.00)	00 (0.00)	45 (64.29)	25 (35.71)	00 (0.00)	29 (96.67)	01 (3.33)	00 (0.00)	181 (65.82)	94 (34.18)	00 (00.00)
	b. Fruits are harvested when the fruit turns yellow at the base and angularities of eyes start reducing and the bract withers	175 (100.00)	00 (0.00)	00 (0.00)	70 (100.00)	00 (0.00)	00 (0.00)	30 (100.00)	00 (0.00)	00 (0.00)	275 (100.00)	00 (00.00)	00 (00.00)
	c. Matured fruits are harvested by breaking/ cutting the stalk a few cm below the fruit	175 (100.00)	00 (0.00)	00 (0.00)	70 (100.00)	00 (0.00)	00 (0.00)	30 (100.00)	00 (0.00)	00 (0.00)	275 (100.00)	00 (00.00)	00 (00.00)
15.	**Ratooning** a. Desuckering is done												

	immediately after harvest leaving 1-2 suckers on the mother plant.	175 (100.00)	00 (0.00)	00 (0.00)	70 (100.00)	00 (0.00)	00 (0.00)	30 (100.00)	00 (0.00)	00 (0.00)	275 (100.00)	00 (00.00)	00 (00.00)
	b. Proper fertilization and earthing up is done for good anchorage of the ratoon crop.	49 (28.00)	126 (72.00)	00 (0.00)	15 (21.43)	55 (78.57)	00 (0.00)	15 (50.00)	15 (50.00)	00 (0.00)	79 (28.73)	196 (71.27)	00 (00.00)
16.	**Storage** a. Harvested fruits are well ventilated and kept in shade/cool place for long storage.	175 (100.00)	00 (0.00)	00 (0.00)	70 (100.00)	00 (0.00)	00 (0.00)	30 (100.00)	00 (0.00)	00 (0.00)	275 (100.00)	00 (00.00)	00 (00.00)
	b. Harvested fruits are protected against pest and disease infestation during storage.	175 (100.00)	00 (0.00)	00 (0.00)	70 (100.00)	00 (0.00)	00 (0.00)	30 (100.00)	00 (0.00)	00 (0.00)	275 (100.00)	00 (00.00)	00 (00.00)
17.	**Post harvest management** a. Harvested fruits are sorted and graded according to shape and size.	175 (100.00)	00 (0.00)	00 (0.00)	70 (100.00)	00 (0.00)	00 (0.00)	30 (100.00)	00 (0.00)	00 (0.00)	275 (100.00)	00 (00.00)	00 (00.00)
	b. Clean bamboo baskets are used for packing the harvested fruits.	175 (100.00)	00 (0.00)	00 (0.00)	70 (100.00)	00 (0.00)	00 (0.00)	30 (100.00)	00 (0.00)	00 (0.00)	275 (100.00)	00 (00.00)	00 (00.00)
18.	**Value addition** a. KMS, sugar and citric acid are used as preservatives during pineapple squash, juice and jam preparation.	26 (14.86)	16 (9.14)	133 (76.00)	08 (11.43)	04 (5.71)	58 (82.86)	02 (6.67)	04 (13.33)	24 (80.00)	36 (13.09)	24 (8.73)	215 (78.18)
	b. Finished product is stored in sterilized bottles.	30 (17.14)	10 (5.72)	135 (77.14)	11 (15.71)	01 (1.43)	58 (82.86)	02 (6.67)	04 (13.33)	24 (80.00)	43 (15.64)	15 (5.45)	217 (78.91)

4.3.2 Overall adoption of sustainable cultivation practices of pineapple

Table 4.3.2 and Fig 4.3.2 revealed that more than half of the respondents from Dimapur (65.71%), Peren (68.57%) and Mokokchung (50.00%) districts had medium level of overall adoption of sustainable cultivation practices of pineapple. 19.43 per cent and 14.86 per cent of the respondents from Dimapur district had high level followed by low level of overall adoption of sustainable cultivation practices of pineapple. 24.29 per cent and 7.14 per cent of the respondents from Peren district had low and high level of overall adoption of sustainable cultivation practices of pineapple respectively. It was also found that half (50.00%) of the respondents from Mokokchung district had high level of overall adoption of sustainable cultivation practices of pineapple. The consolidated data showed that 64.73 per cent of the respondents had medium level followed by high (19.63%) and low (15.64%) level of overall adoption of sustainable cultivation practices of pineapple. Similar findings were observed by Chanu *et al.* (2014), Marak *et al.* (2015), Jamir and Jahanara (2019), Patra and Kense (2020) and Lotha and Jha (2022).

Table 4.3.2: Overall adoption of sustainable cultivation practices of pineapple by the respondents

Level of adoption	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Low (Less than 47.28)	26 (14.86)	17 (24.29)	00 (0.00)	43 (15.64)
Medium (47.28 – 57.66)	**115 (65.71)**	**48 (68.57)**	**15 (50.00)**	**178 (64.73)**
High (More than 57.66)	34 (19.43)	05 (7.14)	15 (50.00)	54 (19.63)
Mean Adoption Index	52.47	50.28	57.56	52.47
SD	5.14	4.26	3.86	5.19

Figures in parentheses indicate the percentage (%) of the respondents

4.3.3 Comparative account of adoption of sustainable cultivation practices among the districts

A perusal of Table 4.3.3 showed that the z value between Dimapur and Peren districts was 3.435 which indicated a relatively large deviation from the mean. The p value of less than 0.01 suggested that the observed difference between the two districts is statistically significant. It was also found that the z value of -5.845 and p value of less than 0.01 indicated a significant difference between Dimapur and Mokokchung district. Similarly, the z value between Peren and Mokokchung districts was -7.334 which was found to be statistically significant at less than 0.01 p value.

Table 4.3.3: Comparative account of adoption of sustainable cultivation practices among the districts

Sl. No.	Name of the district	Mean Adoption Index	Z value	P value
1.	Dimapur	52.47	3.435	$< 0.01^{*}$
	Peren	50.28		
2.	Dimapur	52.47	-5.845	$< 0.01^{*}$
	Mokokchung	57.56		
3.	Peren	50.28	-7.334	$< 0.01^{*}$
	Mokokchung	57.56		

* - Significant at 1 %

4.3.4 Relationship between independent variables and adoption level of the pineapple growers

Table 4.3.4 exhibited the socio-economic and psychological characteristics of the respondents with the adoption level of the pineapple growers. Among the variables studied, sixteen variables, *viz.* age, education, social participation, sources of information utilization, decision making ability, achievement motivation, size of land holding under agriculture, size of land holding under pineapple, annual income, employment generated, economic motivation, management orientation, IPM, INM, training exposure and experience were found to have significant relationship with the adoption level of the respondents.

Age: It was evident from the Table 4.3.4 that variable age was found to have negative but significant relationship with the adoption level of the respondents. It could be inferred that lesser the age, more is the adoption of the sustainable cultivation practices of pineapple. This might be due to the fact that younger farmers are more energetic and active and hence they are able to adopt the sustainable practices. This was in conformity with the findings of Jamir and Jahanara (2019) and Warshini *et al.* (2022).

Education: Education revealed a positive and significant relationship with the adoption level of the respondents. This might be due to the fact that education aid in acquisition and understanding of sustainable cultivation practices of pineapple. The knowledge gained might have helped them made better aware of the sustainable cultivation practices and help them adopt it. Similar finding was observed in the findings of Chanu *et al.* (2014), Jamir and Jahanara (2019), Patra and Kense (2020) and Warshini *et al.* (2022).

Social participation: Social participation had a positive and significant relationship with the adoption level of the respondents. The reason might be farmers involving in social organizations and groups had more opportunities of getting exposed to different sources of sustainable agricultural practices which might have led to adoption of new technologies. This finding was supported by the findings of Patra and Kense (2020).

Sources of information utilization: Table 4.3.4 indicated that there was positive and significant relationship between sources of information utilized and adoption level of the pineapple growers. The probable reason could be farmers who frequently use different sources of information get information from various sources which broadens the understanding and awareness of sustainable agricultural practices. This might have helped the farmers in adopting the sustainable cultivation practices of pineapple. The finding in was in accordance with the findings of Jamir and Jahanara (2019), Patra and Kense (2020) and Warshini *et al.* (2022).

Decision making ability: It was found that decision making ability and adoption level of the pineapple growers had positive and significant relationship. Decision making is very important for agricultural management which help in making better returns from agriculture and activities, information seeking and knowledge utilization. Farmers with strong decision making ability were more likely to adopt new technologies and innovations. This might have helped the pineapple growers in adopting the sustainable cultivation practices of pineapple.

Achievement motivation: It was found that achievement motivation had a positive and significant relationship with the adoption level of the respondents. Farmers with high achievement motivation are more likely open to new ideas and tend to take risk in adopting the innovative technologies and practices. They are inclined towards improving their farming methods, increase productivity and achieve optimum agricultural success. These probable reasons influenced the pineapple growers in adopting sustainable cultivation practices of pineapple.

Size of landholding under agriculture and pineapple cultivation: These variables exhibited positive and significant relationship with the adoption level of the respondents. This positive relationship might be due to the fact that pineapple growers possessing large size of landholdings enabled them to try new and suitable sustainable cultivation practices and implement them in their farm. The findings were in line with the findings of Marak *et al.* (2015), Jamir and Jahanara (2019), Patra and Kense (2020), Kakki *et al.* (2022), Lotha and Jha (2022) and Warshini *et al.* (2022).

Annual income: Annual income and the adoption level of the respondents showed positive and significant relationship which indicated that pineapple growers who were economically sound were able to get better access to resources such as extension services, credit and market opportunities. Farmers with higher income had the greater capacity to invest in new technologies, tools and inputs. These factors might have helped the pineapple growers in adopting sustainable cultivation practices of pineapple. This finding was in line with the findings of Chanu *et al.* (2014), Marak *et al.* (2015), Patra and Kense (2020), Kakki *et al.* (2022) and Warshini *et al.* (2022).

Employment generated: This variable exhibited positive and significant relationship with the adoption level of the respondents. This might be due to the fact that on hiring additional workers in their field, the hired workers may introduce new experiences and expertise which contribute to the adoption of suitable sustainable cultivation practices.

Economic motivation: It was observed that economic motivation had a positive and significant relationship with the adoption level of the pineapple growers. Respondents with higher economic motivation would tend to acquire relevant and latest agricultural practices to get maximum yield and improve their income level which result in higher adoption of sustainable cultivation practices of pineapple. The finding was in conformity with the findings of Marak *et al.* (2015).

Management orientation: This variable was found to have positive and significant relationship with the adoption level of the respondents. Farmers with higher management orientation generally tend to seek new technologies and practices, maintain good rapport with extension workers and participate in agricultural programmes and organizations. Hence, their active approach evolves in higher adoption of sustainable cultivation practices.

Integrated Pest Management (IPM): IPM and adoption level of the pineapple growers had a positive and significant relationship. Respondents with higher knowledge on IPM had higher adoption level of sustainable cultivation practices of pineapple. This may be due to the fact that these farmers have knowledge about the adverse negative impacts of pesticides and chemical use and the benefits of biodiversity conservation which influence in adoption of the sustainable agricultural practices.

Integrated Nutrient Management (INM): There was a positive and significant relationship observed between the INM and adoption level of the respondents. This indicated that respondents with higher knowledge on INM had higher adoption level due to the fact that they have better understanding on the importance of balanced nutrient management, soil health and its enhanced effects on agricultural productivity. This might have influenced the respondents in adopting sustainable cultivation practices.

Training exposure: It was further found that training exposure had a positive and significant relationship with the adoption level of the respondents. Respondents with higher training exposure had higher adoption level of sustainable cultivation practices of pineapple. Training programmes provide farmers with relevant knowledge, information and technical skills about innovative agricultural technologies and innovations, credits, schemes and extension resources. These are the probable reasons for influencing the adoption of sustainable cultivation of pineapple. Similar findings were also reported by Patra and Kense (2020) and Kakki *et al.* (2022).

Experience: It was also revealed that experience in pineapple cultivation had a positive and significant relationship with the adoption level of the respondents.Respondents with more experience had a deeper understanding of the agricultural practices and the local conditions. They have accumulated knowledge and expertise through years of experience in the field and learning through trial and error. These knowledges acquired might have positively influenced the adoption level of the pineapple growers as they are able to analyse the pros and cons of the new agricultural practices. This is in conformity with the findings of Jamir and Jahanara (2019), Patra and Kense (2020), Lotha and Jha (2022) and Warshini *et al.* (2022).

Table 4.3.4: Relationship between independent variables and adoption level of the respondents

Sl. No.	Independent variables	Pearson correlation	p - value
1.	Age	-0.158**	0.009
2.	Family size	0.049	0.423
3.	Occupation	-0.009	0.88
4.	Education	0.148*	0.014
5.	Input self sufficiency	-0.058	0.338
6.	Social participation	0.175**	0.004
7.	Sources of information utilization	0.339**	< 0.01
8.	Innovativeness	0.031	0.607
9.	Risk bearing ability	0.062	0.302
10.	Market innovativeness	-0.06	0.321
11.	Decision making ability	0.144*	0.017
12.	Achievement motivation	0.182**	0.002
13.	Size of land holding under agriculture	0.249**	< 0.001
14.	Size of land holding under pineapple	0.341**	< 0.001
15.	Annual income	0.240**	< 0.001
16.	Profitability	0.035	0.559
17.	Productivity	0.072	0.234
18.	Employment generated	0.338*	< 0.001
19.	Economic motivation	0.294**	< 0.001
20.	Market orientation	-0.056	0.358
21.	Management orientation	0.201**	0.001
22.	IPM	0.356**	< 0.001
23.	INM	0.243**	< 0.001
24.	Extension contact	0.073	0.229
25.	Training exposure	0.131*	0.03
26.	Experience	0.247**	< 0.01
27.	Scientific orientation	0.105	0.084

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

*Correlation is significant at the 0.05 level (2- tailed)

Variables namely, age, education, social participation, sources of information utilization, decision making ability, achievement motivation, size of land holding under agriculture, size of land holding under pineapple, annual income, employment generated, economic motivation, management orientation,IPM, INM, training exposureand experience were found significant. Therefore,

H_o2: There is no association between age, education, social participation, sources of information utilization, decision making ability, achievement motivation, size of land holding under agriculture, size of land holding under pineapple, annual income, employment generated, economic motivation, management orientation, IPM, INM, training exposure and experience with *extent of adoption* of sustainable pineapple cultivation practices was rejected.

Variables, *viz.* farm size, occupation, input self sufficiency, innovativeness, risk bearing ability, market innovativeness, profitability, productivity, market orientation and extension contact were found non significant. Therefore,

H_o2_a: There is no association between the variables farm size, occupation, input self sufficiency, innovativeness, risk bearing ability, market innovativeness, profitability, productivity, market orientation and extension contact with *extent of adoption* of sustainable pineapple cultivation practices was accepted.

4.3.5 Multiple regression of the independent variables with the adoption level of the pineapple growers

Table 4.3.5 indicated the multiple regression model where R^2 value was 0.449. It could be inferred that the variables age, education, sources of information utilization, decision making ability, achievement motivation, profitability, employment generated, economic motivation, market orientation, management orientation, IPM, INM and experience explained and contributed to the extent of 44.9 per cent of the variation in the adoption of sustainable cultivation practices of pineapple. The table further revealed that the predictor variables, *viz.* age, education, sources of information utilization, decision making ability, achievement motivation, employment generated, market orientation, IPM, INM and experience were found to have significantly contributed to the adoption of sustainable cultivation practices of pineapple.

Table 4.3.5: Multiple linear regression of independent variables with Adoption

Sl. No.	Variables	Regression coefficient	't' value	'p' value
1.	Age	0.053*	2.167	0.031
2.	Education	0.694**	2.656	0.008
3.	Sources of information utilization	0.374**	3.194	0.002
4.	Decision making ability	0.329**	2.108	0.036
5.	Achievement motivation	-0.392**	-3	0.003
6.	Profitability	-3.45E-05	-1.792	0.074
7.	Employment generated	0.033**	3.311	0.001
8.	Economic motivation	0.295	1.793	0.074
9.	Market orientation	-0.685**	-2.756	0.006
10.	Management orientation	0.213	1.706	0.089
11.	IPM	0.562**	5.933	< 0.001
12.	INM	0.185**	3.395	0.001
13.	Experience	0.191**	3.215	0.001

R^2 = 0.449 F = 16.362**(p- value = < 0.001) E-05 = 10^{-5}

** Significant at 1% level * Significant at 5% level

4.4. Technological gap in adoption of sustainable cultivation practices among the pineapple growers

Table 4.4.1(a) revealed the practise wise technological gap in adoption of sustainable cultivation practices of pineapple among the respondents from Dimapur district. According to obtainable and obtained mean score, 100.00 per cent mean technological gap was observed in treatment of planting material, growth regulator and was ranked first, 93.00 per cent gap was found in practice of manuring and ranked second, 88.5 per cent, 81.00 per cent,80.25 per cent mean technological gap observed in irrigation, cropping pattern and value addition which were ranked third, fourth and fifth respectively. Integrated pest management and disease management (53.94%), plant population (48.00%), land preparation (46.00%), varieties (45.75%) were ranked sixth, seventh, eight and ninth in the mean technological gap. Further, it was found that no (0.00%) technological gap was observed in practices of propagation, storage and post harvest management.

The overall mean technological gap in adoption of sustainable cultivation practices of pineapple followed by the respondents from Dimapur district observed was 46.71per cent.

Table 4.4.1(a): Practice-wise technological gap among the respondents from Dimapur district on sustainable cultivation practices of pineapple

Sl. No.	Practices	Maximum obtainable score	Obtained mean score	% of technological gap	Rank
1.	Land Preparation	4	2.16	46.00	VIII
2.	Varieties	4	2.17	45.75	IX
3.	Propagation	2	2	0.00	XV
4.	Treatment of planting material	4	0	100.00	I
5.	Spacing	4	2.38	40.5	X
6.	Plant population	4	2.08	48.00	VII
7.	Planting	2	1.97	1.5	XIV
8.	Manuring	6	0.42	93.00	II
9.	Irrigation	2	0.23	88.5	III
10.	Cropping pattern	4	0.76	81.00	IV
11.	Intercultural operations	8	4.98	37.75	XI
12.	Growth regulator	2	0	100.00	I
13.	Integrated Pest Management (IPM) and Disease Management(DM)	18	8.29	53.94	VI
14.	Harvesting	6	5.61	6.5	XIII
15.	Ratooning	4	3.28	18.00	XII
16.	Storage	4	4	0.00	XV
17.	Post Harvest Management	4	4	0.00	XV
18.	Value addition	4	0.79	80.25	V
	Overall	86	45.12	46.71	

Table 4.4.1(b) showed that the mean technological gap among the respondents from Peren district in respect of adoption of sustainable cultivation practices of pineapple ranged from 100.00 to 2.00 per cent. It also showed that

practices such as propagation, storage and post-harvest management were fully adopted by the respondents. The highest mean technological gap (100.00%) was observed in the practices of treatment of planting material and growth regulator and ranked first. Second, third and fourth mean technological gap was observed in the practices of manuring (95.33%), irrigation (91.5%) and cropping pattern (85.00%). Mean technological gap in case of practices valueaddition (84.75%), plant population (58.5%), integrated pest management and disease management (56.62%) practices were ranked fifth, sixth and seventh respectively. The eighth, ninth and tenthmean technological gap was further revealed in the practices of spacing (48.00%), land preparation (45.5%), intercultural operations (42.12%) and varieties (40.5%). Low mean technological gap was reported in practices such as ratooning (19.75%), harvesting (6.00%), IPM and DM (2.37%) and propagation (2.00%).

The overall mean technological gap in case of respondents from Peren district was 45.63 per cent with an overall obtained mean score of 43.21.

Table 4.4.1(b): Practice-wise technological gap among the respondents from Peren district on sustainable cultivation practices of pineapple

Sl. No.	Practices	Maximum obtainable score	Obtained mean score	% of mean technological gap	Rank
1.	Land Preparation	4	2.18	45.5	IX
2.	Varieties	4	2.38	40.5	XI
3.	Propagation	2	2	0.00	XV
4.	Treatment of planting material	4	0	100.00	I
5.	Spacing	4	2.08	48.00	VIII
6.	Plant population	4	1.66	58.5	VI
7.	Planting	2	1.96	2.00	XIV
8.	Manuring	6	0.28	95.33	II
9.	Irrigation	2	0.17	91.5	III
10.	Cropping pattern	4	0.6	85.00	IV
11.	Intercultural operations	8	4.63	42.12	X
12.	Growth regulator	2	0	100.00	I
13.	Integrated Pest Management (IPM) and Disease Management (DM)	18	7.81	56.62	VII

14.	Harvesting	6	5.64	6.00	XIII
15.	Ratooning	4	3.21	19.75	XII
16.	Storage	4	4	0.00	XV
17.	Post Harvest Management	4	4	0.00	XV
18.	Value addition	4	0.61	84.75	V
	Overall	86	43.21	48.64	

Table 4.4.1(c) exhibited the practice wise technological gap on adoption of sustainable cultivation practices of pineapple among the respondents from Mokokchung district. Based on the maximum obtainable score and obtained mean score, the highest technological gap (100.00%) was observed in practices such as treatment of planting material and growth regulator. The second, third and fourth mean technological gap was found in the practices of value addition (88.25%), irrigation (86.5%) and manuring (78.33%) respectively. 52.39 per cent, 50.75 per cent mean technological gap was reported in the practices such as integrated pest management and disease management, plant population and cropping pattern and were ranked fifth, sixth and seventh respectively.

It was also found that there were 50.00 per cent, 49.25 per cent, 37.5 per cent mean technological gap in the practice of varieties, spacing and land preparation with eight, ninth and tenth rank respectively. Negligible mean technological gap was found in the practices of planting (0.75%) and harvesting (0.5%).

While, zero mean technological gap (0.00%) was observed in the practices of storage and post-harvest management. The overall technological gap was 44.85 and 47.06 as obtained mean score.

Table 4.4.1(c): Practice-wise technological gap among the respondents from Mokokchung district on sustainable cultivation practices of pineapple

Sl. No.	Practices	Maximum obtainable score	Obtained mean score	% of mean technological gap	Rank
1.	Land Preparation	4	2.5	37.5	X
2.	Varieties	4	2	50.00	VIII
3.	Propagation	2	2	0.00	XV

4.	Treatment of planting material	4	0	100.00	I
5.	Spacing	4	2.03	49.25	IX
6.	Plant population	4	1.97	50.75	VI
7.	Planting	2	1.97	0.75	XIII
8.	Manuring	6	1.3	78.33	IV
9.	Irrigation	2	0.27	86.5	III
10.	Cropping pattern	4	1.97	50.75	VII
11.	Intercultural operations	8	5.07	36.63	XI
12.	Growth regulator	2	0	100.00	I
13.	Integrated Pest Management (IPM) and Disease Management(DM)	18	8.57	52.39	V
14.	Harvesting	6	5.97	0.5	XIV
15.	Ratooning	4	2.97	25.75	XII
16.	Storage	4	4	0.00	XV
17.	Post Harvest Management	4	4	0.00	XV
18.	Value addition	4	0.47	88.25	II
	Overall	86	47.06	44.85	

Table 4.4.1(d) reflected the practice wise overall technological gap among the respondents. Based on maximum obtainable score and obtained mean score of 86 and 44.67, the highest (100.00%) mean technological gap was observed in the practices of treatment of planting material and growth regulator. This gap may be due to lack of knowledge and awareness of the benefits of these practices. The second, third, fourth and fifth mean technological gap was reported in case of manuring (92.00%), value addition (82.25%), cropping pattern (78.75%) and irrigation (78.00%). The probable reason may be due to lack of awareness on nutrient deficiency of pineapple, nutrient requirement and doses and application of nutrients and financial constraint. In case of value addition, it may be due to lack of knowledge, lack of labour and time during peak season to harvest the fruits, take care of the household chores and also due to lack of post-harvest infrastructures. It was also observed that a number of the respondents practiced monocropping of pineapple cultivation. So, this might be the reason behind the gap. The

respondents practiced rainfed pineapple cultivation. Most of them were dependent on rainwater for irrigation purposes.

In case of Insect Pest Management and disease management, the respondents had a mean technological gap of 54.45 per cent. It was found that the respondents had no knowledge about biocontrol method. The farmers found setting up of traps and poison baits in the field intensive and therefore, the gap was observed.

Mean technological gap for plant population and spacing was 51.00 per cent and 43.5 per cent with a ranking of seventh and tenth respectively. The farmers adopted double spacing, single spacing and triangle shaped spacing. The spacing was not the recommended spacing but with a little variation in the distances between the plants gained from their experiences and also according to their size of landholding.

49.25 per cent mean technological gap was found in the practice of land preparation and was ranked eight. It was found that the most common method of initial clearing of the land for plantations was by slash and burn method. The respondents also practised direct digging of pits and planting the suckers and slips depending upon the topography of their field. Some of the respondents filled the pits with manures.

The mean gap in terms of varieties used was 44.5 per cent and ranked ninth. It was observed that some of the respondents planted Queen, Kew and Giant Kew varieties while some used only one variety and some two varieties. This might be the reason for the gap in application of varieties.

The mean technological gap for intercultural operations was 38.88 per cent and ranked eleventh. It was found that the respondents used paddy straw to cover the pineapple plants for preventing sunburn. The respondents who also cultivated paddy adopted it. Mulching with black polythene was not adopted due to financial constraint and also some of the respondents were of the opinion that using black polythene causes higher retention of water content in the fruit which leads to shorter shelf life of the fruit. Minimal mean technological gap was observed in case of planting (1.5%) and harvesting (5.67%).

Similar findings in practices of treatment of planting material, fertilizer application and micro nutrient application, growth regulators, irrigation and pest control were reported by Roy *et al.* (2013), Das *et al.* (2017), Roy and Bandyopadhyay (2019), Rhonben *et al.* (2021), Shah *et al.* (2022) and Hiwarale *et al.* (2023).

The overall mean technological gap of the respondents with an obtained mean score of 44.67 was 46.61 per cent.

Table 4.4.1(d): Overall practice-wise technological gap among the respondents on sustainable cultivation practices of pineapple

Sl. No.	Practices	Maximum obtainable score	Obtained mean score	% of mean technological gap	Rank
1.	Land Preparation	4	2.03	49.25	VIII
2.	Varieties	4	2.21	44.5	IX
3.	Propagation	2	2	0.00	XV
4.	Treatment of planting material	4	0	100.00	I
5.	Spacing	4	2.26	43.5	X
6.	Plant population	4	1.96	51.00	VII
7.	Planting	2	1.97	1.5	XIV
8.	Manuring	6	0.48	92.00	II
9.	Irrigation	2	0.22	78.00	V
10.	Cropping pattern	4	0.85	78.75	IV
11.	Intercultural operations	8	4.89	38.88	XI
12.	Growth regulator	2	0.00	100.00	I
13.	Integrated Pest Management (IPM) and Disease Management (DM)	18	8.2	54.45	VI
14.	Harvesting	6	5.66	5.67	XIII
15.	Ratooning	4	3.23	19.25	XII
16.	Storage	4	4	0.00	XV
17.	Post Harvest Management	4	4	0.00	XV
18.	Value addition	4	0.71	82.25	III
	Overall	86	44.67	46.61	

4.4.1 (e) Overall technological gap of the respondents

Table 4.4.1(e) and Fig 4.4.1(e) depicted the overall technological gap of the respondents. In case of respondents from Dimapur, more than half (65.14%) of the respondents had medium level of technological gap while 20.00 per cent and 14.86 per cent had low and high level of technological gap respectively.

For respondents from Peren district, majority (70.00%) of the respondents had medium level of technological gap followed by high (24.29%) and low (5.71%) technological gap.

It was also found that half (50.00%) of the respondents had medium level technological gap and the other half (50.00%) had low level

The pooled data further revealed that more than half (64.73%) of the respondents had medium level of technological gap while 19.64 per cent had low level and 15.63 per cent had high level of technological gap. These findings were in line with the findings of Yomgam *et al.* (2019), Shah *et al.* (2022), Hiwarale *et al.* (2023) and Jadhav *et al.* (2023).

Table 4.4.1(e): Distribution of the respondents based on their overall technological gap

Category of technological gap according to land size	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Low gap (< 28.34)	35 (20.00)	04 (5.71)	15 (50.00)	54 (19.64)
Medium gap (28.34 – 38.72)	**114 (65.14)**	**49 (70.00)**	**15 (50.00)**	**178 (64.73)**
High gap (> 38.72)	26 (14.86)	17 (24.29)	00 (0.00)	43 (15.63)
Mean TG Index	33.47	35.72	28.44	33.53
SD	5.22	4.26	3.86	5.19

Figures in parentheses indicate the percentage (%) of the respondents

4.4.2 Comparative account of technological gap of sustainable pineapple cultivation among the districts

Table 4.4.2 displayed the comparison of technological gap in sustainable pineapple cultivation among the three districts. The z value and p value between Dimapur and Peren districts were -3.505 and less than 0.01 respectively. This indicated that significant difference existed between these two districts at a significance level of 0.01. The z value between Dimapur and Mokokchung districts was 6.31 and the associated p value was less than 0.01 which suggested its significance at a level below 0.01. Additionally, the z value between Peren and Mokokchung districts was 8.481 with a p value less than 0.01and indicated a statistically significant difference between the two districts.

Table 4.4.2: Comparative account of technological gap on sustainable pineapple cultivation among the districts

Sl. No.	Name of the district	Mean Technological gap Index	SD	Z value	P value
1.	Dimapur	33.47	5.22	-3.505	< 0.01*
	Peren	35.72	4.26		
2.	Dimapur	33.47	5.22	6.31	< 0.01*
	Mokokchung	28.44	3.86		
3.	Peren	35.72	4.26	8.481	< 0.01*
	Mokokchung	28.44	3.86		

* - Significant at 1 %

4.4.3 Relationship between independent variables and technological gap of pineapple growers

Table 4.4.3 depicted the relationship between the independent variables and technological gap of the respondents. Variable age showed positive and significant relationship with the technological gap of the respondents. The variables education, social participation, sources of information utilization, decision making ability, size of land holding under agriculture, size of land holding under pineapple cultivation, annual income, employment generated, economic motivation, management orientation, IPM, INM, training exposure and experience showed negative and significant relationship with the technological gap of the pineapple farmers.

Age: Age was positively significant with the technological gap of the respondents. This indicated that with increase in age, there is increase in technological gap of the respondents regarding sustainable cultivation practices of pineapple. Older farmers generally have lesser access to information and resources, lesser exposure to modern agricultural practices and innovations, exhibit resistance to change compared to younger farmers. Generational gap also arises during technology dissemination and transfer. Most of the respondents were found middle and old aged. These factors might have contributed to this finding. This was supported by the findings of Sanghavi and Ekale (2021).

Education: There was negative and significant relationship of education with the technological gap of the respondents. This implied that with increase in education, technological gap decreases. Education helps in mental and psychological ability to understand, grasp new ideas, decide and practice. This might be due to the fact that educated pineapple growers were able to understand the scientific agricultural practices and practically apply it in their field situation. Similar findings were observed by Roy *et al.* (2013), Yomgam *et al.* (2019), Shah *et al.* (2022), Hiwarale *et al.* (2023) and Jadhav *et al.* (2023).

Social participation: It exhibited a negative and significant relationship with the technological gap of the respondents. This might be due to the fact that wider and better social contacts with organisations, institutions and progressive farmers might helped them in getting more exposure to new skills, knowledge and technologies resulting in developing favourable attitude and decrease in technological gap. This finding was in conformity with the findings of Roy *et al.* (2013), Hiwarale *et al.* (2023) and Jadhav *et al.* (2023).

Sources of information utilization: It was found that there was negative and significant relationship between sources of information utilization and technological gap of the respondents. This indicated that the use of various communication sources facilitates the individual in gathering relevant information on agricultural technologies and innovations which could be efficiently incorporated in his farm. This inference was found to be in agreement with Hiwarale *et al.* (2023).

Decision making ability: This variable was found to have negative and significant relationship with the technological gap of the pineapple growers. It could be inferred that farmers who possess better decision making abilities are more likely more open to learn new practices, they are able to comprehend better the information and technologies disseminated to them and prioritize on the needs that maximises the benefits of adopting the technologies ultimately reducing the technological gap in the process.

Size of land holding under agriculture and pineapple cultivation: These variables were negatively significant with the technological gap of the respondents. It may be due to the fact that farmers with larger land holdings generally have stable financial resources, which can be utilized for purchasing advanced machineries, tools and equipment. Also, they have more opportunities to try and adopt a variety of relevant technologies in their farm. The respondents with larger land holdings may show keen interest to know and learn about new farm practices which could be adopted in their field and in turn lead to decrease in technological gap. This finding was in accordance with the result of Roy *et al.* (2013), Shah *et al.* (2022) and Jadhav *et al.* (2023).

Annual income: There was a negative and significant relationship between annual income and technological gap of the respondents. This indicated that the pineapple growers with more annual income were able to sustain their pineapple cultivation as they were able to adopt and utilize advanced agricultural technologies and practices in their farms as they were financially sound and could afford the expenses. This reasoning was found to be in agreement with Shah *et al.* (2022) and Hiwarale *et al.* (2023).

Employment generated: This variable showed negative and significant relationship with the technological gap of the respondents. This might be due to the fact the pineapple growers generating employment opportunities may serve as an indicator of higher level of financial stability leading to sustainable technology adoption in their farms and reduction in technology gap.

Economic motivation: A perusal of the table revealed that there was a negative and significant relationship with the technological gap of the respondents. Economic motivation is the desire of the farmers which is oriented towards maximum economic returns or improve their financial well-being. The negative and significant relationship between economic motivation and technological gap of the respondents might imply that with higher economic motivation, higher will be the adoption rate and technological gap will eventually decrease. This finding was supported by Shah *et al.* (2022) and Jadhav *et al.* (2023).

Management orientation: Management orientation exhibited negative and significant relationship with the technological gap of the respondents. Management orientation has been operationally defined as the degree to which a farmer is oriented towards scientific farm management comprising of planning, production and marketing functions of the farm. Management orientation refers to the degree to which a farmer is oriented towards effective scientific farm management. It may be inferred that the respondents who adopted a more strategic approach in farm management were more likely to adopt scientific technologies and innovations.

Integrated Pest Management (IPM): IPM was found to have a negative and significant relationship with the technological gap of the respondents. This implied that with adoption of IPM practices, the technological gap decreases. The possible reason could be that the respondents who integrated IPM practices were more likely to adopt relevant technologies and innovations into their pineapple farming.

Integrated Nutrient Management (INM): There was negative and significant relationship between Integrated Nutrient Management and technological gap of the respondents. This inferred that increase in adoption of INM practices, technological gap decreases.

Training exposure: It was evident from the table that variable training exposure had negative and significant relationship with the technological gap of the respondents. Participation in training programmes, workshops, seminar and field trips enables farmers to give exposure to a wide variety of agricultural practices, innovations, knowledge and information. This implied that training programmes played a pivotal role in bridging the gap by enriching the farmers with knowledge and needed for sustainable cultivation practices of pineapple.

Experience: Experience in pineapple cultivation was found to be negatively significant with the technological gap of the respondents. It indicated that respondents with more experience had lesser technological gap. This might be due to the fact that the longer a pineapple farmer is engaged in pineapple cultivation, the more knowledge and skills he gains over the years and build up confidence to adopt technologies and innovations related to sustainable cultivation practices of pineapple efficiently. Similar finding was observed by Shah *et al.* (2022).

Table 4.4.3: Relationship between independent variables and technological level of the respondents

Sl. No.	Independent variables	Pearson correlation	p - value
1.	Age	0.167**	0.006
2.	Family size	-0.041	0.499
3.	Occupation	0.012	0.841
4.	Education	-0.140*	0.021
5.	Input self sufficiency	0.053	0.381

6.	Social participation	-0.173**	0.004
7.	Sources of information utilization	-0.341**	< 0.001
8.	Innovativeness	-0.042	0.492
9.	Risk bearing ability	-0.062	0.307
10.	Market innovativeness	0.055	0.368
11.	Decision making ability	-0.142*	0.018
12.	Achievement motivation	-0.174**	0.004
13.	Size of land holding under agriculture	-.253**	< 0.001
14.	Size of land holding under pineapple	-0.345**	< 0.001
15.	Annual income	-0.243**	< 0.001
16.	Profitability	-0.036	0.558
17.	Productivity	-0.076	0.208
18.	Employment generated	-0.343**	< 0.001
19.	Economic motivation	-0.291**	< 0.001
20.	Market orientation	0.051	0.395
21.	Management orientation	-0.215**	< 0.001
22.	IPM	-0.358**	< 0.001
23.	INM	-0.235**	< 0.001
24.	Extension contact	-0.084	0.167
25.	Training exposure	-0.122*	0.044
26.	Experience	-0.274**	< 0.001
27.	Scientific orientation	-0.104	0.085

**Correlation is significant at the 0.01 level (2- tailed)
*Correlation is significant at the 0.05 level (2- tailed)

4.4.4 Multiple regression of the independent variables with the technological gap of the pineapple growers

The perusal of the data presented in Table 4.4.4 revealed that out of the twelve variables fitted into the regression analysis, all the variables namely, age, education, sources of information utilization, decision making ability, achievement motivation, productivity, employment generated, market orientation, management orientation, Integrated Pest Management, Integrated Nutrient Management and experience significantly contributed to the prediction of technological gap of the respondents and may be considered as good predictors of technological gap.

The R^2 value of 0.455 depicted that all the selected twelve variables jointly contributed 45.5 per cent towards variation in the technological gap of the pineapple growers. Hence, these variables were significantly effective in predictingthe extent of technological gap of the respondents.

Table 4.4.4: Multiple linear regression of independent variables with technological gap

Sl. No.	Variables	Regression coefficient	't' value	'p' value
1.	Age	-0.05*	-2.04	0.042
2.	Education	-0.684**	-2.625	0.009
3.	Sources of information utilization	-0.426**	-3.626	< 0.001
4.	Decision making ability	-0.33*	-2.107	0.036
5.	Achievement motivation	0.434**	3.388	0.001
6.	Productivity	0.067*	2.26	0.025
7.	Employment generated	-0.033**	-3.554	< 0.001
8.	Market orientation	0.827**	3.382	0.001
9.	Management orientation	-0.354**	-2.879	0.004
10.	IPM	-0.55**	-5.736	< 0.001
11.	INM	-0.211**	-3.939	< 0.001
12.	Experience	-0.226**	-3.799	< 0.001

$R^2 = 0.455$ F = 18.227 (p- value = < 0.001)

** Significant at 1% level * Significant at 5% level

4.7.1 Attitude of pineapple growers towards adoption of sustainable cultivation practices of pineapple

A quick view of Table 4.5.1 and Fig 4.5.1 showed the level of attitude towards adoption of sustainable cultivation practices of pineapple. With respect to respondents from Dimapur district, it was found that majority (75.43%) of the respondents had favourable attitude towards adoption of sustainable cultivation practices of pineapple followed by high (14.29%) and low (10.28%) level of attitude. In case of respondents from Peren district, majority (70.00%) of the respondents had favourable attitude while 28.57 per cent and 1.43 per cent had low and high level respectively. Similarly, majority (70.00%) of the respondents from Dimapur district had favourable attitude followed by high (26.67%) and low (3.33%) level of attitude.

The comprehensive data of the three districts revealed that majority (73.45%) of the respondents had favourable attitude while 14.18 per cent had less favourable and 12.37 per cent had most favourable attitude towards sustainable cultivation practices of pineapple. The overall mean and standard deviation was 43.01 and 3.01 respectively. The probable reason might be that majority of the respondents were educated which might have helped them in understanding the importance of sustainable cultivation practices. They were also found to have medium level of experience in pineapple cultivation which might have exposed them to benefits of sustainable practices. Their medium level of sources of information utilization, social participation and scientific orientation might have also played a factor in developing favourable attitude towards sustainable cultivation practices of pineapple.

Similar findings were also reported by Ghosh and Hasan (2013), Alam and Usmani (2019) and Kharlukhi and Jha (2021).

Table 4.5.1: Distribution of respondents based on their attitude towards adoption of sustainable cultivation practices of pineapple

Level of attitude	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**	**Frequency (Percentage)**
	Dimapur (n_1 = 175)	**Peren (n_2 = 70)**	**Mokokchung (n_3 = 30)**	**Overall (N = 275)**
Less favourable (< 40.00)	18 (10.28)	20 (28.57)	01 (3.33)	39 (14.18)
Favourable (40.00 – 46.02)	**132 (75.43)**	**49 (70.00)**	**21 (70.00)**	**202 (73.45)**
More favourable (> 46.02)	25 (14.29)	01 (01.43)	08 (26.67)	34 (12.37)
Mean	43.44	41.14	44.87	43.01
SD	2.98	2.29	2.59	3.01

Figures in parentheses indicate the percentage (%) of the respondents

4.7.2 Comparative account of attitude of farmers on sustainable pineapple cultivation among the districts

Table 4.5.2 presented the comparison of farmers' attitude towards sustainable pineapple cultivation among the three districts. The table revealed that z value and p value between Dimapur and Peren districts were 6.515 and less than 0.01 respectively, which indicated a statistically significant difference between these two districts. Furthermore, the z value between Dimapur and Mokokchung district was -2.758 which suggested that the difference favoured Dimapur district. It was statistically significant at less than 0.01. Similarly, when comparing Peren and Mokokchung districts, the z value and p value were -6.901 and less than 0.01 respectively. These values indicated a statistically significant difference.

Table 4.5.2: Comparative account of Attitude of farmers on sustainable pineapple cultivation among the districts

Sl. No.	Name of the district	Mean Attitude	SD	Z value	P value
1.	Dimapur	43.44	2.98	6.515	< 0.01*
	Peren	41.14	2.29		
2.	Dimapur	43.44	2.98	-2.758	< 0.01*
	Mokokchung	44.87	2.59		
3.	Peren	41.14	2.29	-6.901	< 0.01*
	Mokokchung	44.87	2.59		

* - Significant at 1 %

4.7.3 Relationship between independent variables and attitude of pineapple growers

Correlation analysis was used to ascertain the relationship between the independent variables and attitude of the pineapple growers. Table 4.5.3 depicted that the variables namely, education, social participation, sources of information utilization, innovativeness, risk bearing ability, achievement motivation, size of land holding under pineapple, annual income, productivity, employment generated, economic motivation, market orientation, management orientation, IPM, INM, extension contact, training exposure, experience and scientific orientation were found to have positive and significant relationship with the attitude of the respondents.

Education: It was revealed that this variable had positive and significant relationship with the attitude of the respondents. Majority of the respondents were found educated and these years of formal education must have the respondents in developing a favourable attitude towards sustainable cultivation practices of pineapple. Similar findings were reported by Kumar *et al.* (2012), Ghosh and Hasan (2013), Rana *et al.* (2017), Nataraju *et al.* (2019) and Ingale (2020).

Social participation: It is evident from Table 4.5.3 that social participation had positive and significant relationship with the attitude of the pineapple growers. This implied that more participation in different organization might have helped the respondents to develop favourable attitude towards sustainable cultivation practices of pineapple. Participation in several organisations might have helped them gather various information related to sustainable agriculture. Pradip (2019) and Ingale (2020) also reported similar findings.

Sources of information utilization: Sources of information utilization showed positive and significant relationship with the attitude of the respondents. Increase in utilization of information sources enabled the respondents to have more exposure to a wide range of information related to sustainable cultivation practices of pineapple. This might have played a key role in forming a favourable attitude towards the sustainable cultivation practices of pineapple. This finding was in line with the findings of Kumar *et al.* (2012), Pradip (2019) and Dharmanand *et al.* (2020).

Innovativeness: The relationship between innovativeness and attitude of pineapple growers was positive and significant. Farmers with high innovativeness are generally enthusiastic to acquire knowledge and learn about new agricultural practices and technologies, participative in organizational programmes and trainings and maintain good rapport with extension experts. These factors might have helped the attitude of the pineapple growers towards sustainable cultivation practices of pineapple. Patel *et al.* (2017), Nataraju *et al.* (2019), Dharmanand *et al.* (2020) and Ingale (2020) also found similar findings in their studies.

Risk bearing ability: Risk bearing ability also had positive and significant relationship with the attitude of the respondents. Respondents with higher risk taking ability possessed the willingness to try new idea and practices, bold to make decisions, adapt to changes and willingness to venture out into different and new initiatives. These traits must have contributed in developing a positive attitude towards sustainable cultivation practices of pineapple. This finding was supported by the result of Nataraju *et al.* (2019).

Achievement motivation: It was found that achievement motivation had positive and significant relationship with the attitude of the respondents. Respondents with higher achievement motivation had more favourable attitude towards sustainable cultivation practices of pineapple. This might be due to the fact that farmers with higher degree of achievement motivation are more goal-oriented, innovative and determined to achieve their goals.

Size of land holding under pineapple: The data in the table revealed that this variable had positive and significant relationship with the attitude of the respondents. This plausible reason could be that respondents with larger land holding have more access to try and adopt new sustainable cultivation practices of pineapple and are more receptive to new skills, ideas and in turn lead to adoption of these technologies. This finding is in compliance with the result of Kumar *et al.* (2012), Ghosh and Hasan (2013), Patel *et al.* (2017) and Pradip (2019).

Annual income: There was positive and significant relationship between annual income and attitude of the respondents. This indicated that respondents with higher annual income had more favourable attitude towards sustainable cultivation practices of pineapple. This could be due to the fact that high annual income gives stable economic status to the farmers and access to ample opportunities to new agricultural innovations and technologies which leads in developing a favourable attitude towards sustainable cultivation practices of pineapple. This finding was in conformity with the findings of Kumar *et al.* (2012), Ghosh and Hasan (2013), Patel *et al.* (2017) and Pradip (2019).

Productivity: Positive and significant relationship was observed between productivity and attitude of the respondents. Respondents with higher productivity exhibited favourable attitude towards sustainable cultivation practices of pineapple.

Employment generated: There was positive and significant relationship between employment generated and attitude of the respondents. Hiring of farm labourers, employing manpower in post-harvest and value-added activities and engaging in agricultural related businesses contribute to job creation and employment generation. This implied that these factors aided the respondents in developing a favourable attitude towards sustainable cultivation practices of pineapple. Nataraju *et al.* (2019) also reported similar findings.

Economic motivation: This variable exhibited positive and significant relationship with the attitude of the respondents. This indicated that achieving maximum economic profit is the ultimate target of a farmer which influences him to develop a favourable attitude towards sustainable cultivation practices of pineapple. This was in accordance with the findings of Kumar *et al.* (2012).

Market orientation: Market orientation also had positive and significant relationship with the attitude of the respondents. The desire to get the best price from the produce by grading, processing and transporting and the knowledge demand must have played a vital role in influencing favourable attitude towards sustainable cultivation practices of pineapple.

Management orientation: It was also revealed that management orientation had positive and significant relationship with the attitude of the respondents.

This maybe due to the fact that respondents with strong management orientation adopted efficient agricultural practices, proper utilization of available resources and innovations which lead to favourable attitude of respondents towards sustainable cultivation practices of pineapple.

Integrated Pest Management: Table 4.5.3 showed positive and significant relationship between Integrated Pest Management and attitude of the respondents. Respondents with strong inclination towards the benefits of integrated pest management recognise the importance and need for sustainable and environment friendly pest management practices which might have motivated the respondents in developing a favourable attitude towards sustainable cultivation practice of pineapple.

Integrated Nutrient Management: There was positive and significant relationship observed between integrated nutrient management and attitude of the respondents. The reason might be that farmers with a desire to adopt integrated nutrient management in their farms are more likely to consider management practices that ensure soil fertility, soil health and minimize nutrient losses. They seek opportunities that facilitate training programmes and extension services on soil management and fertility which creates a positive attitude to achieve sustainability in their farm.

Extension contact: The data in table 4.5.3 revealed that extension contact had positive and significant relationship with the attitude of the respondents. Respondents with higher extension contact had more favourable attitude towards sustainable cultivation practices of pineapple. This might be due to the fact that higher level of extension contact is inclined to generate more recent information, knowledge, skills and innovations sustainable agricultural practices which ultimately lead to developing favourable attitude. This finding is substantiated by the results of Ghosh *et al*. (2019) and Pradip (2019).

Training exposure: Training exposure was found to be positively significant with attitude of the respondents. This indicted that with more exposure to training programmes, the attitude of the respondents become more favourable. The probable reason might be that exposure of farmers to training programmes provides them with information, knowledge, skills and innovations regarding sustainable agricultural practices and they develop a favourable attitude towards sustainable practices as the farmers are empowered through training exposure. Hasan *et al.* (2015) and Rana *et al.* (2017) also reported similar results.

Experience: Table 4.5.3 depicted that there was positive and significant relationship between experience and attitude of the respondents. The likely reason must be that, with maturity in age, the respondents gain experience and expertise in farming practices and develop confidence in managing their farms which might have led them to augmented favourable attitude towards sustainable cultivation practices of pineapple. This finding was in conformity with the result of Kumar *et al.* (2012).

Scientific orientation: The relationship between scientific orientation and attitude of farmers was positive and highly significant. This might be due to the reason that respondents with more scientific orientation were more likely motivated to pursue more information on sustainable cultivation practices and this might have played a vital role is developing favourable attitude towards sustainable cultivation practices of pineapple. This inference was found to be in agreement with Kumar *et al.* (2012), Patel *et al.* (2017) and Londhe and Kadam (2023).

Table 4.5.3: Relationship between independent variables and attitude of pineapple growers

Sl. No.	Independent variables	Pearson correlation	p - value
1.	Age	-0.007	0.912
2.	Family size	-0.103	0.088
3.	Occupation	0.042	0.484
4.	Education	0.175**	0.004

5.	Input self sufficiency	-0.017	0.781
6.	Social participation	0.193**	0.001
7.	Sources of information utilization	0.386**	< 0.001
8.	Innovativeness	0.208**	0.001
9.	Risk bearing ability	0.137*	0.023
10.	Market innovativeness	0.096	0.111
11.	Decision making ability	-0.038	0.529
12.	Achievement motivation	0.208**	0.001
13.	Size of land holding under agriculture	0.102	0.092
14.	Size of land holding under pineapple	0.269**	< 0.001
15.	Annual income	0.245**	< 0.001
16.	Profitability	0.102	0.092
17.	Productivity	0.176**	0.003
18.	Employment generated	0.265**	< 0.001
19.	Economic motivation	0.384**	< 0.001
20.	Market orientation	0.193**	0.001
21.	Management orientation	0.438**	< 0.001
22.	IPM	0.246**	< 0.001
23.	INM	0.251**	< 0.001
24.	Extension contact	0.156**	0.009
25.	Training exposure	0.179**	0.003
26.	Experience	0.154*	0.01
27.	Scientific orientation	0.349**	< 0.001

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

*Correlation is significant at the 0.05 level (2- tailed)

Variables, *viz.* education, social participation, sources of information utilization, innovativeness, risk bearing ability, achievement motivation, size of land holding under pineapple, annual income, productivity, employment generated, economic motivation, market orientation, management orientation, IPM, INM, extension contact, training exposure, experience and scientific orientation were found significant. Therefore,

H_o3: There is no association between education, social participation, sources of information utilization, innovativeness, risk bearing ability, achievement motivation, size of land holding under pineapple, annual income, productivity, employment generated, economic motivation, market orientation, management orientation, IPM, INM, extension contact, training exposure, experience and scientific orientation with *Attitude* towards adoption of sustainable pineapple cultivation practices was rejected.

Variables namely, age, family size, occupation, input self sufficiency, market innovativeness, decision making ability, size of land holding under agriculture and profitability were found non significant. Therefore,

H_o3_a: There is no association between the variables age, family size, occupation, input self sufficiency, market innovativeness, decision making ability, size of land holding under agriculture and profitability with *Attitude* towards adoption of sustainable pineapple cultivation practices was accepted.

4.7.4 Multiple regression of the independent variables with the attitude of the pineapple growers

Table 4.5.4 depicted regression analysis to assess the contribution of the independent variables to the dependent variable *i.e.*, attitude towards sustainable cultivation practices of pineapple.

It was revealed that out of the twelve variables fitted for multiple regression analysis, seven variables, *viz.* occupation, sources of information utilization, employment generated, economic motivation, management orientation, experience and scientific orientation contributed positively and significantly to the prediction of attitude of the respondents and these variables maybe considered as good predictors of attitude. The R square value of 0.518 indicated that all the variables jointly contributed 51.8 per cent of the variations in the degree of the attitude of the respondents. The 'F' value was also found to be significant. It implied that these significant independent variables were effective in predicting the attitude level of the pineapple growers. Similar result was reported by Sadati *et al.* (2010).

Table 4.5.4: Regression analysis of attitude of the respondents with independent variables

Sl. No.	Variables	Regression coefficient	't' value	'p' value
1.	Occupation	0.599*	2.174	0.031
2.	Sources of information utilization	0.204**	2.802	0.005
3.	Innovativeness	0.155	2.238	0.026
4.	Risk bearing ability	-0.251	-2.265	0.024
5.	Achievement motivation	-0.528	-7.208	< 0.001
6.	Employment generated	0.013**	2.776	0.006
7.	Economic motivation	0.379**	4.148	< 0.001
8.	Management orientation	0.291**	5.541	< 0.001
9.	INM	0.057	1.955	0.052
10.	Extension contact	-0.239	-1.811	0.071
11.	Experience	0.09**	3.116	0.002
12.	Scientific orientation	0.31**	6.4	< 0.001

R^2 value = 0.518 F = 23.492 (p- value = < 0.001)

** Significant at 1% level * Significant at 5% level

4.6. Determinants of knowledge and adoption in relation to sustainable cultivation practices of pineapple

4.6.1 Direct, indirect and largest indirect effects of independent variables on knowledge level of sustainable cultivation practices of pineapple

Table 4.6.1 and Fig 4.6.1 revealed the analysis result comprising direct effect, indirect effect and first, second and third largest indirect effect channelled through other variables on knowledge level of sustainable cultivation practices of pineapple.

A closer look at the Table 4.6.1 showed that out of the twenty-seven independent variables selected for path analysis, fifteen variables had positive direct effect while twelve of the independent variables had negative direct effect on knowledge level of sustainable cultivation practices of pineapple.

Ranking of the variables based on their direct effect on knowledge level revealed that the first five ranks were occupied by variables employment generated (X_{18}), sources of information utilization (X_7), management orientation (X_{21}), INM (X_{23}) and scientific orientation (X_{27}). The last five ranks were occupied by variables, *viz.* market orientation (X_{20}), input self sufficiency (X_5), market innovativeness (X_{10}), size of land holding under agriculture (X_{13}) and decision making ability (X_{11}).

In case of total indirect effect on knowledge level, the Table 4.6.1 revealed that the variables extension contact (X_{24}), size of land holding under pineapple cultivation (X_{14}), productivity (X_{17}), size of land holding under agriculture (X_{13}) and market orientation (X_{20}) exerted the highest first five ranks whereas the variables family size (X_2), decision making ability (X_{11}), input self sufficiency (X_5), education (X_4) and occupation (X_3) held the lowest five ranks.

Among the substantial indirect effects, the first largest effect was channelled maximum through employment generated (X_{18}) in 13 variables, sources of information utilization (X_7) in 5 variables, management orientation (X_{21}) in 3 variables, scientific orientation (X_{27}) in 2 variables, training exposure (X_{25}), size of land holding under agriculture (X_{13}), experience (X_{26}), and market orientation (X_{20}) in one variable each.

The second largest indirect effects were channelled maximum through sources of information utilization (X_7) and management orientation (X_{21}) in 8 variables each, scientific orientation (X_{27}) in 3 variables, decision making ability (X_{11}), INM (X_{23}) and employment generated in 2 variables each and extension contact (X_{24}) and economic motivation (X_{19}) in 1 variable each.

It was also found that the third largest indirect effects were channelled through management orientation (X_{21}) and scientific orientation (X_{27}) in 5 variables each, sources of information utilization (X_7) in 3 variables, productivity (X_{17}), employment generated (X_{18}), INM (X_{23}) and training exposure (X_{25}) in 2 variables each, family size (X_2),social participation (X_6), risk taking ability (X_9), decision making ability (X_{11}), economic motivation (X_{19}) and extension contact (X_{24}) in 1 variable each.

It can be concluded from the above path results that employment generated, sources of information utilization and management orientation were the most important variables to have direct and indirect effect on the knowledge level of the respondents. In case of total indirect effect on knowledge level, the key variables were extension contact, size of landholding under pineapple cultivation and productivity.

The path analysis further showed that the residual effect was found to be 0.5096which indicated that 50.96 per cent of the total variability have been left unexplained. Shakya *et al.* (2008), Satyapriya *et al.* (2013), Maji and Meena (2019) and Sengupta *et al.* (2023) also reported similar findings.

Table 4.6.1: Direct, indirect and largest indirect effects of independent variables on knowledge level of sustainable cultivation practices of pineapple (N = 275)

Sl. No.	Variables	Direct effect	Rank	Total Indirect effect	Rank	Three largest indirect effect channelled through
X_1	Age	0.032	X	0.019	VIII	0.0453 (X_{18}) 0.0139 (X_{21}) 0.0127 (X_{11})
X_2	Family size	0.061	IX	-0.018	XXIII	0.0045 (X_{25}) 0.0044 (X_{11}) 0.0043 (X_9)
X_3	Occupation	0.026	XII	-0.116	XXVII	0.0253 (X_{13}) 0.0083 (X_{21}) 0.0064 (X_{24})
X_4	Education	-0.003	XVII	-0.049	XXVI	0.0121 (X_{26}) 0.0108 (X_{27}) 0.0092 (X_{19})
X_5	Input self sufficiency	-0.087	XXIV	-0.03	XXV	0.0275 (X_{27}) 0.0040 (X_{24}) 0.0028 (X_2)
X_6	Social participation	0.031	XI	0.105	XVI	0.0613 (X_{18}) 0.0279 (X_7) 0.0265 (X_{21})
X_7	Sources of information utilization	0.234	II	0.204	VI	0.0833 (X_{18}) 0.0726 (X_{21}) 0.0334 (X_{27})
X_8	Innovativeness	0.004	XV	0.094	XVII	0.0557 (X_{21}) 0.0469 (X_{27}) 0.0461 (X_7)
X_9	Risk bearing ability	-0.079	XXII	0.106	XIV	0.0484 (X_{21}) 0.0363 (X_7) 0.0341 (X_{27})
X_{10}	Market innovativeness	-0.089	XXV	0.148	XII	0.0547 (X_{18}) 0.0452 (X_{27}) 0.0381 (X_{21})
X_{11}	Decision making ability	-0.201	XXVII	-0.021	XXIV	0.0231 (X_{20}) 0.0131 (X_{19}) 0.0054 (X_6)
X_{12}	Achievement motivation	-0.016	XIX	0.014	XXII	0.0389 (X_{27}) 0.0249 (X_{21}) 0.0121 (X_7)
X_{13}	Size of land holding					0.2229 (X_{18})

	under agriculture	-0.181	XXVI	0.276	IV	0.0288 (X_{23}) 0.0197 (X_{25})
X_{14}	Size of land holding under pineapple cultivation	-0.005	XVIII	0.318	II	0.2786 (X_{18}) 0.0737 (X_7) 0.0357 (X_{23})
X_{15}	Annual income	-0.001	XVI	0.160	X	0.1541 (X_{18}) 0.0363 (X_{21}) 0.0333 (X_7)
X_{16}	Profitability	0.007	XIV	0.194	VII	0.1603 (X_{18}) 0.0492 (X_7) 0.1603 (X_{18})
X_{17}	Productivity	0.069	VII	0.288	III	0.1370 (X_{18}) 0.0810 (X_7) 0.0186 (X_{25})
X_{18}	Employment generated	0.289	I	0.028	XXI	0.0675 (X_7) 0.0337 (X_{23}) 0.0329 (X_{17})
X_{19}	Economic motivation	0.066	VIII	0.114	XIII	0.0679 (X_7) 0.0545 (X_{21}) 0.0355 (X_{23})
X_{20}	Market orientation	-0.081	XXIII	0.249	V	0.1255 (X_{21}) 0.0573 (X_{11}) 0.0228 (X_{27})
X_{21}	Management orientation	0.201	III	0.154	XI	0.0848 (X_7) 0.0377 (X_{18}) 0.0345 (X_{27})
X_{22}	IPM	0.012	XIII	0.074	XX	0.0427 (X_{18}) 0.0341 (X_{21}) 0.0185 (X_{27})
X_{23}	INM	0.167	IV	0.106	XIV	0.0583 (X_{18}) 0.0331 (X_7) 0.0329 (X_{21})
X_{24}	Extension contact	-0.044	XX	0.326	I	0.1343 (X_7) 0.0743 (X_{18}) 0.0620 (X_{21})
X_{25}	Training exposure	0.08	VI	0.175	IX	0.1051 (X_{18}) 0.0586 (X_7) 0.0283 (X_{21})
X_{26}	Experience	-0.051	XXI	0.083	XIX	0.0509 (X_{18}) 0.0295 (X_7) 0.0145 (X_{17})
X_{27}	Scientific orientation	0.133	V	0.089	XVIII	0.0586 (X_7) 0.0518 (X_{21}) 0.0231 (X_{18})

Residual effect= 0.5096

4.6.2 Factors influencing the adoption of sustainable cultivation practices of pineapple

The data furnished in Table 4.6.2 studied the factors that influenced the pineapple growers in adoption of sustainable cultivation practices of pineapple. This was performed to pool and simplify a number of variables into lesser number of factors where the Kaiser-Meyer-Olkin value was found to be 0.728. A total of twenty-seven independent variables were conglomerated and thus, eight factors were elicited and renamed. The eight factors accounted for 62.48 per cent variation in the study.

Factor 1

This factor accounted for 18.29 per cent of the total variation embedded with the adoption level of sustainable cultivation practices of pineapple. It could be seen from the Table 4.6.2 that this factor was a conglomeration of variables namely, size of landholding under agriculture (X_{13}), size of landholding under pineapple (X_{14}), annual income (X_{15}), profitability (X_{16}), productivity (X_{17}) and employment generated (X_{18}). This factor was renamed as 'Land use and Income'. This finding inferred that the adoption of sustainable cultivation practices of pineapple was found influenced by a combination of landholding size, economics component and their associated effects. Makate *et al.* (2018) also found farm size and availability of labour associated with adoption and use of climate-smart agricultural practices. The intensity of technology adoption tends to be higher among farmers with higher off-farm income (Diiro, 2013).

Factor 2

The second factor consisted of the variables; innovativeness (X_8), risk bearing ability (X_9), market innovativeness (X_{10}), achievement motivation (X_{12}) and scientific orientation (X_{27}) which contributed 10.29 per cent to the total variance and renamed the factor as 'Motivation' factor. These variables under a single factor drive the farmers to adopt sustainable cultivation practices of pineapple. This factor helped the farmers in developing an entrepreneurial mindset, achievement motivation, scientific orientation and market innovativeness which eventually contributed to sustainability of the farming practices. Marak *et al.* (2016) also revealed similar result.

Factor 3

The third factor was renamed as 'Extension access' factor. Variables sources of information utilization (X_7), productivity (X_{17}), extension contact (X_{24}) and training exposure (X_{26}) comprised of this factor and a total percentage of 7.48 was contributed to the total variance of the study. The farmers with more information sources utilization, more frequency of extension contact and training exposure were found to adopt sustainable cultivation practices willingly. Oyinbo *et al.* (2019) revealed that the availability of extension services played a positive effect on the adoption of new technologies. Paramasivam *et al.* (2021) observed the influence of perception on profitability, training undergone in organic farming, mass media exposure and extension agency contact on rate of adoption of organic agriculture practices. Farmers who have access to extension services are more likely to adopt sustainable agricultural practices (Priya and Singh, 2022).

Factor 4

The fourth factor renamed as, 'Management and market awareness' consisted of variables *viz.,* education (X_4), market orientation (X_{20}) and management orientation (X_{21}) explained 6.35 per cent of the total variance. This inferred that the farmers with educational qualification coupled with effective and efficient management skins and market awareness were more likely to adopt the sustainable cultivation practices. Tey *et al.* (2013) identified education as one common factor to influence adoption of sustainable agricultural practices. Marak *et al.* (2016) and Pradhan *et al.* (2017) also explained about market orientation as a vital aspect in influencing adoption of cultivation practices in their study.

Factor 5

Factor 5 exhibited 5.7 per cent of the total variance. The variables under this factor were social participation (X_6), decision making ability (X_{11}) and economic motivation (X_{19}). Accordingly, the factor was renamed as 'Socio-economic participation'. Active participation in organizations and groups provides the platform to share, experience and learn from one individual to another. Farmers with strong decision making ability and economic motivation allow them to make decisions that encourage sustainability, identify its economic potentiality, adopt and implement them effectively. These variables grouped under this factor allows the farmers to pool in their resources, knowledge and take up strategies that encourage adoption of sustainable practices. Tey *et al.* (2013) highlighted the importance of economic motivation in facilitating sustainable farm management. Social participation was found to be one of the important variables under the factor socio-behavioural dimension in the study conducted by Marak *et al.* (2016).

Factor 6

The sixth factor consisted of variables age (X_1), family size (X_2) and experience (X_{26}). It was found that this factor contributed 5.35 per cent to the total variance and was renamed as 'Socio-economic'. These variables grouped together under this factor played significant role in the adoption of sustainable cultivation practices of pineapple. With years of experience in farming, wide range of knowledge and skills are accumulated which aids in making informed decisions and adopt sustainable cultivation practices effectively.

Higher age revealed an increase in farmers' preference for on-farm environmentally sustainable strategies (Nastis *et al.*, 2019). The number of sustainable agricultural practices adopted increased with the age of household head and household size which may be due to experience accumulated over the farming years. (Oyetunde-Usman *et al.,* 2021).

Factor 7

The seventh factor was renamed as ‘Nutrient management’ which explained 4.68 per cent of the variance. Economic motivation (X_{19}) and INM (X_{23}) were the variables under this factor. The grouping of economic motivation and INM variables in this factor imply that farmers’ economic motivation played an important role in the adoption of sustainable cultivation practices. More economically motivated farmers could identify the probable economic benefits related with sustainable management practices and tend to adopt it. Farmers having the awareness of benefits of INM implement these practices which consequently lead to improved soil health, reduced environmental impacts and increased productivity. Farmers who have access to environmental knowledge are more likely to adopt sustainable agricultural practices (Priya and Singh, 2022).

Factor 8

The eight-factor found to influence the adoption of sustainable cultivation practices of pineapple was renamed as ‘Resource use efficiency’. Variables input self sufficiency (X_5), IPM (X_{22}) and scientific orientation (X_{27}) made up this factor and accounted for 4.3 per cent of the total variance. This factor played a crucial role in adoption of sustainable cultivation practices of pineapple. This may be due to the implication that under the factor, ‘resource use efficiency’, practice of higher input self sufficiency, IPM and scientific orientation lead to reduced environmental impact, enhanced productivity and efficient resource utilization. The sustainability of agricultural systems can be improved by adopting integrated pest management (Priya and Singh, 2022). Dessart *et al.* (2019) also found that farmers’ awareness on impact of sustainable management practices on the environment often leads to adoption of sustainable management. Farmers' perceptions of sustainability, and environmental and moral consciousness such as farmers' awareness of the importance of soil were the motivations for the adoption of specific sustainable agricultural practices (Feliciano, 2022).

Table 4.6.2: Rotated factor matrices of the variables along with the factor loadings, variance and factors renamed

Factors	Variables	Factor loading	% of variance explained	Cumulative % explained	Factors renamed
Factor – 1	Size of landholding under agriculture (X_{13})	0.851	18.293	18.293	Land use and income
	Size of landholding under pineapple (X_{14})	0.915			
	Annual income (X_{15})	0.676			
	Profitability (X_{16})	0.652			
	Productivity (X_{17})	0.437			
	Employment generated (X_{18})	0.919			
Factor – 2	Innovativeness (X_8)	0.647	10.299	28.592	Motivational factor
	Risk bearing ability (X_9)	0.489			
	Market innovativeness(X_{10})	0.671			
	Achievement motivation (X_{12})	0.750			
	Scientific orientation (X_{27})	0.423			
Factor – 3	Sources of information utilization (X_7)	0.782	7.481	36.073	Extension access
	Productivity (X_{17})	0.435			
	Extension contact (X_{24})	0.785			
	Training exposure(X_{26})	0.425			
Factor – 4	Education (X_4)	0.433	6.357	42.430	Management and market awareness
	Market orientation (X_{20})	0.813			
	Management orientation (X_{21})	0.772			
Factor – 5	Social participation (X_6)	0.503	5.707	48.138	Socio-economic participation
	Decision making ability (X_{11})	0.651			
	Economic motivation (X_{19})	0.601			
Factor – 6	Age (X_1)	0.809	5.355	53.493	Socio-economic
	Family size (X_2)	0.598			

	Experience (X_{26})	0.693			
Factor – 7	Economic motivation (X_{19}) INM (X_{23})	0.435 0.664	4.681	58.174	Nutrient management
Factor – 8	Input self sufficiency (X_5) IPM (X_{22}) Scientific orientation (X_{27})	0.734 0.521 0.519	4.312	62.486	Resource use efficiency
	Kaiser-Meyer-Olkin Measure	0.728			

4.7. Constraints perceived by the pineapple growers in adopting sustainable pineapple cultivation practices and suggest strategies to overcome

Garrett ranking technique was used to identify and rank the constraints faced by pineapple growers in sustainable cultivation practices of pineapple.

Table 4.7.1 exhibited the overall ranking of the different aspects of constraints based on the overall mean score. It was found that economic constraint, extension constraint, input constraint, infrastructural constraint, input constraint and other constraints had an overall mean score of 50 and were ranked first. Labour constraint and environmental constraint were ranked second and third with an overall mean score of 49.99 and 49.84 respectively. Moreover, the data showed that technological constraint and marketing constraint were ranked fourth with an overall mean score of 49.83.

Table 4.7.1: Overall ranking of the different aspects of constraints

Sl. No.	Constraints	Mean score	Rank
1.	Economic constraint	50	I
2.	Extension constraint	50	I
3.	Input constraint	50	I
4.	Infrastructural constraint	50	I
5.	IPM constraint	50	I
6.	Other constraints	50	I
7.	Labour constraint	49.99	II
8.	Environmental constraint	49.84	III
9.	Technological constraint	49.83	IV
10.	Marketing constraint	49.83	IV

4.7.2 Economic constraint

Table 4.7.2 revealed the economic constraints faced by the respondents. The highest constraint was poor economic condition of farmers with a mean score of 60.64. The second and third constraints were non-availability of government subsidy/agricultural credit and high cost of planting material. Limited financial resources make the farmers difficult to procure high cost tools, implements and other farm inputs. This also leads to challenges in accessing loans and schemes. These constraints can be intervened by providing financial assistance through government schemes and loans to the weaker economic community. Extension agents should play their role in disseminating information related to loans, schemes and credits. Baruwa (2013), Marak *et al.* (2016), Iwuchukwu *et al.* (2017), Dennis and Okpeke (2018), Sharma *et al.* (2018) and Devi *et al.* (2023) also reported similar constraints.

Table 4.7.2: Economic constraint in adoption of sustainable cultivation practices of pineapple **N= 275**

Sl. No.	Constraints	Mean score	Rank
1.	Non- availability of government subsidy/agricultural credit	51.45	II
2.	Poor economic condition of farmers	60.64	I
3.	High cost of planting material	37.91	III

4.7.3 Extension constraint

Table 4.7.3 showed the extension constraint faced by the respondents in adoption of sustainable cultivation practices of pineapple. Lack of contact with extension agent was the highest constraint with a mean score of 54.91 followed by lack of timely advice and guidance by extension personnel and lack of effective supervision with mean scores of 52.9 and 42.19 respectively. Farmer-extension agent partnership may be maintained through farm visitation, timely meetings, organizing training and capacity building programmes through which interactions, a friendly rapport may be developed. Modern online platforms, SMS services and user-friendly apps may be utilized to disseminate information and knowledge thereby strengthening the link with the farmers.

This was in conformity with the results of Onyemekonwu *et al.* (2019) and Olah and Okon (2022).

Table 4.7.3: Extension constraint in adoption of sustainable cultivation practices of pineapple N= 275

Sl. No.	Constraints	Mean score	Rank
1.	Lack of contact with extension agent	54.91	I
2.	Lack of timely advice and guidance by extension personnel	52.9	II
3.	Lack of effective supervision	42.19	III

4.7.4 Input constraint

The data furnished in Table 4.7.4 indicated the input constraint in adoption of sustainable cultivation practices of pineapple. This constraint may be averted by training the respondents on practices such as vermicomposting, self-reliant management practices, treatment of planting material and accessibility and availability of the inputs at subsidized rates by the concerned authority.

Baruwa (2013) and Das *et al.* (2019) also reported similar findings.

Table 4.7.4: Input constraint in adoption of sustainable cultivation practices of pineapple N= 275

Sl. No.	Constraints	Mean score	Rank
1.	Lack of quality sucker/slip/crown	53.51	II
2.	Non- availability of disease/ pest resistant planting material	47.8	III
3.	Inadequate and timely non availability of fertilizers	34.96	IV
4.	Insufficient organic manure	63.73	I

4.7.5 Infrastructural constraint

Table 4.7.5 revealed that the highest constraint in terms of infrastructural constraint was lack of storage facilities with a mean score of 64.15. The second highest infrastructural constraint was lack of vehicles to carry the fruits to distant market followed by lack of farm machinery and irrigation facilities. Pineapple fruits have short shelf life and so the surplus harvested fruits without proper storage facilities end up in huge losses. These constraints may be minimized by training on on-farm storage facilities collectively as a group or individually, the concerned authority providing transportation facilities. training farmers on setting up water storage facilities. Marak *et al.* (2016), Iwuchukwu *et al.* (2017), Sharma *et al.* (2018), Das *et al.* (2019), Onyemekonwu *et al.* (2019), Roy and Gosh (2022) and Devi *et al.* (2023) also reported similar constraints.

Table 4.7.5: Infrastructural constraint in adoption of sustainable cultivation practices of pineapple **N= 275**

Sl. No.	Constraints	Mean score	Rank
1.	Lack of farm machinery	47.22	III
2.	Lack of vehicles for carrying to distant market	59.14	II
3.	Lack of storage facilities	64.15	I
4.	Lack of irrigation facilities	29.49	IV

4.7.6 IPM constraint

It could be seen from Table 4.7.6 that the highest IPM constraint was damaged by insect where the means score was 54.77, while damage by bees, ants and rats, problems in identification of disease and pest and damaged by insects were ranked second, third and fourth respectively. The farmers maybe enlightened by organizing trainings on disease and pest management and also be provided with trial kits for pest and disease management and assisted with additional information through smartphones and SMS services. This result was supported by the findings of Marak *et al.* (2016), Iwuchukwu *et al.* (2017), Dennis and Okpeke (2018), Onyemekonwu *et al.* (2019), Enibe and Raphael

(2020), Singh and Sharma (2020), Kehinde *et al.* (2021) and Olah and Okon (2022).

Table 4.7.6: IPM constraint in adoption of sustainable cultivation practices of pineapple N= 275

Sl. No.	Constraints	Mean score	Rank
1.	Damaged by insect	54.77	I
2.	Damaged by diseases	45.46	IV
3.	Problems in identification of disease and pest	46.73	III
4.	Damage by bees, ants and rats	53.04	II

4.7.7 Other constraints

Table 4.7.7 revealed that the highest constraint faced by the respondents was weeding problem with a mean score of 55.32 followed by poor shelf life and sunburn of leaves with mean scores of 49.52 and 45.16 respectively.

Weeding issues can significantly lead to competition for nutrients, water and sunlight with the pineapple crop resulting in reduced growth and yield. Proper training and guidance on effective weed management may be organized for the farmers. The importance of weed prevention to minimize competition with the main crop should be emphasized. Poor shelf life can lead to spoilage, reduced market value and most importantly, financial losses to the farmers. Training on post-harvest handling techniques to improve the shelf life, storage methods, packaging, shade management practices may be organized for the farmers. Fields trip may also be organized where farmers can observe and learn the best management practices.

These findings are in line with the results of Baruwa (2013), Iwuchukwu *et al.* (2017), Okal (2018) and Onyemekonwu *et al.* (2019).

Table 4.7.7: Other constraints in adoption of sustainable cultivation practices of pineapple **N= 275**

Sl. No.	Constraints	Mean score	Rank
1.	Poor shelf life	49.52	II
2.	Weeding problem	55.32	I
3.	Sunburn of leaves	45.16	III

4.7.8 Labour constraint

The perusal of data given in Table 4.7.8 revealed that the highest constraint faced by the respondents was high wage rate with a mean score of 52.14 and ranked first followed by non-availability of labour and labour intensive crop. It was found that the labour charge ranged from ₹.300 - ₹.400/- for female and ₹.400- ₹.600/- for male labourers. Majority of the respondents were farmers and did not have additional income. It becomes difficult to pay a huge amount especially during land preparation, intercultural operations and harvesting period. Similar finding was examined by Dennis and Okpeke (2018), Kehinde *et al.* (2021) and Roy and Gosh (2022). Non-availability of labour was ranked second. During the peak season of pineapple cultivation, every household is engaged in their own pineapple fields which leads to non-availability of labour for hiring purpose which pose as a problem for households with few family members or for those with migrant family members. Labour shortage and extensive spending on labour charges during peak season can be minimized by exchange of labourers between the farmers. Onyemekonwu *et al.* (2019) and Devi *et al.* (2023) also reported labour shortage. The least labour constraint was labour intensive crop. Pineapple cultivation is a very intensive crop and the findings of Enibe and Raphael (2020) was in agreement with this constraint.

Table 4.7.8: Labour constraint in adoption of sustainable cultivation practices of pineapple **N= 275**

Sl. No.	Constraints	Mean score	Rank
1.	High wage rate	52.14	I
2.	Non- availability of labour	51.79	II
3.	Labour intensive crop	46.06	III

4.7.9 Environmental constraint

It can be observed from Table 4.7.9 that increase in the temperature with a mean score of 68.64 was the highest constraint in case of environmental constraint. Increase in incidence of pest and diseases was ranked second followed by low soil fertility, erratic rainfall, soil erosion and scarcity of water. The changes affect the growth of the pineapple fruits and eventually in their harvested product.

Higher temperatures can lead to unfavourable effects on the growth and development of pineapple plants causing reduced yield, physiological disorders and increased vulnerability to pest and diseases. Increase in incidence of pest and diseases can result in reduced productivity and crop damage. These environmental constraints can affect the growth, nutrient uptake and overall health of the pineapple plants, eventually affecting the quantity and quality of the harvested fruit.

These issues may be minimized by promoting climate smart agricultural practices like mulching, water conservation techniques, regular monitoring of pest and disease population and use of biological control methods. The farmers may be encouraged to soil test their fields and be informed about the result of their soil testing in order to supplement their soil with required nutrients and also maintain their soil health. They may also be provided guidance on the use of drip irrigation and water conservation techniques. Extension agents may help the farmers by providing them with climate information and advisory services by disseminating weather forecasts and climate resilient practices on a more regular basis.

Marak *et al.* (2016), Dennis and Okpeke (2018), Kehinde *et al.* (2021) and Roy and Gosh (2022) were found to have reported similar constraints.

Table 4.7.9: Environmental constraint in adoption of sustainable cultivation practices of pineapple N= 275

Sl. No.	Constraints	Mean score	Rank
1.	Increase in temperature	68.54	I
2.	Scarcity of water	32.96	VI
3.	Erratic rainfall	44.76	IV
4.	Increase in incidence of pest and diseases	66.97	II
5.	Soil erosion	33.21	V
6.	Low soil fertility	52.57	III

4.7.10 Technological constraint

Table 4.7.10 depicted the technological constraint in adoption of sustainable cultivation practices of pineapple. This highest constraint under this aspect was found to be lack of knowledge on integrated pest management with a mean score of 68.56.

The second constraint was lack of knowledge on latest technology, third constraint was lack of technical know-how on seed treatment. Fourth, fifth and sixth constraints were inadequate training of farmers, lack of knowledge on value addition of pineapple, inadequate availability of mass media sources of information respectively. These gaps may be intervened through training programmes, organizing capacity building programmes, workshops, demonstrations and disseminating information through accessible platforms.

These constraints were also reported by Baruwa (2013), Iwuchukwu *et al.* (2017), Dennis and Okpeke (2018), Das *et al.* (2019), Onyemekonwu *et al.* (2019), Enibe and Raphael (2020), Singh and Sharma (2020) and Kehinde *et al.* (2021).

Table 4.7.10: Technological constraint in adoption of sustainable cultivation practices of pineapple N= 275

Sl. No.	Constraints	Mean score	Rank
1.	Lack of knowledge on latest technology	60.02	II
2.	Lack of knowledge on Integrated Pest Management	68.56	I
3.	Inadequate training of farmers	48.42	IV
4.	Inadequate availability of mass media sources of information	33.84	VI
5.	Lack of technical know-how on seed treatment	50.09	III
6.	Lack of knowledge on value addition of pineapple	38.07	V

4.7.11 Marketing constraint

The data furnished in Table 4.7.11 revealed the marketing constraints faced by the respondents. Lack of reliable market with a mean score of 64.8 was ranked first, lack of proper marketing channel and poor marketing facilities resulting in high risk were ranked second and third while high cost of transportation, exploitation by middlemen and fluctuation in market rate were ranked fourth, fifth and sixth respectively. These aspects of constraints may be minimized through training programmes on market information sources, linking up potential markets, market channels and partnerships and facilitating them with required market infrastructures, storage facilities and processing units. Marak *et al.* (2016), Okal (2018), Sharma *et al.* (2018), Onyemekonwu *et al.* (2019), Enibe and Raphael (2020), Singh and Sharma (2020) and Roy and Gosh (2022) also reported similar constraints.

Table 4.7.11: Marketing constraint in adoption of sustainable cultivation practices of pineapple **N= 275**

Sl. No.	Constraints	Mean score	Rank
1.	Lack of proper marketing channel	63.81	II
2.	Poor marketing facilities resulting in high risk	61.25	III
3.	Fluctuation in market rate	28.90	VI
4.	Exploitation by middlemen	35.08	V
5.	Lack of reliable market	64.8	I
6.	High cost of transportation	45.16	IV

CHAPTER V

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSIONS

Pineapple, indigenous to South America, is one of the most important fruits commercially grown worldwide. Pineapple is a tropical fruit which thrive well in warm and humid climates. Pineapple in India is grown in the humid coastal and northeastern region. The states growing pineapple commercially are Assam, Meghalaya, Tripura, Mizoram, Nagaland, West Bengal, Kerala, Karnataka and Goa. Pineapples were grown in the country in 2020–21 on an area of 1,05,580 ha, producing 17,98,710 metric tonnes and secured 6th rank in the world.

As Nagaland is endowed with favourable climatic conditions and very fertile and organically rich soils, pineapple cultivation thrives in almost all the districts. Pineapple of the state is known for its excellent quality in terms of size, appearance, TSS and other aspects. In Nagaland, pineapple is generally cultivated organic, rainfed and grown over the course of two seasons. Kew and Giant Kew and Queen varieties are grown in this region. With the initiatives of the state government, pineapple is considered as one of the important horticultural crips and since then, have boosted its cultivation. The state has also achieved the unique distinction of branding the pineapple with the tag name, “Naga Pineapple”.

Pineapple cultivation in Nagaland has positively impacted the farmers’ livelihood. However, challenges such as insufficient knowledge on improved practices, limited market availability and lack of storage scientific facilities discourage the pineapple growers. Inadequate transportation and communication facilities make it costly for the farmers to bring their produce from the fields. Additionally, pineapple cultivation can cause soil damage as it is an exhaustive crop, requiring deforestation and disrupting the environment, affecting flora and fauna. Water requirements for pineapple cultivation need assessment for sustainable practices. Farmers may not recognize the long-term adverse impacts of their practices on the environment. Sustainable agriculture is the need of the hour in today's ever-changing world. Food and Agriculture Organization (FAO) defined sustainable agricultural development as the management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Thus, the present study entitled, "Status and Determinants of Sustainable Cultivation Practises followed by Pineapple Growers in Nagaland" was formulated with the following objectives:

1. To study the knowledge level of pineapple growers about sustainable pineapple cultivation practices.
2. To analyze the extent of adoption of sustainable cultivation practices among pineapple growers.
3. To assess the technological gap in adoption of sustainable cultivation practices among the pineapple growers.
4. To study the attitude of pineapple growers towards adoption of sustainable cultivation practices of pineapple.
5. To know the determinants of knowledge and adoption in relation to sustainable cultivation practices of pineapple.
6. To find out the constraints perceived by the pineapple growers in adopting sustainable pineapple cultivation practices and suggest strategies to overcome.

Methodology

The study was conducted in three districts namely Dimapur, Peren and Mokokchung. These districts were selected based on the area covered under pineapple cultivation and highest production. Four (4) Rural Development (RD) Blocks where pineapple was cultivated successfully; one each from Dimapur (Medziphema RD block) and Mokokchung districts (Changtongya RD block) and two (2) from Peren district (Jalukie and Peren Rd block) were purposively selected for the study. Three villages under Dimapur district, Molvom, Bungsang and Medziphema villages, with highest number of pineapple growers were purposively selected. Under Mokokchung district, Changtongya, Nukshiyim, Liroyim and Yaongyimsen villages were purposively selected. Under Peren district, Samzuiram, Mhainamtsi, Kejanglwa, Jalukie, Punglwa and Heningkunglwa villages were purposively selected for the study. Out of the selected 13 villages, 45 per cent of the pineapple growers were selected from the selected districts using proportionate random sampling procedure. Thus, a sample size of 275 respondents was selected for the present study.

Two scales, *viz.* attitude scale and market innovativeness scale were developed by following the procedure suggested by Likert (1932). Thirty independent and three dependent variables selected for the research were quantified by using interview schedule with suitable scales. Data was gathered through personal interview technique with the aid of structured and pre-tested interview. The data was gathered, quantified and analysed using frequencies, percentages, mean, standard deviation, correlation, regression, path analysis and factor analysis to deduce relevant inferences.

Salient findings of the study

The major findings of the study are as follows:

1. The scales developed for measuring the attitude of the respondents towards sustainable cultivation practices of pineapple and for measuring the market innovativeness of pineapple farmers were found reliable, valid and internally consistent. Thus, these scales could be effectively used in measuring these specific aspects among pineapple farmers.

2. In relation to personal and socio-economic characteristics of the respondents, 59.64 per cent of the respondents were middle aged, 63.27 per cent were male, 97.09 per cent were married, 53.82 per cent had medium family size, 41.45 per cent were educated up to middle school, 81.45 per cent were engaged in farming only, 68.36 per cent had medium level years of experience under pineapple cultivation, 71.64 per cent had small size of landholding under agriculture and majority (47.27%) of the respondents possessed 2-5 acres of landholding under pineapple cultivation. Additionally, 78.18 per cent of them had medium level of input self-sufficiency, majority (83.64%) had mandays generated between 100–200 days, 76.73 per cent medium level of integrated nutrient management and 94.91 per cent had medium level of integrated pest management. The mean annual income and income from pineapple cultivation were ₹.2,59,032 and ₹.1,47,441.1 respectively. The average profitability from pineapple cultivation was ₹.50,237.48/ acre. Average productivity of pineapple under Dimapur district was 11.63 mt/ha, 13.52 mt/ha and 13.93 mt/ha in case of Peren and Mokokchung district respectively. The Livelihood Vulnerability Index value for Dimapur, Peren and Mokokchung districts were 0.374, 0.363 and 0.345 respectively.
3. In case of communication characteristics of the pineapple growers, 69.09 per cent of the respondents had medium level of sources of information utilization, 75.27 per cent of them had medium level of extension contact, 64.36 per cent had medium level of social participation ad 57.09 per cent of them had training exposure on pineapple cultivation.
4. With respect to psychological characteristics, 66.91 per cent of the respondents had medium level of innovativeness, 64.00 per cent had medium level of risk taking ability, 71.64 per cent had medium level of market innovativeness, 78.55 per cent had medium level of achievement motivation and 64.73 per cent medium level decision making ability. Further, 74.18 per cent, 78.18 per cent, 65.82 per cent and 76.73 per cent of them had medium

level of management orientation, scientific orientation, economic motivation and market orientation respectively.

5. The result revealed that respondents from Dimapur district had cent per cent knowledge level on practices such as recommended varieties, propagation, planting time, cropping pattern, harvesting, ratooning, storage and post harvest management. The respondents had mean knowledge of 96.38 per cent on land preparation, 91.71 per cent on weed management, 91.24 per cent on intercultural operations and 89.71 per cent mean knowledge on rodent management. It was found that the respondents had zero per cent (0.00%) knowledge on practices such as treatment of suckers and growth regulator.
6. With respect to knowledge of the respondents on cultivation and managerment practices from Peren district, it was found that the respondents had cent per cent (100.00%) knowledge on recommended varieties, propagation, planting time, cropping pattern, harvesting, ratooning, storage and post harvest management. They also had 97.14 per cent knowledge on land preparation, 78.57 per cent knowledge on weed management and 68.09 per cent knowledge on intercultural operations. Whereas, the respondents had no knowledge on treatment of suckers, growth regulator and leaf spot disease.
7. Further, in case of Mokokchung district, the respondents had cent per cent (100.00%) knowledge on recommended varieties, propagation, land preparation, planting time, cropping pattern, harvesting, ratooning, storage and post harvest management. They had 85.00 per cent, 82.22 per cent, 80.00 per cent knowledge on weed management, intercultural operations, rodent management practices respectively. It was also found that the respondents had no knowledge on practices such as treatment of suckers and growth regulator.70.28 per cent of the respondents from Dimapur district had overall medium level knowledge, 58.57 per cent from Peren district had low level of knowledge and 60.00 per cent of the respondents from Mokokchung district had medium level knowledge on overall practices. The pooled data of the

three districts showed that 61.45 per cent of the respondents had medium level overall knowledge of sustainable cultivation practices of pineapple. Further farmers' knowledge on sustainable pineapple cultivation between Dimapur and Peren districts as well as Peren and Mokokchung districts was found significantly different.

8. Independent variables such as education, social participation, sources of information utilization, size of landholding under pineapple cultivation, annual income, profitability, productivity, employment generated, economic motivation, market orientation, management orientation, integrated nutrient management, extension contact, training exposure, experience and scientific orientation had positive and significant relationship with the knowledge level of the respondents. Variables input self sufficiency and decision making ability were found to have negative and significant relationship with the knowledge level of the respondents. In case of multiple linear regression, the result showed that variables education, input self sufficiency, sources of information utilization, risk bearing ability, decision making ability, size of land holding under agriculture, employment generated, management orientation, integrated nutrient management, experience and scientific orientation substantially contributed to the knowledge level of the farmers with an R^2 value of 0.437. Significant predictor variables *viz.,* input self sufficiency, risk bearing ability, decision making ability, size of land holding under agriculture, employment generated, management orientation, integrated nutrient management and scientific orientation were found important in explaining the knowledge level of the respondents.
9. Moreover, the study revealed that majority (88.00%, 88.57% and 83.33%) of the respondents from Dimapur, Peren and Mokokchung districts fully adopted recommended method of digging of pits and solarizing the soil. The pooled data showed that 87.14 per cent fully adopted it. 9.72 per cent, 5.72 per cent and 3.33 per cent of the respondents from Dimapur, Peren and Mokokchung

districts respectively fully adopted the filling of pits with manure and overall, 8.00 per cent fully adopted it. Cent per cent (100.00%) of the respondents from Dimapur, Peren and Mokokchung fully adopted Giant Kew and Kew varieties and 8.36 per cent of the total respondents fully adopted Queen variety. All the respondents (100.00%) fully adopted the recommended practice of propagation. None of the respondents (0.00%) from all the districts adopted the practices of treatment of planting material and use of growth regulators. In case of spacing, 28.37 per cent of the respondents fully adopted single spacing and 50.91 per cent fully adopted double spacing. 20.36 per cent and 26.18 per cent of the respondents fully adopted single and double spacing plant population. 96.73 per cent fully adopted during the recommended planting time. Only 5.09 per cent, 13.09 per cent and 15.64 per cent of the respondents fully adopted irrigation, use of KMS, sugar and citric acid as preservatives during squash preparation and use of sterilized bottles respectively.

10. The result showed that 65.71 per cent of the respondents had medium level of overall adoption of sustainable cultivation practices of pineapple, 68.57 per cent from Peren district had medium level and 50.00 per cent from Mokokchung district had medium level overall adoption of sustainable cultivation practices of pineapple. The consolidated result of the three districts showed that 64.73 per cent of the respondents had medium level adoption of sustainable cultivation practices of pineapple. The comparison of adoption of sustainable cultivation among the three districts demonstrated a statistically significant difference. The p value was less than 0.01.

11. The study further revealed that the independent variables, viz. education, social participation, sources of information utilization, decision making ability, achievement motivation, size of landholding under agriculture and pineapple cultivation, annual income, employment generated, economic motivation, management orientation, integrated pest management (IPM),

integrated nutrient management (INM), training exposure and experience had positive and significant relationship with the adoption level of the respondents while age negative and significant relationship with the adoption level of the respondents. Multiple linear regression result indicated that the R^2 value was 4.49 which showed that the variables age, education, sources of information utilization, decision making ability, achievement motivation, profitability, employment generated, economic motivation, market orientation, management orientation, IPM, INM and experience explained and contributed to the extent of 44.9 per cent of the variation in the adoption of sustainable cultivation practices of pineapple. Variables *viz.*, age, education, sources of information utilization, decision making ability, achievement motivation, employment generated, market orientation, IPM, INM and experience significantly contributed to the adoption of sustainable cultivation practices of pineapple.

12. In case of technological gap among the respondents from Dimapur district, the highest practice-wise mean technological gap was observed in treatment of planting material and growth regulator followed by second, third, fourth and fifth highest mean technological gap in per cent gap was found in practice of manuring (93.00%), irrigation (88.5%), cropping pattern (81.00%), value addition (80.25%). Minimal mean technological gap was observed in planting (1.5%) and harvesting (6.5%). No technological gap was observed in practices of propagation, storage and post-harvest management. Overall mean technological gap was 46.71 per cent.
13. With respect to practice-wise technological gap of respondents from Peren district, the highest (100.00%) mean technological gap was found in treatment of planting material and growth regulator. High mean technological gap was observed in practices such as manuring (95.33%), irrigation (91.5%), value addition (84.75%). Negligible mean technological gap was found in the practices of harvesting (6.00%) and planting (2.00%). No technological gap

was observed in propagation, storage and post harvest management. Overall mean technological gap was 48.64.

14. The result further revealed that in case of practice-wise technological gap among the respondents of Mokokchung district, the highest mean technological gap was found in treatment of planting material (100.00%) and growth regulator (100.00%). Second, third and fourth rank practice-wise technological gap was manuring (92.00%), value addition (82.25%) and cropping pattern (78.75%). Negligible mean technological gap was observed in case of planting (1.5%) and harvesting (5.67%) and no technological gap in case of propagation, storage and post harvest management. The overall mean technological gap was 46.61.
15. The pooled overall mean technological gap of the respondents from the three districts showed that cent per cent mean technological gap was found in the practices of treatment of planting material and growth regulator. 92.00 per cent, 81.75 per cent and 78.00 per cent mean technological gap was observed in manuring, value addition and irrigation respectively. Lowest mean technological gap was found in the practices of harvesting (2.5%) and planting (1.5%). Overall mean technological gap was 44.14 per cent.
16. The study revealed that majority (65.14%, 70.00% and 50.00%) of the respondents from Dimapur, Peren and Mokokchung districts had medium level of technological gap. The pooled data of the three districts showed that 64.73 per cent of the respondents had medium level of technological gap towards sustainable cultivation practices of pineapple.
17. A study on relationship of independent variables with technological gap of the respondents interpreted that the variable age showed positive and significant relationship with the technological gap of the respondents. Meanwhile, education, social participation, sources of information utilization, decision making ability, size of land holding under agriculture, size of land holding under pineapple cultivation, annual income, employment generated,

economic motivation, management orientation, IPM, INM, training exposure and experience had negative and significant relationship with the technological gap of the pineapple farmers. Further, multiple regression analysis indicated that the R^2 value was 0.455 where the variables namely, age, education, sources of information utilization, decision making ability, achievement motivation, productivity, employment generated, market orientation, management orientation, Integrated Pest Management, Integrated Nutrient Management and experience significantly contributed to the prediction of technological gap of the respondents and may be considered as good predictors of technological gap. Result on comparison of technological gap among the districts showed that all the three districts were statistically significant with each other at p value less than 0.01 level.

18. The result on attitude of respondents towards sustainable cultivation practices revealed that majority (75.43%) of the respondents from Dimapur district had medium level of attitude. Similarly, 70.00 per cent of the respondents from both Peren and Mokokchung districts had medium level of attitude. It was also found from the consolidated data of the three districts that majority (73.45%) of the respondents had medium level of attitude towards sustainable cultivation practices of pineapple. Correlation analysis revealed that the independent variables education, social participation, sources of information utilization, innovativeness, risk bearing ability, achievement motivation, size of land holding under pineapple, annual income, productivity, employment generated, economic motivation, market orientation, management orientation, IPM, INM, extension contact, training exposure, experience and scientific orientation had positive and significant relationship with the attitude of the respondents. In addition, multiple regression analysis result showed that variables occupation, sources of information utilization, employment generated, economic motivation, management orientation, experience and scientific orientation significantly

contributed to the attitude of the respondents towards sustainable cultivation practices of pineapple. The R^2 value indicated that the independent variables contributed 51.8 per cent variation in attitude level of the respondents. The results of z test conducted to compare the attitude of farmers towards sustainable pineapple cultivation among the districts indicated a statistically significant difference between the three districts with a p value of less than 0.01.

19. Path analysis was applied to know the direct and indirect effects of independent variables on knowledge level of sustainable cultivation practices of pineapple. With regards to direct effects on knowledge level, employment generated stood first followed by information sources utilization and management orientation. Likewise, extension contact had the highest indirect effect followed by size of landholding under pineapple cultivation. The residual effect was found to be 0.5096.
20. Factor analysis was employed to analyze the factors that influence the adoption of sustainable cultivation practices of pineapple. Eight (8) factors were extracted through conglomeration of independent variables which was later renamed. These eight factors explained 62.48 per cent variance in adoption of sustainable cultivation practices of pineapple.
21. With respect to constraints faced by the pineapple growers in adoption of sustainable cultivation practices of pineapple, the highest constraint faced under labour constraint was high wage rate with a mean score of 52.14. Under economic constraint, the highest constraint faced was poor economic condition of farmers (60.64). In case of technological gap constraint, lack of knowledge on IPM with a mean score of 68.56 was the highest constraint and ranked first. Lack of reliable market (64.8) under marketing constraint was ranked first. It was also found that lack of contact with extension agent with a mean score of 54.91 was the highest extension constraint faced by the respondents. In case of input constraints, lack of organic manure was found

to be the highest constraint with mean score of 63.73. Lack of storage facilities, damage by insect, increase in temperature and weeding problem were the highest constraints faced by the pineapple growers under infrastructural, IPM, environmental and other constraints respectively. Overall ranking of the different aspects of ranking revealed that economic, extension, input, infrastructural, IPM and other constraints were ranked first with an overall mean score of 50.

Implications and recommendations of the study

1. The scales developed for measuring the attitude of farmers towards sustainable cultivation practices of pineapple and market innovativeness were found to be reliable, valid and consistent. Thus, these scales can be used to measure the attitude of farmers towards sustainable cultivation practices and market innovativeness in agricultural research for imparting need based trainings.
2. Majority of the respondents were educated and middle aged between 36-50 years. These educated groups of farmers can be guided and trained properly, to enhance the productivity and profitability of pineapple by adopting sustainable farming practices.
3. Majority of the pineapple farmers belonged to marginal land holding category. It becomes crucial to consider the aggregation of products and formation of cooperative farming initiatives. This can be achieved through the promotion of pineapple-based Farmer Producer Organizations (FPOs), which can aid the farmers to achieve higher levels of income and overall development.
4. Majority of the respondents had medium level sources of information utilization, extension contact and social participation. This calls for improvement in these areas to empower the farmers with the required knowledge and skills, right information platform and enhance their well-

being. These can be achieved by strengthening information dissemination through extension services, mobile apps and community interaction.

5. Pineapple growers had medium level of knowledge and adoption towards sustainable cultivation practices of pineapple. It was found that the respondents lacked knowledge on practices such as treatment of planting material, use of growth regulators, application of manures and fertilizers, pest and disease management and value addition. These gaps can be addressed by organizing need-based training, workshops, exposure trips, demonstrations, disseminating relevant knowledge and information through pamphlets, brochures, folders and through digital platforms such as mobile apps, SMS services and social media. This can also be improved by the concerned department and stakeholders take more active role in sensitizing and educating the farmers about the basic and latest sustainable cultivation practices.
6. The study revealed that variables such as education, social participation, sources of information utilization, size of landholding, annual income, profitability, productivity, employment generated, economic motivation, market orientation, management orientation, integrated nutrient management, extension contact, training exposure, experience, scientific orientation, decision making ability, achievement motivation and integrated pest management were significant in influencing the knowledge, adoption, technological gap and attitude of the respondent towards sustainable cultivation practices of pineapple.
7. The pineapple growers' lack of knowledge on processing and value addition can be addressed through active involvement of the extension agencies. They can play a vital role by organizing training programmes and demonstrations specifically focused on processing and value addition of pineapple fruits. These knowledge and skills will not only generate income and employment opportunities but also help prevent post-harvest losses whenever they are

unable to sell in the market. The extension agencies can also provide proper guidance on market opportunities for processed pineapple products and create a link between the sellers and buyers. Efforts can also be made by the concerned departments and change agents to establish small-scale processing units or industries which can facilitate the farmers with infrastructure and equipment for processing the fruits.

8. Farmers need to be made aware of credit facilities and loans provided by the government and semi-private companies. Extension agents can conduct awareness programmes on the various financial avenues available and guide them how to access the facilities.
9. The extension workers also need to give attention to promote low-cost technologies, educate the farmers in improving their knowledge on IPM and IDM, importance on maintaining fertility of their agricultural lands, importance of technologies for gaining more information on sustainable agriculture. Collaboration with the Ministry of micro, small and medium can be initiated by extension agencies and policymakers to explore opportunities such as schemes, subsidies for the pineapple growers.
10. Medium level of technological gap indicated the potential for improving the technology adoption by farmers even after so years of concentrated extension work. The technological gap in case of nutrient management can be reduced through planting more green leaf trees, ensuring timely availability of fertilizers. Proper maintenance of spacing, application of FYM and treatment of planting material is a pointer towards better yield realization without additional investment towards cost of cultivation.
11. The study also revealed that the farmers faced constraints with respect to assured market. Besides the available marketing network, steps should be taken to aggregate the volume of products through FPOs as catalyst and promoting e-marketing for further improvement of the marketing scenario.

12. Extension agents, policy makers and stakeholders have a pivotal role in prioritizing and encouraging adoption of sustainable agricultural practices though effective policies and programmes. These efforts can contribute to the development of resilient farming systems, protection of our natural resources, ensure long-term food security and environment sustainability.

Suggestions for future research

1. The present study was conducted in three leading pineapple growing districts of Nagaland. Similar type of study may be conducted in other districts of the state as well as in the other north-eastern region.
2. The present study had the limitation of time and resource of a single investigator with a sample size of 275. Thus, comprehensive study with a large sample size including a higher number of farmers may be taken up for in depth results and for wider application of the results.
3. Further research related to sustainable agricultural practices may be taken up as it is one of the growing concerns in today’s agriculture.

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APPENDICES

APPENDICES

INTERVIEW SCHEDULE

(Topic: Status and determinants of sustainable cultivation practices followed by pineapple growers in Nagaland)

Respondent No.: ________ Date: _____________

Part- A

1. General information:

1. Name of the respondent:
2. Village:
3. RD Block:
4. District:
5. Soil type:
6. Whether soil health card is issued:

2. Socio- economic, personal and psychological characteristics:

2. 1 Personal characteristics

1. Age: _________ years
2. Sex: Male:______ Female: ______
3. Marital status: Married: ______ Unmarried: ______
4. Family size: Adult Male: _____ Adult Female: _____ Children: _____ Total: ____
5. Education (Please tick ✓ where appropriate):

   Illiterate/ Fn illiterate/ Primary/ Middle (5-7)/ Highschool/ Higher sec/ Graduate/ Above graduate
6. Formal education: ___________ (No. of years of schooling)

2. 2 Economic characteristics

1. Occupation (Please tick ✓ where appropriate):
   i. Farming: ( ) ii. Farming + Business: ( )
   iii. Farming + Service: ( ) iv. Farming + Business + Service: ( )
2. Size of the total land holding under agriculture: _______ bigha/acre/hectare
3. Size of the total land holding under pineapple cultivation: _______ bigha/acre/hectare
4. Total production of pineapple: _______ quintals
   a. No. of fruits harvested per season: _______
   b. No. of times harvested in a season: _______
5. Pineapple is grown:
   a. On a separate plot: ____ if yes ______bigha/ acre/hectare

b. As mixed crop: _____ if yes _____ bigha/acre/ hectacre. Crops grown:___________________________ ____________________________________

c. Crops grown other than pineapple in a year in all the seasons

a. _________ b. __________ c. __________ d. __________ e. __________ f. ___________

6. Do you also rear livestock? If yes, pl state the following details

Sl. No.	Name of livestock	Name of the breed	No.	Purpose Meat/Others	Income per yr	Do you recycle the animal waste to make compost/manure?

- What is your primary motive of pineapple cultivation: Give your rank preference
  - a. For home consumption: _______
  - b. Selling and profit making: _____
  - c. Because other farmers are also cultivating: _____
  - d. As govt. is providing subsidy?____. If yes, how much do u receive/yr? _________
  - e. To become the highest pineapple producer in my area:_______
  - f. Any other, pl specify: ____

7. Annual Income

i. Income from Agriculture : Rs__________

ii. Income from Business : Rs__________

iii. Income from Service : Rs__________

iv. Income from other enterprises

a. Dairy : Rs__________

b. Piggery : Rs__________

c. Poultry : Rs__________

d. Duckery : Rs__________

e. Fishery : Rs__________

f. Goatery : Rs__________

g. Others (Pl mention) : Rs__________

Total Annual Income : Rs__________

8. Income from pineapple cultivation /yr: Rs__________

9. Productivity of land under pineapple cultivation: _________

10. Profitability

Please provide the following details:

Items	2016	2017	2018
Area under pineapple cultivation in acre:			
Production			

Cost of production (Rs)			
a. Planting materials			
b. Labour charges			
c. Implements			
d. Manure			
e. Fertilizer			
f. Plant protection			
g. Storage			
h. Transportation			
i. Any others			
HH consumption (Kg)			
Total quantity sold (q)			
Quantity sold in nearest market			
Quantity sold in other market (q)			
Rate of sale (Rs./Kg) in nearest market			
Rate of sale in other market			
Total income from pineapple cultivation			

11. Experience in pineapple cultivation: _______ years
12. Employment generated

    Please mention the number of mandays generated for every practice during sustainable pineapple cultivation:

Labour	Duration of month	Land Prepa-ration		Plant-ing		Man-Uring		Irriga-tion		Weed-ing		IPM		DM		Harvesting		Post Harvest Manag-ement		Value Addition		Ratooning	
Family Labour																							
Hired Labour																							

13. Input self sufficiency
    a. Planting material

       From where do you get your planting material?

Sl. No.	**Statements**	**Yes**	**No**
1.	Preserved from the previous season?		
2.	Purchased from the market? Rate the price if yes.		
3.	Free of cost from the concerned Department?		
4.	At subsidized rate from the concerned Department? Rate the price if yes		

b. Manure

Manure	Source			
	Own farm	**Purchase from the market. If yes, rate & quantity purchased**	**Free of cost from concerned department**	**At subsidized rate from concerned department. Rate of purchase**
1. FYM/ Cowdung				
2. Vermicompost				
3. Compost				
4. Poultry litter				
5. Azolla				
6. Any others				

c. Tools/implements

Tools/ Implements	Personally owned	Hired	No. of days hired	If hired, rate/ implement
1. Tractor				
2. Drill				
3. Dao				
4. Irrigation tools				
5. Bullock				
6. Plough				
7. Sickle				
8. Spray pump				
9. Power tiller				
10. Weeder				
11. Others, if any				

13. Household vulnerability
    1. Socio- demographic profile
        1. Can you please list the ages and sexes of every person who eats and sleeps in the house? If you had a visitor who ate and slept here for the last three days, please include them as well.

Sl. No.	Age (Years)	Gender (M/F)
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		

2. Are you the head of the household? Yes/ No
3. Age of the head of the household: _______________
4. Gender of the head of the household: ____________
5. Did you ever go to school? Yes/ No
6. Are there any children less than 18 years old from other families living in your house because one or both of their parents has died? Yes/ No
   If yes, how many children? ________________________

2. Livelihood
   1. How many people in your family go to different community to work?_______________
   2. Do you or someone else in your household raise animals? __________________
   3. Do you or someone else in your household grow crops? If yes, what are the crops grown?
      ____
   4. Do you or someone else in your household collect something from the bush, forest or lakes and rivers to sell? _________________

3. Health
   1. How long does it take you to get to a health facility (nearest)? _______________min/hours
   2. Is anybody in your family chronically ill? ___________________________
   3. Has anyone in your family been so sick in the past 3 months that they had to miss work or school? _________________________

4. Social Network
   1. Did you borrow any money from friends or relatives in the past few months? ___________
   2. Did you and your family help friends and relatives in ending money during the past few months? ___________________________
   3. Are you and your family a member of any group(s) and involved in its activities?_________
   4. In the past 12 months, have you or someone in your family gone to your community leader for help? ______________________

5. Food
   1. From where does your family get most of its food?
      Grown by family/ Bought from market/ Collected from the forest
   2. Does your family have adequate food the whole year? Yes/ No
   3. How many months a month do your family have trouble getting enough food? ___ months
   4. What are the different types of crops your family grow in your field?

____

5. Do your family save some of the crops you harvest to eat during the different time of the year? Yes/ No
6. Do your family save the seeds to grow the next year? Yes/ No

6. Water
   1. Do you experience increasing water shortages, prolonged frequency of droughts and increase in soil salinity? Yes/ No
   2. From where do you collect your water from?

      Tap water/ Well/ Rainwater/ River (Tick wherever applicable)
   3. How long does it take to get to your water source? ____________ minutes/hours
   4. Is the water available everyday? Yes/ No

7. Natural disaster and climate variability
   1. How many times has your area been affected by landslide/ flood/ drought/ cyclone during 2012- 2017?
   2. Did you receive warning about the landslide/ flood/ drought/ cyclone before it happened? Yes/ No
   3. Do you experience in temperature during the past 10 years? Yes/ No
   4. Do you receive lesser rain than average rainy days during the past 10 years?

      Yes/ No
   5. Do you practice any adaptation measures to climate change/ weather problems? Yes/ No
   6. Monthly average temperature (Maximum and minimum) and precipitation during 2014 – 2018: _____________________

2. 3 Communication attributes of the pineapple growers

1. Training exposure

   Have you undergone trainings related to pineapple cultivation during the last 5 years? _________(Y/N)

   If yes, please give the following details:

Sl. No.	**Name of the organization imparting training**	**Year of training**	**Area / Topic**	**No of days attended**

Was the training beneficial to you? Y/N. Do you require more training? Y/N

Pl mention specific areas for which training is required: ____

2. Extension Contact

Please mention from which of the following and frequency of contact you seek for pineapple cultivation:

Extension workers	**Frequency of visit**		
	Regularly	**Occasionally**	**Never**
AFA/HEA			
AO/SDAO/HO			
KVK			
ATMA			
NGOs			
Others			

3. Information sources utilization

Please mention which of the following information sources you refer for pineapple cultivation:

a) Mass- Media sources:

Sources of Information	**Most often**	**Sometimes**	**Never**
1. Radio			
2. Television			
3. Exhibition			
4. Printed media (Poster/folder/ leaflet/ etc)			
5. Newspaper			
6. SMS based services			
7. Agricultural apps/ WhatsApp/ Facebook/ Instagram			
8. Videoconferencing			

b) Formal information sources:

Sources of Information	**Most often**	**Sometimes**	**Never**
1. AFA/ HEA			
2. AO/SDAO/HO/HEA			
3. KVK			
4. ATMA			
5. NGOs			
6. Any other			

c) Informal information sources:

Sources of Information	**Most often**	**Sometimes**	**Never**
1. Friends			
2. Relatives			
3. Neighbours			
4. Progressive farmers			

4. Social Participation

Are you are a member(s) of any of the following organizations and actively take part? If yes, please mention the details:

Organization	**Membership**		**Frequency of participation**		
	Member	**Office bearer**	**Regularly**	**Occasionally**	**Never**
1. Village Council/ Village Panchayat					
2. Village Development Board					
3. Farmer Cooperative Society					
4. Farmers' Club					
5. SHG					
6. Youth Club					
7. Others					

2.4 Psychological characteristics of pineapple growers

A- Agree UD- Undecided DA- Disagree

1. Innovativeness

Statements	**Continuum**		
	A	**UD**	**DA**
1. I am very much interested in adopting improved varieties of pineapple			
2. Since I am not sure of success of new varieties of pineapple, I would like to wait till others adopt.			
3. Since new varieties of pineapple are not promising, I am not interested in it.			
4. I try to keep myself well informed about any new varieties of pineapple and try to adopt as soon as possible.			
5. New varieties of pineapple are not easily adoptable and hence I do not adopt.			

2. Risk- taking ability **A-Agree UD- Undecided DA- Disagree**

Statements	**Continuum**		
	A	**UD**	**DA**
1. A farmer should grow more number of crops to avoid greater risks involved in growing one or more crops.			
2. A farmer should rather take more of a change in making a big profit than to be content with a smaller but less risky profit.			
3. A farmer who is willing to take greater risks than the average farmer usually has better financial condition.			
4. It is good for a farmer to take risk when he knows his chance of success is high.			
5. It is better for a farmer not to try new farming methods unless most other farmers have used them with success.			
6. Trying an entirely new method in farming by a farmer involves risk, but it is worth.			

3. Achievement motivation

A-Agree **UD- Undecided** **DA- Disagree**

Statements	**Continuum**		
	A	**UD**	**DA**
1. Work should come first even if one cannot get proper rest in order to achieve one's goal.			
2. It is better to be content with whatever little one has, than to be always struggling for more.			
3. No matter what I have done, I always want to do more.			
4. I would like to try hard at something which is really difficult even if it proves that I cannot do it.			
5. The way things are nowadays, discourage one to work hard.			
6. One should succeed in occupation even if one has to neglect his family.			

4. Decision making ability

A-Agree **UD- Undecided** **DA- Disagree**

Statements	**Continuum**		
	A	**UD**	**DA**
1. To try new sustainable pineapple cultivation practices.			
2. To increase/decrease crop area in sustainable pineapple cultivation.			
3. To hire farm labour for sustainable pineapple cultivation.			
4. To borrow loan for the inputs and farm work for sustainable pineapple cultivation.			
5. To buy farm equipments.			
6. To try new variety of crops.			

5. Management Orientation

SA- Strongly Agree, A- Agree, UD- Undecided, DA- DisAgree, SDA- Strongly DisAgree

a) Planning Orientation:

Statements	**Continuum**				
	SA	**A**	**UD**	**DA**	**SDA**
1. One should think about the sustainable practices that can be incorporated in pineapple cultivation.					
2. The amount of inputs needed for the economic activity should be assessed well in advance.					
3. It is not necessary to make prior decisions about the sustainable practices to be followed.					
4. It is not necessary to think ahead the total cost involved in starting the sustainable practice.					
5. One should not consult experts and experienced persons for planning the activities.					
6. It is possible to increase the returns through farm production plans.					

b) Production Orientation:

Statements	**Continuum**				
	SA	**A**	**UD**	**DA**	**SDA**
1. Determining nutrient analysis by soil testing saves no money.					

2. Sowing the appropriate variety ensures good yield.					
3. With high water rate, one should use as much irrigation water as available.					
4. For timely solving of problems, one should use appropriate problem solving techniques.					
5. For timely harvest, one should analyze the maturity of crop.					
6. Activities should be adopted as recommended by specialists/ experts.					

c) Market Orientation:

Statements	**Continuum**				
	SA	**A**	**UD**	**DA**	**SDA**
1. Market information is not useful for pineapple cultivation.					
2. A farmer can get good price by grading his produce.					
3. One should sell his produce to the nearest market irrespective of prices.					
4. Better market facilities can help the pineapple growers to get a better price for his produce.					
5. One should sell his produce through middlemen.					

6. Scientific Orientation

Statements	**Continuum**				
	SA	**A**	**UD**	**DA**	**SDA**
1. Scientific methods always confuse me.					
2. Application of scientific methods is wastage of time.					
3. Scientific techniques damage the ecology.					
4. Profitable agricultural production is possible through scientific technique.					
5. I prefer scientific techniques of pineapple production.					
6. Scientific technique require high infrastructure.					
7. New methods of farming gives better results to a farmer than the old method.					
8. The way farmer's forefathers practiced agriculture is the best way even today.					
9. Even a farmer with lots of experience should use new method in agriculture.					
10. Though it takes time for a farmer to learn new methods, it is worth the effort.					
11. A good farmer experiments with new ideas in farming.					
12. Traditional methods in farming have to be modified in order to raise the level of living a farmer.					

7. Economic motivation

Statements	**Continuum**				
	SA	**A**	**UD**	**DA**	**SDA**
1. A pineapple grower should work towards higher yield and economic profit.					
2. The most successful pineapple grower will make more profit.					
3. It is difficult for the growers' children to make a good stand unless he provides them with economic assistance.					

4. A grower should try any new ideal technologies that may earn more money.					
5. A grower should grow cash crops to increase monitory profits instead of field crops for home consumption.					
6. A grower must earn his living but most important thing in life is one in which it can be defined in economic terms.					

8. Attitude towards sustainable pineapple cultivation practices:

Sl. No.	Statements	Continuum				
		SA	A	UD	DA	SDA
1.	One should go for adopting sustainable pineapple cultivation practices as it is beneficial to farmers.					
2.	Soil and water resources belong to only the present generation and so maximum resources must be used to make it sustainable.					
3.	A farmer should prepare compost from the farm waste in sustainable cultivation practices.					
4.	Sustainable pineapple cultivation practices benefits only the producers and not the environment.					
5.	In order to sustainably manage a pineapple farm, a farmer should essentially go for curing of suckers and slips.					
6.	Sustainable pineapple cultivation practices can be practiced only by small farmers.					
7.	Maintaining good drainage system is not a sustainable practice in pineapple cultivation.					
8.	One should opt for adopting biological pest control practices in sustainable cultivation practices.					
9.	A farmer should not be aware that drip irrigation help in maintaining optimum growth of the plant in sustainable pineapple cultivation.					
10.	Biocontrol is not a sustainable practice to control the insect-pest population in pineapple field.					
11.	Using black polythene film as mulch is a sustainable method of controlling weed growth and conserving soil moisture in sustainable pineapple cultivation.					
12.	More pesticide and weedicide are required for controlling pests and weeds in sustainable cultivation practices.					
13.	A farmer must practice mulching the pineapple plantation with black polysheet to conserve the soil moisture and check soil erosion.					
14.	Desuckering practice in pineapple population is not advisable for sustainable cultivation.					

9. Market Innovativeness

Please give your opinion by ticking on any of the options provided below:

A- Agree **UD- Undecided** **DA- Disagree**

Sl. No.	Statements	SA	A	UD	DA	SDA

1.	I try to keep my self upto date with highest market price of Pineapple in the local market.					
2.	I try to keep my self upto date with latest market price of Pineapple in market outside the state of Nagaland.					
3.	I always keep myself updated about new markets where I can get the best price of pineapple.					
4.	I am heavily dependent on the traders who approach me to take surplus pineapple right from my farm.					
5.	I always take a lead in supplying the best varieties of pineapple in the market to fetch high price.					
6.	I feel that packaging of pineapple may unnecessarily reduce my profit in marketing.					
7.	I try to be the first in my area to supply the pineapple for marketing early in the market so as to fetch premium price.					
8.	I go for improved method of packaging pineapple so that it retains its quality during transportation so as to gain maximum profit.					
9.	I am seeking opportunities so as to export pineapple outside my country.					
10.	I am interested to develop value added products of Pineapple so as to maximize my profit from my pineapple enterprise.					
11.	I prefer selling pineapple in local market for easy and assured profit.					
12.	I grade pineapple before selling in market for getting premium price.					
13.	I usually want to see what results my fellow farmers obtained before I tryout the new marketing channels.					

Part- B

1. Knowledge level of pineapple growers regarding pineapple cultivation practices:

Please choose the correct options:

I. VARIETIES

1. Recommended varieties of pineapple are:
   a) Queen & Kew b) Charlotte c) Queen, Kew & Giant Kew d) Giant Kew

II. PROPAGATION

1. The preferred method of propagation for pineapple cultivation is:
   a) Sucker b) Slip c) Crown d) Disc e) Suckers and slips f) Crown & disc

III. LAND PREPARATION

1. The most common method of initial clearing of land for plants is by:
   a) Slash and burn b) Slash c) Burn the field

2. Pit digging and solarization is usually practiced in the month of:
   a) February b) March c) September d) November

3. Filling of pits with manures is practiced in the month of :
a) April b) May c) October d) November

IV. TREATMENT OF PLANTING MATERIAL
Suckers can be treated in _________ and by dipping them in a mixture of __________ and dried for 6-10 hours:
a) Neem oil solution @5ml/l and Cow pat pit b) Difoltan (0.4%) & neem oil @5ml/l c)Dithane Z-78 (0.3%) and cow pat pit

V. PLANTING
1. In single row system of planting, plants are planted at :
a) 30-60cm (P-P) & 75cm (R-R)
b) 40-60cm (P-P) & 75cm (R-R)
c) 30-60cm (P-P) & 80cm (R-R)
d) 40-60cm (P-P) & 80cm (R-R)

2. In double row system, the spacing is:
a) 30cm (P-P), 60cm between rows & 90cm between double rows from the centre
b) 40cm (P-P), 60cm between rows & 60cm between double rows from the centre
c) 45cm (P-P), 70cm between rows & 90cm between double rows from the centre
d) 30cm (P-P), 60cm between rows & 60cm between double rows from the centre

3. Plant population/ha for single row system:
a) 44,000 plants/ha b) 44,500 plants/ha c) 50,000 plants/ha d) 55,000 plants/ha

4. Plant population/ha for double row system:
a) 44,000 plants/ha b) 45,500 plants/ha c) 50,000 plants/ha d) 60,000 plants/ha

VI. PLANTING TIME
1. In Nagaland, Pineapple is planted during:
a) March – May and September – November
b) May – July and November – December
c) February – April and June – August
d) March – April and September – November

VII. MANURING
1. A dose of ______ t/ha of FYM (compost/cattle manure) can be applied as basal dressing:
a) 15t/ha b) 18t/ha c) 20t/ha d) 23t/ha

2. Green leaf and _______________ can be broadcasted around the plant after weeding and mixed with sol by light hoeing or forking:
a) Compost/cattle manure b) Neem cake c) Lime

3. ________ kg azotobacter/azospirrilum and ________ phosphotika for 1ha are mixed with 500kg compost.

a) 5kg and 5kg b) 10kg and 10kg c) 15kg and 15kg

VIII. INTERCULTURAL OPERATIONS:
MULCHING

1. Pineapple is covered with straw to prevent from:
   a) Sunburn b) Pest attack c) Fruit development

2. Black polythene mulching before pineapple plantation is laid to:
   a) Reduce expenditure on weeding, conserve the soil moisture and check soil erosion
   b) Reduce weeding
   c) Conserve the soil moisture
   d) Check soil erosion

3. During the summer months, the fruits are protected from scorching sun by:
   a) Covering with grasses as mulching materials
   b) Leaves of intercropping and mixed cropping leaves
   c) Both a & b

IX. CROPPING PATTERN

1. Pineapple can be mix cropped with crops such as
   a) Colocassia b) Yam c) Chillies d) Sweet potato
   e) Cabbage & Cauliflower f) Soybean g) All of these

2. Pineapple is extensively intercropped with:
   a) Turmeric b) Ginger c) Cowpea d) Colocassia
   e) Coconut &Arecanut f) Mango g) All of the above

X. IRRIGATION

1. Generally, source of water is solely dependent on:
   a) Rainwater b) Drip irrigation c) Sprinkler irrigation

2. For irrigation purpose, the methods are:
   a) Sprinkler b) Drip c) Rainwater
   d) Both a & b e) b & c f) All of these

3. In extreme dry conditions, the ideal way of maintaining the soil moisture requirement for optimum growth of plants is:
   a) Drip irrigation b) Sprinkler irrigation c) Furrow method

4. During the dry months, pineapple plantation requires _______ irrigation at an interval of 20-25 days.
   a) 4-5 b) 5-6 c) 6-7 d) 7-8

XI. WEED MANAGEMENT

1. Weed can be controlled manually, mechanically and chemically by:

a) Cutlassing, hoeing, uprooting, forks, etc b) Tractor drawn implements
c) Chemicals d) All of the above

2. Weeding is practiced throughout the pineapple plantation season depending upon______:
a) The population of the weeds b) No. of plants planted

3. The uprooted weeds can be used for making _________:
a) Organic compost b) Mulch c) Both a & c

4. An effective way of controlling weeds is :
a) Mulching with black polythene before planting b) Irrigation c) Earthing up

XII. GROWTH REGULATOR
To induce flowering of the plants, which of the following should be applied?
a) Ethrel @ 100ppm b) NAA @ 200-300ppm c) Planofix&celemone @ 10-20ppm

XIII. PEST AND DISEASE MANAGEMENT
PEST
1. MEALY BUG
1. Symptoms appear first on the _______:
a) Shoot b) Roots c) Crown
2. The roots cease to ___________ causing the plant to wilt:
a) Grow, collapse and rot b) Rot c) Collapse

3. Infected plants show __________growth:
a) Stunted b) Discolored c) Uncontrolled
4. Wilting at the tip of leaves develops a __________ colour:
a) Greenish b) Reddish c) Yellowish d) Reddish yellow

MANAGEMENT
1. The pest can be controlled by cultivating :
a) Unaffected plant material b) Affected plant material

2. _________harbouring in the pineapple field should be removed:
a) Butterflies b) Bees c) Ants

3. The incidence of pest can be reduced by applying :
a) Micro organisms like *Bacillus gordonae* b) Beetles

2. RODENTS
MANAGEMENT
1. Rodents can be controlled by setting up:
a) Cage trap with attractive baits b) Cage trap with insects

2. Rodents are fed poison bait with the following ingredients:
   a) Crushed rice/maize grains, vegetable oil, zinc phosphide/sodium fluoro acetate
   b) Crushed rice/maize grains, water and vegetable oil

DISEASE

1. HEART ROT

Symptoms

1. The disease causes complete ________ of the central portion of the stem:
   a) Drying b) Rotting c) Burnt out

2. The top leaves turn _________
   a) Black b) Yellow c) Brown

3. The basal portion of the leaves ________ with foul smell:
   a) Burn b) Rot c) Both a & b

Management

1. Good ___________ should be maintained.

a) Soil drainage b) Plant distance c) Both a & b

2. One must use ___________:
   a) Untreated planting material b) Unhealthy planting material
   c) Healthy planting material

3. _________ has the potential to control heart rot:
   a) Trichoderma b) Azolla c) Bacillus gordonae

2. LEAF AND FRUIT ROT:

1. The disease of planting material occurs when they are not _________:
   a) Dried b) Washed c) Soaked
2. The fungus also destroys other plants by entering through:
   a) Stem b) Wounds c) Stalk

3. In severe conditions, the entire plant may turn dark and _______:
   a) Die b) Rot c) Dry

MANAGEMENT

1. Diseased plants must be:
   a) Preserved b) Destroyed c) Both a & b

2. Suckers for propagation must be from:
   a) Infested areas b) Uninfested areas c) Both a & b

3. _________ has the potential to control leaf rot:

a) Trichoderma b) Azolla c) Bacillus gordonae

3. LEAF SPOT:
1. Initial symptoms are ___________ on the leaves:
   a) Water soaked lesions b) Green colored lesions c) Yellow colored lesions

2. The spots later ________ in size and gradually dry up:
   a) Enlarge b) Decrease

MANAGEMENT
1. Good ___________ should be maintained:
a) Soil drainage b) Plant distance c) Both a & b

2. One must use ___________:
   a) Untreated planting material b) Unhealthy planting material
   c) Healthy planting material

3. _________ has the potential to control leaf spot:
   a) Trichoderma b) Azolla c) Bacillus gordonae

4. BLACK ROT/ SOFT ROT
Symptoms
1. Small, __________ appear at the stalk end of the fruit:
   a) Circular, water soaked spots b) Water soaked spots

2. Fruit _______ and emit foul smell:
   a) Dry up b) Rot c) Both a & b

3. Delay between harvest and utilization of the ripe fruit leads to:
   a) Emergence of the disease b) Development of disease

MANAGEMENT
1. Avoid injury to the fruit during:
   a) Weeding b) Harvest c) Transit d) Harvest & transit

2. _________ has the potential to control black spot:
   a) Trichoderma b) Azolla c) Bacillus gordonae

XIV. HARVESTING
1. The fruit takes about ________ months for the fruit to mature:
   a) 12- 15months b) 15- 18 months c) 15-20 months

2. Observing the change in _________ is most common method of determining the maturity of fruits:
   a) Shape b) Size c) Colour

3. The fruit is harvested by ___________ the stalk a few cm below the fruit:
   a) Pulling out   b) breaking/cutting

4. Ripe fruits is determined by:
   a) Size of fruit   b) Colour of fruit   c) Brix content   d) All of these

RATOONING

1. Desuckering should be immediately done after harvesting leaving how many suckers in the mother plant?
   a) 1   b) 2   c) 3   d) 4

2. Plants should be well fertilized and properly earthed to allow the ratoon crop to have?
   a) Good anchorage   b) Nutrients

XV. STORAGE

1. For long storage, the harvested fruits should be:
a) Well ventilated and kept in cool/shade place   b) Well packed

2. Care should be taken to protect the harvested fruits against:
   a) Pest infestation   b) Fungal infestation   c) Viral infection

XVI. POST HARVEST MANAGEMENT:

a. CLEANING

The harvested fruits are cleaned by:
a) Removing the stalk and leaves from both ends
b) Removing the stalk and leaves from one end
c) Removing only the stalk
d) Removing only the leaves

b. COOLING

The harvested fruits are kept in _________ for cooling:
a) Shade   b) Covered with dried leaves   c) Baskets

c. GRADING & PACKAGING

1. The harvested fruits can be separated and graded according to:
a) Color   b) Shape   c) Size   d) Shape and size
2. _____________are used for packaging pineapple:
a) Plastic basket   b) Clean bamboo baskets   c) Jute basket

d. VALUE ADDITION

1. Pineapple juice can be prepared by using which of the following ingredients?
   a) Ripe pineapple fruits, KMS, water & sugar   b) Ripe pineapple fruits only

2. Which of the following ingredients are required for preparing pineapple squash?

a) Healthy and fully matured pineapple fruits, sugar, citric acid, KMS, essence and color
b) Healthy and fully matured pineapple fruits only

3. For the preparation of pineapple jam, the ingredients required are?
a) Pineapple bulb, sugar, citric acid, pectin powder, essence and color
b) Pineapple bulb and sugar only

2. Technological gap in adoption of sustainable cultivation practices of pineapple

Please tick in the adoption column where your level of adoption practice is applicable.

FA: Fully Adopted **PA: Partially Adopted** **NA: Not Adopted**

Sl. No.	Practices	Adoption			Gap %
		FA	PA	NA	
1.	**Land Preparation**				
	a. Digging of pits and solarising the soil				
	b. Pits are filled with manure				
2.	**Varieties**				
	a. Giant Kew & Kew				
	b. Queen				
3.	**Propagation** a. Suckers and slips are used as planting material				
4.	**Treatment of planting material**				
	a. Suckers/slips are dipped in a mixture of cow pat pit and dried for 6-10 hours before planting.				
	b. Suckers/Slips treated in neem oil solution @ 5ml/l before planting.				
5.	**Spacing**				
	a. In single row system: 30cm x 60cm x 75cm				
	b. In double row system: 30cm x 60cm x 90cm				
6.	**Plant population**				
	a. Plant population in single row: 44,500 plants/ha				
	b. Plant population in double row: 60,000plants/ha				
7.	**Planting time** March- May and September- November.				
8.	**Manuring**				
	a. A dose of 18t/ha of FYM (Compost/cattle manure) as basal dressing is applied.				
	b. Green leaf + compost/manure + soil applied around the plant after weeding. c. 10kg azotobacter/azospirillum and 10kg phosphotika for 1ha mixed with 500kg compost is applied.				
9.	**Irrigation**				
	a. The field is irrigated 5-6 times at an interval of 20-25 days during the dry period.				
10.	**Cropping pattern**				

	a. Pineapple is intercropped with mango, arecanut, coconut, ginger, turmeric, cowpea, colocassia, etc.				
	b. Pineapple is intercropped with crops such as colocassia, yam, chillies, sweet potato, cabbage, cauliflower, soybean, etc.				
11.	**Intercultural operations**				
	1. Mulching				
	a. Pineapple plants are covered with straw to prevent sunburn.				
	b. Black polythene is used to cover the plants as mulches.				
	c. Uprooted weeds are used as organic compost and mulch.				
	2. Weed management				
	a. Weeds are uprooted atleast twice in year.				
12.	**Growth regulator** a. Growth regulators such as planofix and celemone are applied @10-20ppm to induce flowering.				
13.	**Integrated Pest Management (IPM) &** **Disease Management (DM)**				
	1. Mealy bug:				
	a. Controlled by cultivating unaffected plant material.				
	b. Ants harbouring in the field are removed.				
	c. *Bacillus gordonae* is applied.				
	2. Rodent:				
	a. Cage trap with attractive baits.				
	b. Poison bait (Crushed rice/maize grains with vegetable oil & zinc phosphide/sodium fluoro acetate) is fed.				
	3. Heart rot, leaf rot & fruit rot:				
	a. Good soil drainage is maintained.				
	b. Healthy planting material is used.				
	c. Suckers are treated with *Trichoderma* @200 gm in 15-20l water for 10 minutes before planting.				
	d. 2% neem oil mixed with any detergent powder @40-50g/100l is sprayed.				
14.	**Harvesting**				
	a. The fruits are harvested 15-20 months after planting.				
	b. Fruits are harvested when the fruit turns yellow at the base and angularities of eyes start reducing and the bract withers.				
	c. Matured fruits are harvested by breaking/cutting the stalk a few cm below the fruit.				
15.	**Ratooning** a. Desuckering is done immediately after harvest leaving 1-2 suckers on the mother plant.				

	b. Proper fertilization and earthing up is done for good anchorage of the ratoon crop.				
16.	**Storage**				
	a. Harvested fruits are well ventilated and kept in shade/cool place for long storage.				
	b. Harvested fruits are protected against pest and disease infestation during storage.				
17.	**Post harvest management**				
	a. Harvested fruits are sorted and graded according to shape and size. b. Clean bamboo baskets are used for packing the harvested fruits.				
18.	**Value addition**				
	a. KMS, sugar and citric acid are used as preservatives during pineapple squash, juice and jam preparation.				
	b. Finished product is stored in sterilized bottles.				

Constraints faced by the farmers

Please rank the constraints based on constraints faced highest during sustainable cultivation practices of pineapple

1. Labour constraint

Sl. No.	Constraints	Rank 1	Rank 2	Rank 3
1.	High wage rate			
2.	Non- availability of labour			
3.	Labour intensive crop			

2. Economic constraint

Sl. No.	Constraints	Rank 1	Rank 2	Rank 3	Rank 4
1.	Non- availability of government subsidy/ agricultural credit				
2.	High cost of technology				
3.	Poor economic condition of farmers				
4.	High cost of planting material				

3. Technological constraint

Sl. No.	Constraints	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6
1.	Lack of knowledge on latest technology						
2.	Lack of knowledge on Integrated Pest Management						
3.	Inadequate training of farmers						
4.	Inadequate availability of mass media sources of information						

5.	Lack of technical know-how on seed treatment						
6.	Lack of knowledge on value addition of pineapple						

4. Marketing constraint

Sl. No.	Constraints	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6
1.	Lack of proper marketing channel						
2.	Poor marketing facilities resulting in high risk						
3.	Fluctuation in market rate						
4.	Exploitation by middlemen						
5.	Lack of reliable market						
6.	High cost of transportation						

5. Extension constraint

Sl. No.	Constraints	Rank 1	Rank 2	Rank 3
1.	Lack of contact with extension agent			
2.	Lack of timely advice and guidance by extension personnel			
3.	Lack of effective supervision			

6. Input constraint

Sl. No.	Constraints	Rank 1	Rank 2	Rank 3	Rank 4
1.	Lack of quality sucker/slip/crown				
2.	Non- availability of disease/ pest resistant planting material				
3.	Inadequate and timely non availability of fertilizers				
4.	Insufficient organic manure				

7. Infrastructural constraint

Sl. No.	Constraints	Rank 1	Rank 2	Rank 3	Rank 4
1.	Lack of farm machinery				
2.	Lack of vehicles for carrying to distant market				
3.	Lack of storage facilities				

4.	Lack of irrigation facilities				

8. IPM constraint

Sl. No.	Constraints	Rank 1	Rank 2	Rank 3	Rank 4
1.	Damaged by insect				
2.	Damaged by diseases				
3.	Problems in identification of disease and pest				
4.	Damage by bees, ants and rats				

9. Environmental constraint

Sl. No.	Constraints	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6
1.	Increase in temperature						
2.	Scarcity of water						
3.	Erratic rainfall						
4.	Increase in incidence of pest and diseases						
5.	Soil erosion						
6.	Low soil fertility						

10. Other constraints

Sl. No.	Constraints	Rank 1	Rank 2	Rank 3
1.	Poor shelf life			
2.	Weeding problem			
3.	Sunburn of leaves			


Pineapple flower


A young pineapple fruit


Suckers for propagation


A lady sorting out good & bad suckers


Slash & burned land for pineapple cultivation


Crown and slip for propagation

Plate 1


Single spacing


Double spacing


Triangle spacing


Mixed cropping with pineapple

Plate 2

Banana bordering pineapple field

Intercropping with *Zanthoxylum rhesta*

Covering of pineapple fruit with leaves and branches for protection from extreme heat

Mixed cropping with yam & maize

Plate 3

Pineapple fields in the plains and hills

Plate 4

Pineapple fields

Mulching with black polythene

Mulching with twigs & dried leaves

Infected pineapple plant

Pineapple fruit attacked by rodents

Plate 5

Pineapple farmers working in the field

A lady sowing the suckers in the field

Researcher interacting with the farmer in the field

Plate 6

Harvesting pineapples

Harvested pineapples

Harvested pineapples loaded in the vehicle

Harvested pineapples loading for transporting to the market

Pineapple stalls in the National Highway

Plate 7

Value addition of pineapple

Basket used for harvesting pineapple

Plate 8

Researcher with the respondents

Plate 9

Researcher with the respondents

Plate 10