A STUDY ON SUSTAINABLE CULTIVATION PRACTICES FOLLOWED BY NAGA KING CHILLI (*Capsicum chinense* Jacq.) GROWERS IN NAGALAND

Thesis
submitted to

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in partial fulfillment of requirements for the Degree

of

DOCTOR OF PHILOSOPHY

in

AGRICULTURAL EXTENSION EDUCATION

by

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DECLARATION

I, Tzubentula Jamir, 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.

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

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LIST OF ABBREVIATIONS

ISO	=	International Organization for Standardization
UN	=	United Nations
NEDFi	=	North Eastern Development Finance Corporation Ltd
ITP	=	Indian Trade Portal
BC	=	Before Christ
GI	=	Geographical Indication
et al.	=	and others
ºC	=	Degree Celsius
RH	=	Relative Humidity
viz.	=	Namely
ac	=	acre
ha	=	Hectare
q	=	Quintal
q/ac	=	Quintal per acre
MT	=	Metric tones
PUC	=	Up to college
%	=	Per cent
SHUs	=	Scoville Heat Units
APEDA	=	Agricultural and Processed Food Products Export Development Authority
NSAMB	=	Nagaland State Agricultural Marketing Board
ITC	=	Indian Tobacco Company
ICCOA	=	International Competence Centre for Organic Agriculture
FPOs	=	Farmers Producers Organisations

SSC	=	Secondary School Certificate
$	=	Dollar
TZS	=	Tanzanian Shilling
GAP	=	Good Agriculture Practice
NGOs	=	Non- Government Organizations
NPV	=	Nuclear Ployhedrosis Virus
SAP	=	Sustainable Agricultural Practices
FYM	=	Farm Yard Manure
SME	=	Small and Medium-sized enterprises
MPS	=	Mean Percent Score
^{o}	=	Degree
$'$	=	Feet
N	=	North
E	=	East
mm	=	Millimetre
Sq. km	=	Square Kilometre
km	=	Kilometres
RD	=	Rural Development
$\bar{\chi}$	=	Mean
σ	=	Standard Deviation
$<$	=	Less than
$>$	=	Greater than
VEW	=	Village Extension Worker
AO	=	Agriculture Officer
HO	=	Horticulture Officer
SDAO	=	Sub Divisional Agriculture Officer

SDHO	=	Sub Divisional Horticulture Officer
KVK	=	Krishi Vigyan Kendra
ATMA	=	Agriculture Technology Management Agency
ICAR	=	Indian Council of Agricultural Research
NSRLM	=	Nagaland State Rural Livelihood Mission
A	=	Agree
SA	=	Strongly Agree
DA	=	Disagree
SDA	=	Strongly Disagree
UD	=	Undecided
R	=	Relevant
MR	=	Most Relevant
LR	=	Less Relevant
MRS	=	Mean Relevancy Score
KI	=	Knowledge Index
AI	=	Adoption Index
EI	=	Entrepreneurial Index
SI	=	Sustainability Index
r	=	Correlation
f	=	Frequency
R	=	reliability coefficient
Sl. No.	=	Serial Number
H_0	=	Null Hypothesis
Fig	=	Figure
PUC	=	Pre-University Course
Rs.	=	Rupees

IPM	=	Integrated Pest Management
IDM	=	Integrated Plant Disease Management
Avg.	=	Average
Prod.	=	Production
Product.	=	Productivity
Min.	=	Minimum
Max.	=	Maximum

ABSTRACT

The study entitled "**A study on sustainable cultivation practices followed by Naga king chilli (*Capsicum chinense* Jacq.) growers in Nagaland"** was undertaken to analyze the socio-economic, personal and psychological characteristics of Naga king chilli growers, status of knowledge, attitude, extent of adoption of sustainable cultivation practices, entrepreneurial behaviour of Naga king chilli growers, and to identify the constraints faced by the respondents in following sustainable cultivation practices and suggest strategies to overcome them. The study was conducted in three districts of Nagaland *viz.*,Peren, Mon and Dimapur district. Further two RD blocks from each district were selected randomly. A total of twelve villages, two villages from each RD block were selected randomly. A sample size of 250 respondents was selected following proportionate random sampling procedure. The findings revealed that 69.20 per cent belonged to the age group of 35 to 55years, while, 66.40 per cent had medium family size with 5 to 8 members; 94.40 per cent of them had education upto graduate level; 69.20 per cent had 2.50 to 5.0 acres of land holding under agriculture; 82.00 per cent had 1acre to 2 acre of land under Naga king chilli cultivation; 44.44 per cent had annual income between Rs.50, 000 to Rs.1, 00,000; 72.40 per cent had annual income from king chilli cultivation between Rs 19,294 to Rs 59,145; 47.60 per cent had received training on sustainable Naga king chilli cultivation during the last five years; 66.80 per cent had medium level of training need; 49.60 per cent had high experience in Naga king chilli cultivation;73.60 per cent of them had medium level of information sources utilization; 46 per cent and 58.80 per cent had medium level of marketing orientation and economic motivation respectively; 63.20per cent had high level of social participation with an average productivity of 1.72 q/acre; 60.40 per cent had medium knowledge; 64.00 per cent had favourable attitude towards sustainable Naga king chilli cultivation; 66.40 per cent had medium adoption level; 62.00 per cent had medium level of entrepreneurial behaviour. Correlation analysis revealed that variables *viz.*, size of total land under Naga king chilli and extent of adoption showed significant association with knowledge of Naga king chilli growers at 1 per cent level of probability, while, family size, training exposure and information sources utilization displayed a significant association with knowledge at 5 per cent level of probability. The variables annual income from Naga king chilli, economic motivation, productivity and entrepreneurial behaviour of Naga king chilli growers had significant association with attitude of Naga king chilli growers towards sustainable Naga king chilli cultivation practices of at 1 per cent level of probability while size of total land under Naga king chilli showed significant association at 1 per cent level of probability. Regression analysis revealed that economic motivation and entrepreneurial behaviour of Naga king chilli growers showed significant association with the attitude of the farmers and explained 64.60 per cent of variance with the dependent variable attitude. Path analysis revealed that variables *viz.*, size of total land under Naga king chilli, extent of adoption, entrepreneurial behavior and information source utilization were the major variables exerting highest direct positive influence on respondents' knowledge. While, size of total land under Naga king chilli and entrepreneurial behaviour exerted maximum total indirect effect on the knowledge of the respondents. In respect of the total direct effects on the respondents attitude towards sustainable Naga king chilli cultivation practices, the findings revealed that entrepreneurial behaviour and age delivered the highest positive influence in Naga king chilli cultivation. In addition, entrepreneurial behaviour and age made the highest positive indirect influence on the respondents' attitude towards sustainable Naga king chilli cultivation practices. Out of different dimensions of sustainability, it was found that social sustainability contributed the highest with Sustainability Index of 78.43 followed by environmental sustainability (70.38), economic sustainability (48.80) and institutional sustainability (29.51). Factor analysis revealed that 'Land use and income' factors accounted for 19.53 per cent of total variations towards the sustainability of Naga king chilli cultivation practiced by the farmers followed by 'Entrepreneurial attributes' (13.31%), 'Resource management' (11.01%), 'Extension accesses'(9.50%), 'Marketing strategy' (6.11%) and 'Socio economic' (5.8%). All these six factors combinedly contributed 65.32 per cent towards achieving sustainable Naga king chilli cultivation. Major constraints faced by the respondents included biotic & abiotic constraints, technical constraints, extension contact, post-harvest, input supply, marketing constraints, land/soil related constraints, economic constraints, social constraints and labour constraints. It is recommended that sensitization of farmers on the importance of sustainable production and need based training on technical know-how of sustainable Naga king chilli cultivation practices should be imparted to the respondents along with requisite assistance from the government to promote and upgrade Naga king chilli cultivation towards sustainability and entrepreneurship development for market led production. Farmers may also be motivated on production practices which are environment friendly, economically viable as well as socially acceptable so that productivity level is sustained with optimum utilization of inputs and resources without compromising the availability of products for future generation.

Keywords: *Naga king chilli, sustainability, attitude, technology adoption, Nagaland*

CHAPTER-I

INTRODUCTION

INTRODUCTION

Sustainability in agricultural production has become a pressing priority for availability of sufficient food, assured employment to growing populations and conservation of natural resources as well as the environment. (Bairwa *et al.*, 2014). Sustainable cultivation focuses on production practices which are environment friendly, economically viable as well as socially acceptable so that productivity level is sustained for the practicing farmers with optimum utilization of inputs and resources without compromising the availability of products for future generation. Attaining a guaranteed worldwide food supply remains incomprehensible to multilateral partners, analyst, scientist, policy makers and state governments. At present the circumstances has changed dramatically and is complicated than any other time as a result of the unprecedented adversities facing global food production systems (Godfray *et al*., 2010; Foley *et al*., 2011; Ochola *et al.*, 2013; Grote, 2014; Fan & Brzeska, 2016; Mockshell and Kamanda, 2017). In addition, the booming world population, which is estimated to reach 8.5 billion by 2030, and 9.7 billion by 2050 (Mockshell and Kamanda, 2017; UN, 2023). As the world population endures to grow at an exponential rate (Muhie, 2022), food production is anticipated to enhanced by almost three quarters to satisfy the needs of the swelling population (Shields, 2019). Assuring sustenance for the burgeoning population is a paramount challenge. Additionally, against the rapidly advancing climatic variations, decline of biological diversity and prolonged dry period, it is apparent that world agriculture production must swiftly and decisively shift toward sustainability (Carlisle *et al.,* 2019). Adopting sustainable and innovative farming techniques with the primary goal to strengthen environmental protection, increase productivity, economic security and improve livelihood is the key for a long-term well-being. (Smith and Serna, 2023).

Amidst the global concern, India has established a reputation with respect to production and export of spices. India produces about 75 of the 109 varieties of spices recorded by the International Organization for Standardization (ISO) and attribute close to fifty per cent of the spices traded worldwide (NEDFi, 2021). Production in 2020 to 2021 stood at 10.88 million tonnes. Chilli, turmeric, ginger, cumin and coriander alone makes up over three quarters (76.00%) of the entire production. India is the largest exporter of spice and spice products. During 2020 to 2021, the export of spices accomplished an exceptional all-time high both in terms of value and volume by recording a rise of 17 percent in US dollar terms and 30 percent in volume terms (ITP, 2022). Northeast region of India produces 7, 37,550 tonnes of spices per annum from an area of 2, 28,950 ha (Ralte and Ekhe, 2022) which accounts for 9 percent of the total production of spices in the country (NEDFi, 2021). The North-eastern hill region are default organic in nature and is home to some endemic spice crops like black turmeric, Lakadong turmeric, king chilli, bird's eye chilli, Assam lemon, etc., which has high market demand for their unique features. Spices account for a major category of agricultural commodities which fairly indispensable not only in the culinary world but also for the growing global demand from the emerging nutraceutical sectors (NEDFi, 2021), while boosting the economy of the country.

Chilli is a perennial dicotyledonous flowering plant belonging to the family *Solanaceae*. The most valued economic trait of the crop is a small berry which is pungent and aromatic (Jamir and Jha, 2020). Chilli is a prominent spice crops of the world and has been an integral component of the human diet since at least 7500 BC. Chilli was first introduced in India by the Portuguese towards the end of 15th century and ascribed to its taste, unlimited utility, adaptability in Indian climatic conditions, its cultivation gained popularity in 17th Century (Indira *et al.,* 2007). Since then, Indian chillies have been dominating the international chilli market. Besides being the largest producer and consumer, India is also the largest exporter of chilli in the world. During 2021 to 2022, the single largest spice exported from India was chilli followed by spice oils and oleoresins, mint products, cumin and turmeric. Chilli alone contributes 42 percent of the total spice export quantity of the nation and is predominantly exported to countries like China, Vietnam, Thailand, Sri Lanka, Indonesia and Malaysia. India is the top producer of chilli with 1.98 million tonnes and contributes about half (43.00%) of the world chilli production, followed by Thailand and China, (Anonymous, 2021a). The most important chilli growing states in India are Andhra Pradesh with total production of 7.97 lakh tonnes covered under 1.77 lakh ha with 4489 kg/ha productivity followed by Telangana, Madhya Pradesh, Karnataka and West Bengal. The country has exported 4, 84,000 tonnes of chilli and chilli products valued at Rs. 6,211.70 crores which contributed to more than 40 per cent in volume and 29 per cent in value of India's total spice exports (Anonymous, 2021c). With just a marginal part (8.00%) of the land under chilli cultivation, the Northeast region of India contribute 51.72 percent of its production annually (Spice Board, 2004). The Northeast region of India has a diverse range of chilli genotypes serving as a reservoir of genetic variability for chilli breeders (Dutta, 2017) and hence, recognized as the hot-spot for chilli diversity (Mathur *et al.* 2000). There are over twenty-two wild and five cultivated species under the genus *Capsicum*, which include *C. annum, C. baccatum, C. chinense, C. frutescens and C. pubescens* (Bosland & Baral, 2007).

Among the many landraces of chilli that are cultivated in the northeastern states, the king chilli (*C. chinense* Jaqc.) is best known worldwide. A number of indigenous king chilli cultivars are noted in the north-eastern region of India (Kumar *et al.* 2011) with different indigenous names such as 'Naga mircha' in Nagaland, 'Bhoot Jolokia' in Assam and 'U-Morok' in Manipur. It is cultivated mainly in the state of Nagaland, Assam and Manipur and to some extent in Mizoram, Arunachal Pradesh and Meghalaya. The chilli is also cultivated in the north eastern region of Bangladesh (Bhuyan *et al.* 2015). Naga king chilli, which surpass the capsaicin content (3-5%) of other Indian chillies, is an important food item with traditional values and assumed to be indigenous to the inhabitants of Nagaland (Baruah *et al.*, 2014). Naga king chilli is a naturally occurring hybrid and occupies a taxonomic position between *C. chinense* and *C. frutescens*, clustering more closely with *C. chinense* group (Bosland & Baral, 2007)

Nagaland, a potential state of Northeast India is basically an agrarian state endowed with favorable agro-climatic conditions and a rich bio-diversity of flora and fauna. Naga king chilli is cultivated nearly in all the districts of the state. Sensing the potential of this crop, nutritionally as well as economically, the farmers have started taking interest in Naga king chilli farming and the area has risen from 600 ha to 1385 ha during 2013 to 2016 (Statistical Handbook of Nagaland, 2017).

The prospects of Naga king chilli in pharmaceutical and food industry is immense and has acquired much significance in global market apart from using as dried, flakes or powdered chilli products. The people of the North Eastern India use the fruits of king chilli in different food formulations like flavouring curries due to its high-quality fragrance and pungency and also utilize as therapeutics for headache, nyctalopia, arthritic diseases, gastritis, axial spondyloarthritis, digestive illness (Sarwa *et al.*, 2012) and to minimize chronic sinusitis (Bhagowati & Changkija, 2009; Jamir & Jha, 2020). Naga king chilli, abundant in Vitamins A, B (thiamin) and C is also known for its high richness in ascorbic acid, a very essential antioxidant for human nutrition and proper functioning of body (Igwemmar *et al.* 2013). Clinically, it has already been proved that capsaicin has the ability to dilate blood vessels thus giving relief in chronic congestions and wheezing (Baruah *et al.* 2014). Bhoot Jolokia is characterized by very high capsaicinoid content, ranging from 2.45% (Sarwa *et al.* 2013) to 5.36% (Liu *et al.* 2010). The average capsaicin in Indian chilli varieties is about 0.2 to 0.3 percent. Hence, most of the Indian varieties are not suited for commercial extraction of capsaicin as one percent capsaicin is a standard needed for its commercial extraction (Meetei, *et al.* 2016).

Naga king chilli after declearing in “The Guinness book of world records” as the world’s hottest chilli (measuring 1,001,304 SHU) in 2006, has marked its significance in the research community (Bhagowati and Changkija, 2009). To this day it is also one of the hottest known chilli peppers and the only naturally occurring chilli pepper that measures 1 million SHU on Scoville scale (Anonymous, 2024). Furthermore, besides its intrinsic values, the chilli holds vast potential in industrial and pharmaceutical sectors and renders an immense scope in international markets. Henceforth, realizing the commercial importance of Naga king chilli, the State Government of Nagaland in 2008 obtained the patent rights and Geographical Indication (GI) tag (Jamir & Jha, 2020), to provide some safety net to Naga king chilli growers in the region (Anonymous. 2021b). Moreover, in a major boot to exports of Geographical Indications (GI) products from the north-eastern region, Agricultural and Processed Food Products Export Development Authority (APEDA) in collaboration with the Nagaland State Agricultural Marketing Board (NSAMB), coordinated the first export consignment of fresh king chilli from Nagaland to London for laboratory testing in June and July 2021 (Anonymous. 2021b). In addition, the department has also secured market alliance with Indian Tobacco Company (ITC), Spices Limited, Spices Board of India and International Competence Centre for Organic Agriculture (ICCOA) to boost the economy and livelihood of Naga king chilli farmers (Sharma, 2016; Sentizungla, *et al*. 2021).

Statement of the problem

The prospects of sustainable Naga king chilli farming is boundless, considering the favourable agro-meteorological situation of the region. However, attributing to lack of awareness on the available sustainable innovative technologies, the state faces many challenges regarding sustainable farming of Naga king chilli. The vast majority of Naga king chilli growers of the region rely on indigenous or local knowledge for sustainable farming. However, the use of such primitive skills has not significantly enhanced the yield and efficiency of the crop. There is a wide gap between available knowledge of sustainable improved technology and actual practice and this has had a considerable effect on the attempt at improving sustainable Naga king chilli production (Adio *et al*. 2016). At the same time there exist a formidable challenge of post-harvest management and marketing which limits the production and profitability. The farmers can progress very well economically if relevant technical know-how is imparted to them for taking up of sustainable Naga king chilli cultivation as an entrepreneurial venture while, exploiting available marketing platforms to generate economic security and rural livelihood upliftment among the farming community. Hencefort, it is necessary to examine the present status of cultivation practices followed by Naga king chilli growers in the concerned areas and the factors that contribute towards promoting sustainable production of Naga king chilli. In this context following research questions were developed:

1. Up to what extent the Naga king chilli growers are aware of the improved technologies of sustainable cultivation practices of Naga king chilli?
2. Do Naga king chilli growers of the region have the entrepreneurial mindset while producing Naga king chilli?
3. What factors contribute towards sustainable production of Naga king chilli?
4. What strategies can be followed for promoting sustainable production of Naga king chilli?

Considering these issues, a research study entitled "**A study on sustainable cultivation practices followed by Naga king chilli (*Capsicum Chinense* Jacq.) growers in Nagaland"** was executed under the following objectives:

Objectives

1. To study the socio-economic, personal and psychological characteristics of Naga king chilli growers,

2. To assess the knowledge and attitude of farmers towards sustainable cultivation practices of Naga king chilli,

3. To examine the extent of adoption of sustainable cultivation practices by Naga king chilli growers,

4. To analyze the entrepreneurial behavior of Naga king chilli growers,

5. To know the constraints faced by Naga king chilli growers in following sustainable cultivation practices and suggest strategies to overcome them.

Scope and importance of study

The present study has been undertaken to examine the potential of sustainable Naga king chilli farming in increasing productivity, income, entrepreneurial development among the Naga king chilli growers as well as sustainability of Naga king chilli cultivation practices. The outcome of the study shall be helpful to examine the entrepreneurial potentials and constraints faced by the Naga king chilli growers of the region.

The outcomes of the study are expected to help in formulating strategies and policy guidelines for promoting improved technologies in sustainable Naga king chilli cultivation and minimize the constraints faced by the farmers, thereby generating employment opportunities and livelihood security among Naga king chilli farmers of the region.

Limitations of the study

Limited time, resources, COVID-19 pandemic, self-reported data and cultural biasness posed considerable constraints throughout the research period. The study was geographically confined hence, applicability of the findings may differ to other Naga king chilli cultivating areas. Despite the limitations, conscious attention was given to conduct the study is the best possible way.

Organization of the thesis

Thesis has been organized in order of the following chapters:

Chapter 1 **"INTRODUCTION"-** It includes importance of the study, statement of the problems, objectives, scope and limitations of the study.

Chapter 2 **"REVIEW OF LITERATURE"-** It has dealt with the available literature related to the present study.

Chapter 3 **"RESEARCH METHODOLOGY"** –This constitute research methods and procedures followed in the study.

Chapter 4 **"RESULTS AND DISCUSSION"-** This chapter includes the findings of the study and the essential discussion.

Chapter 5 **"SUMMARY AND CONCLUSIONS"-** It summarizes the study and gives implications, recommendations and suggestions for further research.

References and Appendices have been included at the end of the thesis.

CHAPTER-II

REVIEW OF LITERATURE

REVIEW OF LITERATURE

In research, a body of literature is a collection of published information and data relevant to a research questions. A literature review goes beyond the search of information and includes the identification and articulation of relationship between existing literature and the field of research. Literature review essentially involves an extensive study of research publications, books and other documents related to the defined problem. Review of literature has been listed under the following heads:

2.1 Socio-economic, personal and psychological characteristics of farmers

2.2 Knowledge and Attitude of farmers towards sustainable farming

2.3 Sustainable cultivation practices followed by farmers

2.4 Entrepreneurial behaviour of farmers

2.5 Constraints faced by the farmers in cultivation and management of crops

2.1 Socio-economic, personal and psychological characteristics of farmers

2.1.1 Age

Malangmeih *et al.* (2015) conducted a study on rural livelihood system in Manipur with special reference to cultivation of king chilli and reported that majority (58.00 %) of the households belonged to the age category of more than 50 years followed by 32 per cent under 30-50 years and 10 per cent under less than 30 years.

Singhal and Vatta (2017) in their study on impact of Krishi Vigyan Kendra on adoption of improved agricultural production practices reveal that majority of the beneficiary respondents belonged to middle age group (47.22 per cent) followed by young age group (34.72 per cent) and old age group (18.06 per cent).

Dessie *et al.* (2019) conducted a study on crop diversification analysis on red pepper dominated smallholder farming system: evidence from northwest Ethiopia and reported that the mean age of diversified producers (48.98 years) was higher than the non-diversifier (45.56 years).

Jha and Das (2019) reported from their study on adoption of recommended production technology by chilli growers in Tripura that majority (58.33%) of the respondents belonged to the middle age group ranging 35-50 years followed by 33.33 per cent of them who were more than 50 years of age. None of the respondents were found below the age group of 35 years. Thus it can be inferred that middle aged people were mostly engaged in chilli cultivation.

Singh *et al.* (2020) in their study on aassessment of farmers' knowledge and their perceive constraints to recommended chilli production practices in Punjab, India, revealed that almost half of the respondents (49.00%) were of the age group 50-62 years, followed by age group of 36-50 (38.00%) and remaining 14.5 per cent were of age group 25-35 years.

Thakur *et al.* (2020) conducted a study on extent of adoption of recommended chilli (*Capsicum annum* L.) production technology among the farmers of Patharia in Madhya Pradesh and found that majority of the respondents (65.83%) belonged to middle age, followed by 24.17 per cent who belonged to old and 10.00 per cent of the respondents belonged to the young age.

Nagulananthan *et al.* (2021) in their study on pesticide use behavior of chilli growing farmers in Southern districts of Tamil Nadu found that 32.00 per cent of them are of the 40 to 50 age group and 36.00 per cent of them are middle age group (30 to 40 years).

Uddin (2022) performed a study on productivity and profitability of local cultivar of brinjal and chilli in Chattogram district and revealed that the average age of the Brinjal and Chili farmers were respectively 40.87 years and 49.84

years indicating that farmers involved in local cultivar production were fairly young.

Ilesanmi et *al.* (2023) conducted a study on resource-use efficiency of pepper farmers in ado-local government area of Ekiti Stateand finding indicated that the mean age of pepper was 41.1 years old.

Jose *et al.* (2023) conducted a study on socio- psychological constructs and perceived economic variables impacting the farmer producer organization members in Kerala: a quantitative analysis and revealed that more than half of the respondents (52.50%) belonged to middle age group. 40.83 per cent of the respondents belonged to old age group followed by young age group (6.67%). This result is an indication that old aged farmers have a sentimental approach towards farming and might not be much interested to get engaged as agripreneurs whereas young farmers are more interested in commercialized agriculture.

2.1.2Education

Malangmeih *et al*. (2015) conducted a study on rural livelihood system in Manipur with special reference to cultivation of king chilli and reported that more than 50 per centhouseholds had 5-10 average years of schooling and 22.00 per cent had average years of education more than 10.

Verma *et al*. (2018) stated in their study on socio-economic and psychological attributes of chilli growers in Raipur district that, maximum numbers 45.83 per cent of respondents were found to possess primary school level of education, 10.83 per cent were illiterates, 16.67 per cent were functionally literate, 16.67 per cent had middle school education. The high school level of education was obtained by only 10.00 per cent of respondents. The category wise mean score was 0.21 for illiterate, 0.33 for functionally literate, 0.91 for primary school, 0.33 for middle school and 0.20 for high school level education. The overall mean score was 1.98.

Manaswi *et al.* (2020) in their study on impact of farmer producer organization on organic chilli production in Telangana found that, 30 per cent of them have education up to primary level, followed by high school (34%) and higher secondary (20%). In case of non-members of FPO, it was found that 45 per cent of the total sample farmers were found to be educated up to primary level, followed by high school (37%) and higher secondary (13%). It is observed that members of FPO were relatively better educated than non-members.

Peer *et al.*(2020) revealed from their study on socio economics profile of chilli growers in district Baramulla (J&K) that, majority 30.00 per cent of the growers were illiterate, 25.00 per cent had primary education and middle education each followed by 10 per cent with high school and 10 per cent had graduate level of education.

Shamshuddin and Venkateswrulu (2020) conducted a study on socio economic challenges of the red chilli farmers with reference to Warangal district of Telangana and found that, 42.30 per cent possessed S.S.C. followed by 19.23 per cent with primary education. While, it was interesting to notice that there are large numbers of farmers (nearly 38%) with graduates and post-graduates.

Kumari (2022) found out from an in-depth study of farmers' knowledge and attitudes towards organic farming in Uttar Pradesh that,25.83 percent were having education up to middle school followed by primary (22.50%) and 17.50 percent and 12.50 per cent of respondents had education in high school and higher secondary. Only 8.33 per cent of the respondents were identified as illiterate, while the remaining 6.67 percent possessed an educational background up to graduation or beyond.

Hota and Tirkey (2023) conducted a study on economic analysis of production of chilli (*Capsicumannum* L.) in Raigarh district of Chhattisgarh and it was observed that, 25.87 per cent of the total sampled populations have primary level of education while these figures are 25.40 per cent, 15.85 per cent, 13.51 per cent, 7.45 Per cent, and 4.42 per cent for middle, high school, higher secondary school, graduate and post-graduation level of education.

Ilesanmi et *al.* (2023) conducted a study on resource-use efficiency of pepper farmers in ado-local government area of Ekiti State and revealed that, the educational level of the farmers was low, with about 41.70 per cent having no formal education, 18.30 per cent having only primary school education, 30.80 per cent having secondary school education, and 9.20 per cent having tertiary education.

2.1.3 Family size

Malangmeih and Rahaman (2016) conducted a study on rural livelihood system in Manipur with special reference to cultivation of king chilli and reported that, majority (70%) of the households had family size of 3-6 members while 16 per cent of the households had family size of more than 6 member and 14 per cent with less than 3 members.

Shamshuddin and Venkateswrulu (2020) conducted a study on socio economic challenges of the red chilli farmers with reference to Warangal district of Telangana and found that, 68.45 per cent of the farm families had 3-7 members, while nearly 16.00 per cent of the farm families had 8 to 10 members.

Thakur *et al.* (2020) conducted a study on extent of adoption of recommended chilli (*Capsicum annum* L.) production technology among the farmers of Patharia in Madhya Pradesh and the result indicates that, majority of the respondents (79.17%) had medium size of family (6 to 12 members), followed by 11.67 per cent with small size of family (up to 5 members). Rest of the respondents (9.17%) belonged to big size of family (more than 12 members). It can be concluded that the majority of the respondents belonged to mediumsize of family.

Hota and Tirkey (2023) conducted a study on economic analysis of production of chilli (*Capsicumannum* L.) in Raigarh district of Chhattisgarh and revealed that, average family size was 4.76 for small category farmers, 5.8 for medium category farmers, 6.34 for large category and the overall average family size was recorded at 5.72.

Shivaji and Madhuprasad (2023) concluded from their study on profile characteristics, constraints and suggestions of farm youth practicing family farming in Parbhani district of Maharashtra that, majority of farm youth belonged to medium family size (46.24%) followed by large (29.38%) and small (24.38%) sized family.

2.1.4 Size of total land holding

Sachithra (2020) reported that majority (69.7%) of the cinnamon farmers in Sri Lanka had less than 5 acres of land for cultivation followed by 26.30 per cent of farmers with 5 to 10 acres of land and 3.90 per cent with 11 to 20 acres of land for cultivation purpose.

Thakur *et al.* (2020) conducted a study on extent of adoption of recommended chilli (*Capsicum annum* L.) production technology and the result showed that, maximum number of the respondents (39.16%) had marginal size of land holding under (up to 1 ha), followed by 31.66 per cent of the respondents who had small size of land holding (1.1 to 2 ha), 21.66 per cent of the respondents had large size of land holding(above 4 ha) and 7.5 per cent of respondents had medium size of land holding (2.1 to 4 ha). It could be concluded from the table that maximum number of the respondents had marginal size of land holding.

Khose *et al.* (2022) conducted a study on entrepreneurial behavior of ginger growers and found that 38.33 per cent of the respondents had Semi-medium (2.01 to 4ha.) size of total land holding followed by 26.66 per cent with small (1.01 to 2 ha.) size, 21.67 per cent with medium (4.01 to 10 ha.) size, 06.67 per cent with large (10.01 ha. and above) size and 06.67 per cent with marginal (up to 1 ha.) size of total land holding.

Ilesanmi*et al.* (2023) reported that most of the pepper farmers in Ado-Local government area of Ekiti state operated on a small scale, with 1-2 hectares accounting for 95% of the respondents in the study area.

Jha (2023) reported that majority (70.00 %) of the ginger growers possessed 1 to 2 ha of land for farming followed by 21.67 per cent with less than 1 ha of land and only 08.33 per cent with more than 2 ha of land for farming.

Nagula *et al*. (2023) conducted a study on socio economic characteristics of different stakeholders of turmeric value chain in Warangal rural district and found that, majority of farmers (44.16%) were small farmers with land holdings of 2.5 acres or less, followed by medium farmers (40%) with holdings of 2.5 to 5 acres, while the least number of farmers (15.83%) were large farmers with holdings of more than 5 acres.

2.1.5 Size of landholding under spice farming

Manaswi *et al.* (2020) in their study on impact of farmer producer organization on organic chilli production in Telangana found that, marginal farmers accounted for the highest percentage (37.00%) of the total sample farmers, followed by large (23.00%) and semi-medium (17.00%). Whereas, in the case of non-members of FPO, the marginal farmers were the dominant group comprising 50.00 per cent of the total farmers. The other categories of the farmers with a considerable share were small (22.00%) and semi-medium (11.00%).

Shrestha *et al*. (2020) reported that the mean area of large cardamom cultivation in the study area was found to be 0.3735 ha. More than half (52.5%) of the respondents had cultivated large cardamom in 0.25 to 0.5 ha, 27.5% of respondents in less than 0.25 ha and 20% of respondents in greater than 0.5 ha.

Singh *et al*. (2020) conducted a study on assessment of farmers' knowledge and their perceive constraints to recommended chilli production practices in Punjab, India and found that, majority (61.5%) of the chilli farmers had an area of up to 1 acre under chilli cultivation followed by 31.00 per cent with 1 to 2 acre and 7.5 per cent with 2 to 4 acres of land under chilli cultivation.

Nagulananthan *et al.* (2021) in their study on pesticide use behavior of chilli growing farmers in Southern districts of Tamil Nadu found that, 34.00 per cent of the respondents had 5 to 10 acres followed by 18.00 per cent with 11 to 20 acres, 28 per cent with less than 5 acres and 10.00 per cent of the farmers with more than 20 acres of land under chilli cultivation.

Khose *et al.* (2022) conducted a study on entrepreneurial behavior of ginger growers and found that 50.00 per cent of the farmers were under small (up to 0.36 ha.) category of farmers followed by 48.33 per cent under medium category of farmer with 0.36 to 0.74 ha of land under ginger and only 01.67 per cent under high (Above 0.74 ha.) category of farmers.

Kwingwa*et al*. (2023) conducted a study on determinants of market information accessibility among smallholder spice farmers in Tanzania and found that, majority (85.9%) of respondents own one to three acres of land under spice farming while those with less than one acre were 1.2 per cent.

2.1.6 Annual income

Dharmanand *et al.* (2020) conducted a study on attitude of farmer towards organic farming in Jabalpur district of Madhya Pradesh and found that,55.00 per cent of the respondents had medium annual income followed by high (21.17%) and low (15.83%).

Singh *et al.* (2020) in their study on assessment of farmers' knowledge and their perceive constraints to recommended chilli production practices and revealed that, 45.5 per cent respondents had annual income up to Rs.1, 10,000 and 36.5 per cent respondents had annual income between Rs.1,10,000 to 1,90,000.

Khose *et al.* (2022) reported that majority (61.67%) of the ginger growers were found to have low (up to Rs.3,33,333) annual income followed by medium

(23.33%) annual income ranging from Rs.3,33,333 to Rs.6,66,666 and only 15.00 per cent with high (above Rs.6,66,666) annual income.

Kumari (2022) conducted a study on in-depth study of farmers' knowledge and attitudes towards organic farming and found that, 87.50 percent were having a medium level of annual income, followed by 10 percent in the low-income category. Only 2.50 percent of the farmers belonged to the high income group.

Jha (2023) reported that the majority (65.00 %) of the ginger growers had an average annual income ranging \$1207to \$2414 followed by 21.67 per cent with less than \$1207 and only 13.33 per cent with more than \$2414 with a mean annual income of \$1475.

2.1.7 Annual income from spice farming

Mazza *et al.* (2019) in their study factors affecting farmers' income generation from ginger production in Abia and Imo states, Nigeria revealed that the farmers had average annual income of seventy two thousand four hundred and eighty seven naira fifty kobo (N72, 487.50) from ginger sales. It was observed that majority (85.00%) of the farmers had annual income between 60,000-79,000 followed by 80,000-99,000 (8.75%) and 40,000-59,000 (6.25%).

Thakur *et al.* (2020) reported that 32.50 per cent of the chilli farmers of Patharia in Madhya Pradesh, were found to have annual income ranged between Rs. 35,001- 60,000, followed by 30.00 per cent of the respondents with annual income up to Rs 35,000. Whereas 28.33 and 9.17 per cent of the respondents were found to have annual income more than Rs.1,00,000 and Rs.60,001 to 1,00,000, respectively.

Kassem *et al.* (2021) conducted a study on exploring the relationship between information-seeking behaviour and adoption of bio fertilizers among onion farmers and found that, 50.9 per cent of the onion farmers' income accounted for less than 25.00 per cent of total income. While, only 8.8 per cent accounted for more than 75.00 per cent of total family income.

Kwingwa *et al*. (2023) conducted a study on determinants of market information accessibility among smallholder spice farmers in Tanzania and found that, annual spice income showed that 41.2 per cent of the farmers had annual spice income between 100 000 TZS-300 000 TZS.

2.1.8 Training exposure

Vashishtha (2012) conducted a study on assessment of knowledge and adoption of chilli (*Capsicum annum* L.) production technology in Udaipur district of Rajasthan and revealed that, only 31.32 per cent of the respondent had received training on recommended technology in chilli cultivation.

Kandel (2019) in his study on economics of production and marketing of organic large cardamom in Panchthar district of Nepal reported that, about 35.38 per cent of the respondents had received cardamom related training while remaining 64.62 per cent hasn't received any training related to cardamom.

Mahat *et al.* (2019) in their study on factors affecting ginger production in Surkhet district, Nepal reported that, 31 per cent of the respondents had participated in training related to ginger cultivation.

Neupane *et al.* (2019) conducted a study on socio-economic analysis of ginger production in Surkhet district of Nepal and revealed that, only 52.5 per cent of the respondents had attended trainings for ginger production.

Hasan *et al*. (2021) stated from their study on training need analysis model at Central Java Agricultural Training Center and revealed that, garlic farmers require training on irrigation, pest control, storage, packaging, Good Agriculture Practice (GAP), marketing, and group success. Chili farmers require training on irrigation, pest control, marketing strategies, and group success.

Kassem *et al.* (2021) in their study on exploring the relationship between information-seeking behavior and adoption of biofertilizers among onion farmers, the results showed that, 68.00 per cent of the respondents had not received any training.

Shrestha *et al*. (2021). Conducted a study on factors affecting turmeric production in Sunsari District, Nepal and concluded that, 77.00 per cent of the farmers had not attended training related to turmeric production.

Jose *et al.* (2023) conducted a study on socio- psychological constructs and perceived economic variables impacting the farmer producer organization members in Kerala and indicated that, 42.50 per cent of respondents had attended a maximum of two trainings followed by 40.83 per cent of respondents, who attended three or more training and 16.67 per cent of the respondents attended only one training. This suggests that a significant portion of respondents had participated in a relatively small number of training sessions.

2.1.9 Experience

Mazza *et al.* (2019) in their study factors affecting farmers' income generation from ginger production in Abia and Imo states, Nigeria revealed that, on the average the respondents have five years' experience in ginger production. It was observed that majority (71.25 %) of the respondents had 1-10 years of experience in ginger production while 28.75 per cent with 11-20 years of experience in ginger production.

Neupane *et al.* (2019) conducted a study on socio-economic analysis of ginger production in Surkhet district of Nepal and revealed that, 42.5 per cent of the farmers had been cultivating ginger from more than 20 years followed by 10-15 years (17.5%), 5-10 years (16.2%) 1-5 years (12.5%) and 15-20 years (11.2%).

Chami (2020) from his study contemporary dynamics in Zanzibar's clove industry: prospects and challenges facing smallholder farmers in Wete district, Pemba, Zanzibar revealed that, majority (60.00%) of the farmers had farming experience of 21-30 years followed by 11-20 years (25.00%) and 1-10 years (15.00%) respectively.

Shrestha *et al.* (2020) conducted a study on entrepreneurial behaviour of large cardamom growers: a case study in Lamjung district of Nepal and reported that 46.3% of respondents had 5 to 9 years of experience, 31.2% had less than 5 years of experience and 22.5% had greater than 9 years of experience in large cardamom farming. The average year of experience in large cardamom farming was found to be 7.13 years.

Nagula *et al*. (2023) conducted a study on socio economic characteristics of different stakeholders of turmeric value chain in Warangal rural district and found that, majority of farmers (88.33%) have more than 20 years of experience. Farmers with 11 to 20 years of experience come in second (9.1%), and farmers with 6 to 10 years of experience come in last (5%).

Shivaji and Madhuprasad (2023) concluded from their study on profile characteristics, constraints and suggestions of farm youth practicing family farming in Parbhani district of Maharashtra that, majority of the farm youth had medium level of farming experience (61.25%), followed by high (23.12%) and low (15.63%) level.

2.1.10 Information sources utilization

Dessie *et al.* (2019) conducted a study on crop diversification analysis on red pepper dominated smallholder farming system: evidence from northwest Ethiopia and reported that, 53.51 per cent and 10.13 per cent of diversifier and non-diversifier had access to market information while, 63.90 per cent and 14.55 per cent of the diversifier and non-diversifier had access to extension services respectively.

Kandel (2019) in his study on economics of production and marketing of organic large cardamom in Panchthar district of Nepal reported that, majority

(60.00%) of the farmers received price related information from exporter and traders followed by magazines (20.00%) and government office (20.00%).

Neupane *et al.* (2019) conducted a study on socio-economic analysis of ginger production in Surkhet district of Nepal and revealed that, majority (63.00%) of the respondents had access to extension services and had been in touch with the extension officers.

Yewatkar *et al.* (2019) conducted a study on entrepreneurial behaviour of garlic growers and reported that majority, of the respondents (56.67%) had medium extension contact with agencies for seeking information and extension contact had positive and significant relationship at 0.01% level of probability with entrepreneurial behaviour of the garlic growers.

Dessie *et al.* (2020) in their study on estimation of technical efficiency of black cumin (*Nigella sativa* L.) farming in northwest Ethiopia revealed that, about 61.17 per cent and 46.81 per cent of the producers had access to market information and extension service, respectively.

Kumari (2022) reported that 30.00 percent of the farmers gained knowledge about organic farming through agricultural extension programmes. 20.00 percent of farmers come to know about organic farming through their friends/ relatives and from newspapers/ magazines. 19.00 percent of the farmers gather information about organic farming from private agricultural organizations or NGOs, while an additional 16.00 per cent acquire such knowledge through television and radio broadcasts.

Lalhlimpuii and Bose (2023) revealed from their study on knowledge of farmers towards improved cultivation practices of ginger in Serchhip District of Mizoram that, 46.67 per cent of the respondents had medium level of utilization of different sources of information followed by high (31.66%) and low (21.67%) level of utilization of different sources of information

2.1.11 Marketing Orientation

Shanthya and Premavathi (2018) carried out an analytical study on turmeric cultivation and found that, majority (69.40%) of the respondents had medium level of marketing orientation followed by low (17.10%) and high (13.50%).

Elakkiya and Karthikeyan (2020) concluded from their analytical study on training needs of farmers on organic farming that, 60.00 per cent of the farmers possessed medium level of marketing orientation followed by high level (40.00%). Majority of the farmers were aware about organic market, prices of organic products and preference of organic products among people.

Khose *et al.* (2022) conducted a study on entrepreneurial behavior of ginger growers and found that majority (66.67%) of the farmers had medium level of marketing orientation followed by high (20.00%) low (13.33%) level of marketing orientation.

Jha (2023) in his study on entrepreneurial behaviour of ginger growers, it was found that, majority (60.00%) of the farmers had medium level of marketing orientation followed by high (28.33%) and low (11.67%) level of marketing orientation.

2.1.12Economic motivation

Dhruw *et al.* (2018) conducted a study on psychological attributes of turmeric growers about turmeric production technology and the findings revealed that, majority of the respondents (75.00%) had medium level of economic motivation.

Shanthya and Premavathi (2018) carried out an analytical study on turmeric cultivationand found that, majority of the respondents had medium level of economic motivation (66.70%) followed by low (17.10%) and high (17.20%).

Verma *et al*. (2018) reported that 37.50 per cent of the chilli growers in Raipur districts were in the low economic motivation category, while 39.17 per cent were in the medium economic motivation category and only 23.33 per cent were in high economic motivation category.

Yewatkar *et al.* (2019) conducted a study on entrepreneurial behaviour of garlic growers and study revealed that, majority (60%) of the respondent had medium level of economic motivation while 35 per cent and 5 per cent of the respondents had low and high level of economic motivation.

Khawale *et al*. (2021) in their study on factors influencing on entrepreneurial behavior of turmeric growers, it was found that more than half (55.83%) of the respondents had medium level of economic motivation followed by low (23.34%) and high (20.83%) level of economic motivation.

Bushetti and Krishnamurthy (2022) reported that more than half (55.00%) and more than one fourth (28.89%) of Byadagi chilli growers in Haveri district of Karnataka belonged to medium and low category of economic motivation respectively.

Khose *et al.* (2022) reported that majority (71.67%) of the ginger growers were found to have medium level of economic motivation followed by high (15.00%) and low (13.33%) level of economic motivation.

Jha (2023) in his study on entrepreneurial behaviour of ginger growers, 48.33 per cent of the farmers had medium level of economic motivation followed by high (37.50 %) and low (14.17%) level of economic motivation.

2.1.13Social participation

Kandel (2019) in his study economics of production and marketing of organic large cardamom in Panchthar district of Nepal observed that, 95. 38 % respondents were found to be the members of any various social organizations related to agriculture.

Mahat *et al.* (2019) conducted a study on factors affecting ginger production in Surkhet district, Nepal and reported that, majority (74%) of the respondents had membership of farmers' groups.

Yewatkar *et al.* (2019) conducted a study on entrepreneurial behaviour of garlic growers and reported that, about 40.84 percent of the respondents have medium level of social participation and had positive and significant relationship at 0.05% level of probability with entrepreneurial behaviour of the garlic growers.

Manaswi *et al.* (2020) in their study on impact of farmer producer organization on organic chilli production in Telangana observed 45.87 percent of the framers' participation in production and marketing activities while, 29.85 per cent and 15.88 per cent of the farmers participation in extension and organizational activities respectively.

Khose *et al.* (2022) reported that more than half (55.00%) of the ginger growers were found to have medium level of social participation followed by low (28.33%) and high (16.67%) level of social participation.

Jose *et al.* (2023) conducted a study on socio- psychological constructs and perceived economic variables impacting the farmer producer organization members in Kerala and indicated that, majority of the respondents (62.53%) belonged to medium category of social participation, followed by 14.36 per cent of the respondents in high social participation category. 13.26 per cent and 02.50 per cent of the respondents belonged to low level of social participation and never participated category of social participation respectively.

2.1.14 Productivity

Adhikari and Bhandari (2022) concluded from their study on socio-economic analysis of ginger production in Terhathum district that, the overall productivity of ginger in the study area was found to be 19.3 MT/ha.

Uddin (2022) conducted a study on productivity and profitability of local cultivar of chilli in Chattogram district and found that, the yield of *Halda Morich* was found to be 7.94 tons/ha as green Chilli and 1.98 tons/ha as dried Chilli.

Aimol *et al.* (2023) reported that on the basis of mean performance of eighteen hybrids of chilli, hybrids 20CHIHYB4 and 21CHIHYB3 yield were found to be 50.03 q/ha and 49.47 q/ha respectively and were found superior in terms of fruit yield (q/ha).

Lepcha *et al.* (2023) conducted a study on red cherry pepper (*Dalle khursani*): remunerative organic crop for doubling the farmers' income of Sikkim and found that, the fruit yield ranges from 80–150 q/ha with average productivity of 120 q/ha.

Natarajan *et al.* (2023) in their study on cost of cultivation and economic returns from chilli crop growing districts of Telangana, India observed that, the average yield was found to be 72.00 quintal per hectare Data observed that the average yield on different size of holdings was found to be 79.00 quintals per hectare on large size is the highest yield followed by 75.00 quintals per hectare on medium size followed by 69.00 quintals per hectare on small size followed by 65.00 quintals per hectare on the marginal size of land holding.

2.2. Knowledge and attitude of farmers towards sustainable cultivation practices

2.2.1 Knowledge

Kshash (2017) conducted a study on vegetable grower's knowledge levels regarding some sustainable agriculture practices: a case study in Taleeyaa district, Babylon Province, Iraq and the study revealed that, majority of the respondents (48.9%) were observed in low category of knowledge followed by medium (31.7%) and (20%) high levels of knowledge, respectively.

Ghosh *et al.* (2020) in their study on knowledge of farmers to sustainable agriculture practices: a case study in south western region of Bangladesh resulted that, about 85 per cent respondents of the study area had low to medium knowledge on sustainable agricultural practices. The highest proportion (51.1%) of the respondents fell in low knowledge category compared to 48.9 % had medium to high knowledge category.

Singh *et al.* (2020) in their study on aassessment of farmers' knowledge and their perceived constraints to recommended chilli production practices in Punjab, revealed that, majority of the respondents possessed knowledge with regard to practices like earthing up (99.0%), sowing time (97.5%), weeding (93.5%), recommended varieties (87.9%) and seed rate (85.5%). It was also observed that small percentage of the respondents had knowledge about practices like spacing (21.5%), diseases, insect-pests and their control (41.0%), split dose of nitrogen (31.0%), seed treatment (31.0%) and potassium dose (30.0%).

Sundresha *et al.* (2020) revealed from their study on knowledge level of ginger growers on improved cultivation practices in Hassan District, India that, majority of the ginger growers possessed high (60.00%) level of knowledge about improved cultivation practices. While, education, achievement motivation, risk orientation, cosmopoliteness, economic motivation and mass media participation were significantly and positively associated to their extent of knowledge of ginger growers at 5 per cent level and management orientation, extension contact and extension participation were significant at 1 per cent level.

Lama and Ghosh (2022) carried out a study on personal, socio economic, psychological and communicational attributes of the farmers' practicing Diversified Farming Systems and found that, education, economic motivation, extension contact, extension participation, mass media exposure, independency, risk orientation and innovativeness of farmers had a positive and significant relationship with their perception and extent of knowledge.

Lalhlimpuii and Bose (2023) conducted a study on knowledge of farmers towards improved cultivation practices of ginger in Serchhip District of Mizoram and indicated that, 55.83 per cent of the respondents had a medium level of knowledge about ginger cultivation practices. A significant proportion of ginger farmers, approximately (24.17%), had a low level of knowledge, while 20.00 per cent of the farmers who had taken part in the survey had a high level of knowledge about ginger cultivation practices. Independent variables namely age, size of the family, education, annual income, extension contact, sources of information utilized, scientific orientation, risk orientation and mass media exposure were positive and highly significant at 0.01% level of probability with the level of knowledge towards improved ginger cultivation practices. Size of land holding is positively significant at 0.05% probability while gender and marital status had non-significant association with the level of knowledge towards improved ginger cultivation practices.

Malik *et al*. (2023) conducted a study on farmers' readiness for organic farming and indicated that majority of farmers were knowing the 'use of *neem* tree leaves in grain storage (94.17%)', followed by 'crops for green manuring (92.50%)' and the benefits of summer ploughing (85.83%). Almost four-fifths of the respondents knew 'manures and fertilizers used in organic farming', 'vermicompost preparation' and the 'role of mulching in weed management'. At least seven out of ten respondents (71.25%) were having knowledge about the importance of 'pulse crops in crop rotation' followed by usage of 'bio-agent for seed treatment (67.08%). Less than two fifths of respondents (36.25%) having knowledge about 'concept of organic farming', and use of trap crops and Nuclear Ployhedrosis Virus (NPV).

2.2.2 Attitude

Hameed and Sawicka (2017) in their study on farmers' attitudes towards sustainable agriculture practices in Lublin province, reported that majority (69.41 %) of the respondents showed neutral attitude towards sustainable agriculture practices and about 30.59 per cent with favourable and unfavourable attitude towards sustainable agriculture practices.

Parihar (2017) showed on his study of attitude of farmers towards use of bio-fertilizers in Jabalpur district of Madhya Pradesh that majority (59.17%) had medium attitude followed by 22.5 per cent high attitude and 18.33 per cent had low attitude towards use of bio fertilizers.

Kiranmayi and Vijayabhinandana (2018) revealed that, more than half of the farmers had moderately favourable attitude towards farming. The correlation analysis revealed that education, annual income, extension contact, mass media exposure, scientific orientation, risk orientation and market orientation had positive and significant relationship with the attitude of farmers towards farming. Further, Multiple Linear Regression analysis showed that all the independent variables of owner farmers put together explained 81.04 per cent variation embedded with the dependent variable, attitude towards farming; while the independent variables of tenant farmers all together explained 86.28% variation in attitude

Verma *et al.* (2018) reported that 40.83 per cent of the chilli growers of Raipur district were in low category of attitude towards improved technology followed by 33.33 per cent in the medium category and 25.84 per cent in high category. The mean score of the low attitude towards improved technology was found to be 0.75, followed by 0.62 and 0.48 for medium and high categories respectively. The overall mean score was 1.85.

Sihare *et al.* (2020) found that majority (61.67%) of the farmers showed highly favourable attitude towards organic farming. While, the variable family size showed positive and significant relationship with practices related to organic farming. However, livestock possession and knowledge about improved agricultural practices had negative and significant relationship with the practices related to organic farming.

Pawar (2021) revealed that, majority (74.00%) of the respondents had a medium attitude towards Sustainable Agricultural practices (SAP) followed by 26.00 per cent with low attitude, while none had high attitude towards SAP. Study reveals that there is a significance at the p=0.5 level between farmer's ages and education status towards SAP. Therefore, the study suggests that respondents should get proper training, field exposures, and capacity-building programs from production to marketing to alter their attitude towards SAP.

Kumari (2022) reported that 50.83 per cent of the farmers showed favourable attitude towards organic farming followed by highly favourable (30.00%), whereas 19.17 percent of the respondents were having an unfavourable attitude towards organic farming.

Chandhana *et al*. (2023) in their study on knowledge level and attitude of farmers towards organic farming in Ananthapuramu District, Andhra Pradesh revealed that, education, extension contact, information seeking behaviour and awareness about organic farming variables were positively significant and highly correlated with attitude of farmers towards organic cultivation. Age, land size, family size, income were positive and non-significant.

Khuvung and Mishra (2023) conducted a study on attitude of farmers towards shifting cultivation in selected districts of Nagaland and found that, majority (63.7%) of respondents had a moderately favourable attitude towards shifting cultivation, while 20% of them had a highly favourable attitude and 16.33 per cent had a low favourable attitude towards shifting cultivation.

2.3 Adoption of sustainable cultivation practices

Barman *et al*. (2015) conducted a study on adoption of improved *Bhut jolokia* (*Capsicum chinense*) cultivation practices by farmers of the upper Brahmaputra valley zone of Assam and adoption level of improved practices by the farmers was 51.00 per cent in high level category, followed by 49.00 per cent in medium level. More than 80 per cent farmers adopted the improved cultural practices like planting at recommend time (98.00%), proper drainage facilities (88.00%), pesticide application (87.00%) as suggested.

Chigadolli *et al.*(2019) in their study on extent of adoption of improved cultivation practices by turmeric growers in Belagavi district, Karnataka, India, the findings revealed that, 47.50 per cent of turmeric growers belonged to medium level of overall adoption, followed by high (32.50%) and low (20.00%) level overall adoption of improved cultivation practices. With respect to adoption of individual improved turmeric cultivation practices, majority of turmeric growers fully adopted the land preparation practices (84.00%), mother rhizomes for seed purpose (88.33%), recommended variety and planting time (85.00 %), planting method (100.00%), intercropping (84.17%), FYM-Farm Yard Manure (89.17 %), nitrogen and potassium application (98.33%), number of irrigations to turmeric (83.33%), manual weeding (71.66%), maturity and harvesting practices (75.00%), traditional method of preservation of rhizomes (81.67%) and post-harvest management practices (80.00%).

Suji and Kumar (2019) conducted a study on adoption of botanical pesticides and its relationship with the characteristics of the respondents and the constraints and the study showed that, more than half of the respondents were found with low level adoption of botanical pesticides. Application of neem cake and kerosene to control paddy green leaf hopper was adopted by 34.16 per cent of the respondents.

Thakur *et al*. (2020) revealed that, majority (65.83%) of the chilli growers showed medium level of adoption regarding recommended chilli production technology. Whereas 20.00 per cent respondents had high level of adoption and 14.17 per cent respondents had reported low level of adoption. The high level of adoption by the chilli growers was reported in practices like selection of land (79.17%), storage (65.00%), use of fertilizers (64.17%), earthing (63.33%), crop rotation (58.33%), time of sowing (51.67%), preparation of land (45.00%), preparation of nursery (38.33%), time of transplanting (36.67), harvesting (time of picking) and identification of diseases and their control measures (21.67%), seed rate (15.00%), variety (10.00%), marketing and distance between row to row and plant to plant (9.17%) irrigation and use of manures (8.33%) and identification of insects and their control measures (3.33%). education, social participation, contract with extension agencies and annual income were found positively and significantly related with adoption at 0.05 per cent level of significance. However, the variables size of land holding, occupation, sources of information were found positively and highly significantly correlated with adoption at 0.01 per cent level of significance.

Kassem *et al*. (2021) conducted a study on exploring the relationship between information-seeking behaviour and adoption of bio fertilizers among onion farmers andfound that, 35.00 per cent of the respondents had adopted bio fertilizers for onion cultivation. The findings also reveal that farm size, attitude toward bio fertilizers and the credibility of information sources positively and significantly influence farmers’ adoption of bio fertilizers.

Navyasri (2023) conducted a study on factors influencing the adoption of drip cum plastic mulch and drip irrigation systems in red chilli cultivation in Bhadradri Kothagudem district of Telangana and found that, the education level, farm size, family size etc., have positively influencing the probability for adopting drip irrigation system and drip cum plastic mulch irrigation system in red chilli cultivation.

2.4 Entrepreneurial behaviour of farmers

2.4.1 Concept of entrepreneurship

According to Patel and Desai (2016), entrepreneurship is the de fact barometer of overall economic, social and industrial growth has brought revolutionary changes in the society. It has facilitated large scale production and distribution. It has widened the area and scope of the marketing of goods and services. It is a creative and innovative response to the environment.

Khan *et al.* (2016) stated that entrepreneurship is the attempt to create value through recognition of business opportunity, the management of risk taking appropriate to the opportunity and through the communicative and management skills to mobilize human, financial material resources necessary to bring project to fruition.

Adhikari *et al.* (2017) defined entrepreneur as a change-oriented and value creating unit that willing to embrace innovation to utilize opportunities. In here, authors argued that attitudes and behavior towards change-orientation, value creation, innovation and utilizing opportunities are key characteristics of entrepreneur farmer.

According to Jones *et al.* (2020), in most conceptualizations of entrepreneurship, it involves creating value thereby having a positive effect in society.

Segal *et al*. (2023) stated that entrepreneurship is one of the most significant building blocks of economic growth. An entrepreneurial approach involves aspects of risk-taking, responsibility, self-efficacy, and innovation, all of which are connected to a person's tendency to explore opportunities and grow.

2.4.2 Entrepreneurial competencies and entrepreneurial intentions

Olagunju (2004) stated that an entrepreneurial competence is one‘s ability to take advantage of an idea and to create an entrepreneurial initiative, not only for making personal profit but also social and development one.

Wilson *et al.* (2009) widely recognized entrepreneurial competence as a significant element for developing skills, attitudes, and behavior in fostering economic growth and enhancing individual development and workability in society

Mitchelmore and Rowley (2010) Entrepreneurial competence constitutes a set of qualities encompassing knowledge, motives, traits, self-image, and skills essential for establishing and growing businesses.

According to Garavan *et al.* (2016), in measuring business success, entrepreneurial competence plays a crucial role, given that knowledge, attitudes, and skills are essential elements in improving the performance of Small and Medium-sized enterprises (SME).

Wirda and Rivai (2019) suggests that entrepreneurs' knowledge, attitudes, skills, and behavior are vital components of entrepreneurial competence and significantly affect performance and competitiveness.

Garcia *et al.* (2021), supported that entrepreneurial competence constitutes a set of qualities encompassing knowledge, motives, traits, self-image, and skills essential for establishing and growing businesses and contend that competency-based training is vital in promoting entrepreneurial learning and developing entrepreneurship as a competence.

Gunartin *et al.* (2023) concluded to broadening knowledge about the role of entrepreneurial competence in improving performance so that entrepreneurial skills can be developed, which are very important for business actors in improving their performance to be competitive and sustainable. Entrepreneurial competence is important in increasing business success, competitiveness, and sustainability, which can encourage economic growth.

2.4.3 Entrepreneurial behaviour of farmers

Sabale *et al.* (2014) in their study on entrepreneurial behaviour of farmers in Marathwada region of Maharashtra revealed that majority of farmers (51.20%) belonged to medium level of innovativeness, medium farm decision making (63.20%) with medium achievement motivation (58.40%). About (55.20%) farmers had medium knowledge of farm enterprises with medium (71.20%) risk taking ability. The data revealed that 63.20 per cent had medium information seeking behaviour with low leadership ability (40.00%) and medium cosmopoliteness (56.80%).

Maratha *et al*. (2017) conducted a study on corollary relationship between entrepreneurial behaviour and other attributes of chilli growers at Sawai Madhopur in Rajasthan and observed that majority of the respondents had medium (59.16%) to low level of entrepreneurial behavior.

Dhruw *et al.* (2018) conducted a study on psychological attributes of turmeric growers about turmeric production technology and the findings revealed that majority of the respondents (72.81%) had medium level of scientific orientation. Majority of the respondents (80.31%) had medium level of risk orientation. More than half of the respondents (52.19%) had medium cosmopoliteness. It was found that majority of the respondents (63.75%) had medium level of achievement motivation. It was also found that majority of the respondents (75.00%) had medium level of economic motivation.

Astuti *et al.* (2019) in their study on entrepreneurial characteristics and behaviors of Muntok white pepper farmers' showed that the entrepreneurial characteristics of pepper farmers are risk-taking, responsive to opportunities, innovative, and motivated. Also, the results showed that the entrepreneurial characteristics of pepper farmers positively and significantly influence their entrepreneurial behavior.

Shrestha *et al.* (2020) conducted a study on entrepreneurial behavior of large cardamom growers: a case study in Lamjung district of Nepal and the results showed that a greater proportion of large cardamom growers were found to have medium level of innovativeness (45%), decision-making ability (51.2%), information-seeking ability (48.8%), risk orientation (46.2%), leadership ability (43.8%), achievement motivation (46.2%) and low management orientation (56.3%) which contributed to the overall medium entrepreneurial behavior (47.5%), low entrepreneurial behavior (35%) and high entrepreneurial behavior category (17.5%) of large cardamom growers in the study area.

Bushetti and Krishnamurthy (2022) found that nearly equal number (43.33 and 41.67%) of the Byadagi chilli growers belonged to medium and low innovativeness category respectively. Less than half (42.22%) of the farmers belonged to medium category of scientific orientation, whereas, more than one third (37.22%) belonged to low category. Half (50.00%) of the farmers belonged to medium category of risk orientation. Nearly three fourth (72.78%) of the Byadagi chilli growers belonged to medium decision making ability category. More than half (55.00%) of the farmers belongs to medium category of economic motivation. More than half (53.89%) of the farmers belongs to medium category of management orientation. Overall entrepreneurial behaviour score based on the cumulative raw scores of all the six dimensions revealed that, more than two third of (68.33%) of the Byadagi chilli growers had medium level of entrepreneurial behaviour followed by 19.45 percent under low category and remaining (12.22%) had high entrepreneurial behaviour.

Jha (2023) revealed that most (78.33 %) of the ginger growers had moderate level of innovativeness. While, majority (76.67 %), of the ginger growers had medium level of achievement motivation followed by risk orientation (73.33%) and decision making ability (65.00 %). Furthermore, majority (56.67 %) of the ginger growers were found to have low level of scientific orientation. High level of self-confidence was evident in case of 56.67 per cent of the respondents and most (48.33%) of the respondents had high level of economic motivation.

Maryati*et al.* (2023) found that the entrepreneurial activities of garlic farmers in the national garlic production center area of Sembalun district, were still dominated by low levels of entrepreneurial activity in the criteria of entrepreneurial qualities (63.75%) and entrepreneurial competencies (51.25%). While the managerial competencies criteria are at a high level (51.25%), and the technical competencies criteria are at a moderate level (51.25%).

2.5 Sustainable cultivation practices followed by farmers

2.5.1 Concept of sustainable agriculture

According to U.S. Farm Bill (1990), sustainable agriculture is an integrated system of plant and animal production practices having a site specific application that will, over the long term: satisfy human food and fiber needs; enhance environmental quality; make efficient use of non-renewable resources and on-farm resources and integrate appropriate natural biological cycles and controls; sustain the economic viability of farm operations; and enhance the quality of life for farmers and society as a whole.

Reganold *et al.* (1990) stated that for a farm to be sustainable, it must produce adequate amounts of high-quality food, protect its resources and be both environmentally safe and profitable. Instead of depending on purchased materials such as fertilizers, a sustainable farm relies as much as possible on beneficial natural processes and renewable resources drawn from the farm itself.

According to Neher (1992), sustainable agriculture is an approach or a philosophy that integrates land stewardship with agriculture. Land stewardship is the philosophy that land is managed with respect for use by future generations.

Häni *et al.* (2003) stated that sustainable agriculture adopts productive, competitive and efficient production practices, while protecting and improving the natural environment and the global ecosystem, as well as the socio-economic conditions of local communities.

Królczyk and Latawiec (2015) defined agricultural sustainability as "when current and future food demand can be made without unnecessarily compromising economic, ecological and social/political needs then agriculture is considered to be sustainable".

According to Fallah-Alipour *et al.* (2018), agricultural sustainability can be outlined as follows: agricultural sustainability includes a set of features on the basis of which a given agricultural system is considered as "agriculture for sustainable development". Accordingly a sustainable agricultural development system is characterized by protecting the environment, improving the appropriate agricultural production processes, and enhancing the welfare of humans (the farmer and the society) over time.

DiMento *et al.* (2023) in their work on the concept of sustainability in international law: a research and policy bibliography, expressed that, sustainability is a paradigm for thinking about the future in which environmental, societal and economic considerations are balanced in the pursuit of an improved quality of life.

Fischer *et al.* (2023) expressed that, we can change our institutional frameworks to make businesses and our economic system more sustainable. There are five parameters in our sustainability efforts that can steer us in the right direction First, civil society organization, that is, the contributions that community organizations can make through self-organization and social innovation. Second, government has some responsibility; by developing appropriate policy instruments, it can ensure that sustainability is increasingly incorporated into decision-making through the internalization of externalities. Third, the financial system provides the financial framework for companies and individuals and can therefore also contribute directly to sustainable development. Fourth, enterprises can also make a positive contribution to a more sustainable world through greener and fairer production methods and the development of sustainable products. Fifth, individuals also play a role, as each consumer contributes to a more sustainable world through what and how much they buy.

2.5.2Measurement tools of sustainable agriculture

Zhen and Routray (2003) proposed a set of operational indicators for measuring agricultural sustainability in developing countries which include

1. Ecological indicators involving amounts of fertilizers and pesticides used, irrigation water used, soil nutrient content, depth to the groundwater table, water use efficiency, quality of groundwater for irrigation, and nitrate content of both groundwater and crops.
2. Economic indicators include crop productivity, net farm income, benefit–cost ratio of production, and per capita food grain production.
3. Social indicators encompass food self-sufficiency, equality in food and income distribution among farmers, access to resources and support services, and farmers' knowledge and awareness of resource conservation. This article suggests that the selection of indicators representing each aspect of sustainability should be prioritized according to spatial and temporal characteristics under consideration.

Rasul and Thapa (2004) examined the sustainability of two production systems in terms of their environmental soundness, economic viability and social acceptability. Twelve indicators were selected to evaluate sustainability. The findings suggested that ecological agriculture has a tendency towards becoming ecologically, economically and socially more sound than conventional agriculture.

Gomez-Limon and Sanchez-Fernandez (2010) developed a practical methodology for evaluating the sustainability of farms by means of composite indicators. This methodology was based on calculating 16 sustainability indicators that cover the three components of the sustainability concept (economic, social and environmental).

Bachev (2016) conducted a study on sustainability of unregistered agricultural holdings in Bulgaria and employ a holistic framework and assess sustainability of unregistered agricultural holdings in Bulgaria. An assessment is made of integral, governance, economic, social, environmental sustainability of unregistered agricultural farms in general and of different size, production specialization, ecological and geographical location as well as on their comparative sustainability in relations to other type of farms in the country.

Latruffe *et al.* (2016) in their study measurement of sustainability in agriculture: a review of indicators described sustainability indicators used in the literature following the typology based on the three sustainability pillars: environmental, economic and social. The literature review shows that the environmental pillar has undergone an 'indicator explosion', due to the multitude of themes covered and the attention given by society to this dimension of sustainability. By contrast, economic indicators target a relatively small number of themes. Social indicators typically cover two main themes: sustainability relating to the farming community and sustainability relating to society as a whole.

Fallah-Alipour *et al.* (2018) conducted a framework for empirical assessment of agricultural sustainability: the case of Iran and proposed a comprehensive framework for the assessment of agricultural sustainability and present an empirical application of the proposed framework in south-east Iran (Kerman province). The framework is based on a stepwise procedure, involving:

1. The calculation of economic, social, environmental, political, institutional and demographic indicators, covering the actual and potential aspects of unsustainability;
2. The application of fuzzy pair wise comparisons and analytic hierarchy process to construct composite indicators, with the purpose of incorporating the concept of social construct into the assessment process; and

3. The application of sustainability maps, diagrams and barometer of sustainability for presenting and analyzing the results. Overall, the results suggest that the proposed framework can be an effective tool for the assessment of agricultural sustainability.

Fischer *et al.* (2023) discussed that sustainability not only refers to the environment, but also to society and the economy. Although the ecological challenges are often at the forefront of today's discussions they cannot be considered separately, as they are closely linked to economic and social challenges. Droughts in one country, for example, can lead to refugee flows, which in turn create social tensions in other countries. Just as Raworth's Doughnut Economy model does, it is therefore essential to include the social dimension to achieve sustainable development. At the same time, ecological challenges also have direct economic consequences. For example, if the sea level rises by 5 m, many cities with millions of inhabitants will be affected by floods, which will obviously lead to huge economic costs. The three dimensions of sustainability must accordingly be understood as a system, whereby interrelation-ships must be considered to make efficient decisions.

2.6 Constraints faced by the farmers in cultivation and management of crops

Ovhar and Dhenge (2014) in their study on constraints faced by turmeric growers about improved cultivation practices revealed that (72.22%) majority of turmeric growers faced constraints like low price of turmeric crops. While one third of turmeric growers (63.33%) faced with non-availability of labour at the time of transplanting and harvesting, followed by irregular supply of electricity and non-availability of storage facilities (60.11%), inadequate availability of improved seed (50.56%), high wages of labour (40.00%), inadequate sources of finance for agriculture (38.89%) and inadequate availability of FYM (22.22%).

Malangmeih and Rahaman (2016) conducted a study on rural livelihood system in Manipur with special reference to cultivation of king chilli and revealed that lack of improved method of cultivation and crop management was found to be the most important constraints faced by the farmers followed by lack of extension services improper or lack of processing and storage facilities and susceptibility of the crop to various pests and diseases infestations and lack of control measures, problems in marketing and unpredictable climatic condition leading to price and income instability.

Bhattarai and Mariyono (2016) in their study on the economic aspects of chilli production in Central Java revealed that over 97.00 per cent of chilli growers reported viral diseases as their top concern in chilli farming. Fungal disease and bacterial disease also were reported as major problems by 96.00 per cent and 92.00 per cent of the households, respectively. The high fluctuation of price was reported as the highest ranking factor (1.03) by 66.00 per cent of households.

Sharma (2016) conducted a study on Sustainable economic analysis and constraints faced by the Naga king chilli growers in Nagaland and observed that the foremost constraints was lack of warehouse / go down for proper storage, followed by lack of market information, problem of credit facilities, lack of transportation facilities, etc.

Biswas *et al.* (2017) conducted a study on constraints faced by the Naga king chilli growers in Mokokchung district of Nagaland and revealed that lack of proper post-harvest storage of Naga king chilli (90.00%) was found the most problematic area faced by majority of the Naga king chilli growers.

Sharma and Sharma (2017) in their study on constraints of recommended production technology of fennel cultivation by the farmers in Nagpur district of Rajasthan, India, indicated that 43.33 per cent of the total respondents were in important constraints group, whereas 38.33 per cent in most important and remaining 18.33 per cent respondents were observed in the group of least important constraints in the study area. It was also observed that poor knowledge about irrigation management and lack of knowledge about plant protection chemicals (technical constraints), supply of inferior quality seed by the agencies and green color maintaining variety is not available (input constraints), lack of knowledge about market intelligence and incorrect weight measurement by businessman (marketing constraints), late sowing reduces the yield and cloudy weather and rainfall at the time of flowering (miscellaneous constraints) were perceived as most important constraints by the fennel growers.

Kumar *et al.* (2018) in their study on constraints perceived by the farmers in adoption of improved ginger production technology- a study of low hills of Himachal Pradesh indicated that technological constraints (MPS 77.86) were up to greatest extent followed by economic and marketing constraints (MPS 76.75), input supply constraints (MPS 75.00) and general constraints (MPS 59.67), which indicated the need of strengthening the research-extension farmer linkage, provision of cheap credit facilities, establishment of processing units as well as organized regulated markets for efficient production and marketing of ginger crop in the study area.

Tangjang and Sharma (2018) conducted a study on problem faced by the large cardamom growers during production and marketing: A case study of Tirap district of Arunachal Pradesh, India and revealed that lack of knowledge and training in scientific methods of cultivation (100.00), post-harvest losses (97.00), pest and disease incidence and their management (96.00) were some of the major problems faced by the large cardamom growers.

Naik *et al.* (2019) in their study on assessment of constraints encountered by the chilli growers of Khammam district in adoption of recommended chilli production technologies along with suggestions revealed that major constraints in adoption of recommended Chilli production technologies were high labour charges (91.07%), high cost of agricultural inputs (83.03%), low market price of chilli (100.00%), lack of training regarding recommended chilli production technology (100.00%), lack of knowledge about insects, pests and diseases (80.35%) and electricity problem (100.00%).

Yewatkar *et al.* (2019) conducted a study on constraints and suggestions of garlic growers in Akola district and the findings of the study revealed that fluctuation of rates in garlic (89.16%), lack of information about garlic cultivation (87.50%) and power cut off (80.00%) is the majority of the respondent's problem. Scarcity of water (58.33%) is the nearly half of the respondents problem. potential market away from garlic cultivation area (31.66%) is the some of the respondent's problem.

Rais *et al.* (2021) revealed that major constraints faced by the chilli growers of Sindh were insect pests and disease problem (82.00%), lack of modern irrigation system (76.00%), imbalance use of fertilizer and pesticide (75.00%), lack of training (70.00%) respectively. In marketing side major constraints were commission agent charges are not reasonable (76.00%), price fluctuations (56.00%) and lack of proper storage facilities (47.00%) recorded in Sindh. Furthermore lack of grading facility (90.00%) was the major constraints faced by the chilli traders in study areas. Lack of storage facility (77.00%) was recorded as a second highest constraints faced by the traders followed by high risk is involved in selling of chillies distant places (73.00%) in Sindh.

Adorada *et al.* (2023) revealed that, extreme weather conditions such as heat, drought, excessive rains, insect pest and disease occurrences, and inaccessibility to market with high pricing for locally produced garlic are the most encountered problems by garlic farmers across the regions. Continuous heavy rainfall during the planting season caused extreme damage to the crop, in which 41.00 per cent of the respondents mentioned this as a major concern. The presence of different field and storage insect pests and diseases of garlic resulting in lower yield was also cited by 32.00 per cent of the respondents.

Logesh *et al*. (2023) conducted an analysis of constraints faced by organic farmers in the Cauvery Delta Zone of Tamil Nadu and found that labour scarcity, increasing cost of hiring labourers was a prime constraint faced by organic farmers. A persistent challenge faced by organic farmers includes organic certification process, lack of technical assistance and guidance, lack of supportive institutions for organic farming, inadequate availability of quality inputs, inadequate of subsidies for organic agriculture. The discharge of effluents from dyeing units in Tiruppur into the Noyyal River, which eventually flows into the Cauvery in Karur, has been burning issue for the farmers of the region. The absence of dedicated weed management inputs for organic farming and therefore farmers are compelled to resort to labour-intensive hand weeding or mechanized weeding, which incurs significant costs. The primary constraint with reference to marketing is challenge in finding proper marketing channel.

CHAPTER-III

RESEARCH METHODOLOGY

RESEARCH METHODOLOGY

Research methodology is a logical, systematic plan to resolve a research problem. It provides the structural arrangement of the study for conducting research within the framework of the objectives. It includes a detailed plan that helps to keep researchers on track, making the process smooth, effective and manageable. It consists of methods, tools, techniques and approaches for the research work. A research methodology gives research legitimacy and provides scientifically sound findings.

The research methods and procedures used for conducting the study are described under the following heads:

3.1. Research design

3.2. Locale of research

3.3. Sampling procedure

3.4. Selection of variables and their empirical measurement

3.5. Tools and techniques used for data collection

3.6. Analysis of data

3.1 RESEARCH DESIGN

Research design is the plan, structure and strategy and investigation concaved so as to obtain search question and control variance (Borwankar, 1995). Henry Manheim says that research design not only anticipates and specifies the seemingly countless decisions connected with carrying out data collection, processing and analysis but it presents a logical basis for these decisions (Selltiz, 1962).

The research design is primary to a research endeavour and works as a harbour light to guide the research exercises. It serves as a series of guideposts to keep the progression of research headed in the right direction. The research design is essential because it ensures a better, systematic and organised plan of the research undertaken. It enhances the efficiency of the researcher in his implementation and allows a comprehensive review of the proposed study, which will be set before the research begins Harish and Thakur (2021).

A research design not only includes the objectives of the study but also the scope, coverage, timeline, limitations, methods of data collection, tools of analysis and the data analysis and presentation. Decisions regarding what, where, when, how much, by what means concerning an inquiry or a research study constitutes a research design. Research design defines the study type (descriptive, correlational, semi-experimental, experimental, review, meta-analytic) and sub-type (e.g., descriptive-longitudinal case study), research problem, hypotheses, independent and dependent variables, experimental design, and, if applicable, data collection methods and a statistical analysis plan (Creswell, 2014). The basic factor in experimental study is the influence of an independent variable on the dependent variable. Experimental design classified into Chapin's and Greenwood's classification of experimental design where the former is further classified into cross-sectional experimental design, projected experimental design and ex-post-facto research design and the latter into trial and error experiment, controlled observation study, natural experiment, ex-post-facto experiment and laboratory experiment.

Ex-post-facto research design is the narration of the present situation as an effect of some previously acting casual factors and effort to trace back, over an interval of time to some assumed casual complex of which started operating at an earlier date. Hence, ex-post-facto research design was employed in the present research as the events have already occurred and design was considered appropriate.

3.2 LOCALE OF RESEARCH

3.2.1 Selection of state

The present study was conducted in the state of Nagaland (Fig 3.2.1). The state came into existence as the 16th state of India on 1st December, 1963.The

NAGALAND

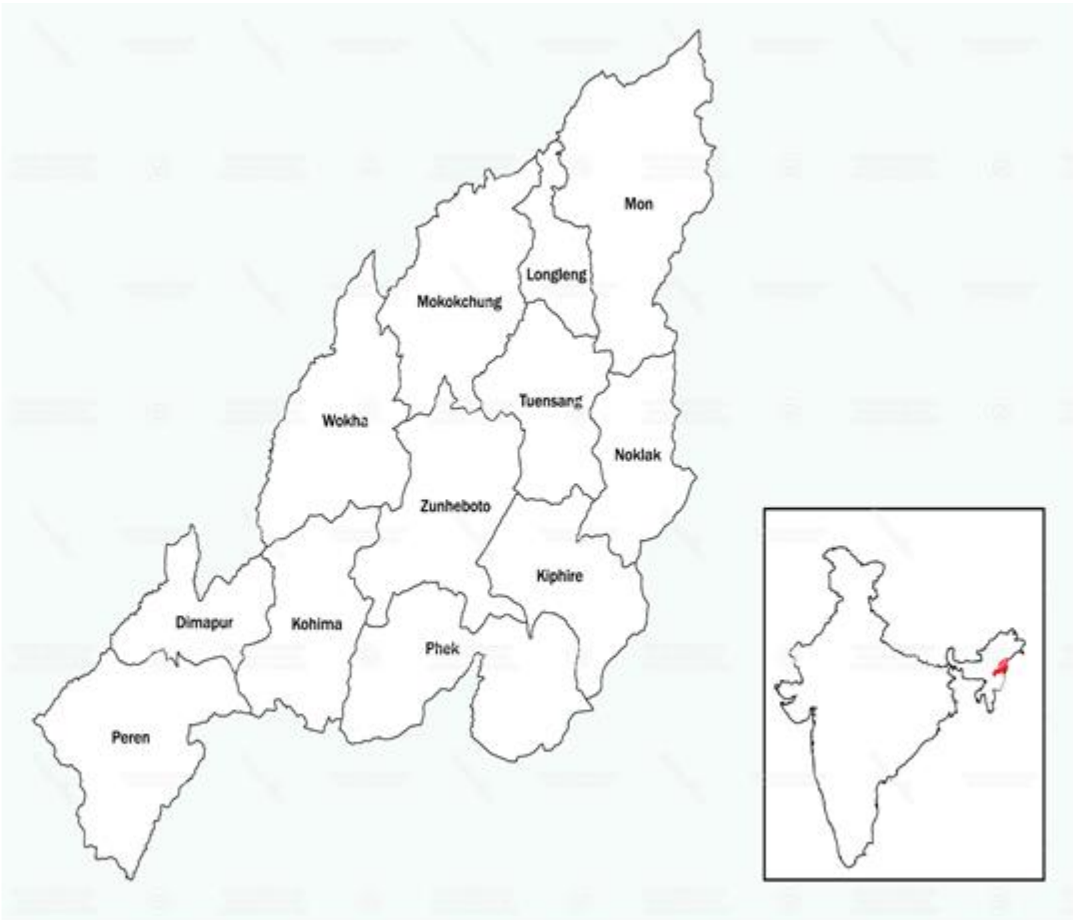

Fig 3.2.1: Selection of state

state covers an area of 16,579 square kilometer, lies between 25°6' and 27°4' N and 93°20' and 95°15' E with its highest point at an elevation of 3,825 meters above sea level. It is situated in the north-east region of India. It is one of the eight sisters of north-east India. It borders the state of Assam to the west, Arunachal Pradesh and part of Assam to the north, Burma to the east, and Manipur to the south. Kohima district is the state capital. The state has 16 administrative districts *viz.,* Chűmoukedima, Dimapur, Kiphire, Kohima, Longleng, Mokokchung, Mon, Niuland, Noklak, Peren, Phek, Shamator, Tuensang, Tseminyű, Wokha and Zunheboto, and inhibited by 17 major tribes Angami, Ao, Chakhesang, Chang, Khiamniungan, Konyak, Kuki, Kachari, Lotha, Phom, Pochury, Rengma, Sangtam, Sumi, Tikhir, Yimkhiung and Zeliang. Each of whom have their distinct customs, attires, dialect and agricultural practices.

The state of Nagaland is mountainous except 9.00 per cent of the total area bordering Assam valley and enjoys a salubrious climate with maximum average temperature recorded in summer is 31ºC while the minimum is as low as 4ºC and an average annual rainfall of 2000 mm to 2500 mm. The state is drained by four chief rivers of Doyang, Jhanji, Dhansiri and Dikhu. While mineral resources like oil, Iron, limestone, cobalt, coal, nickel and chromium are found in abundance in the state. Nagaland has four soil types-inceptisols, entisols, alfisols, and ultisols. The mountainous slopes of the state of Nagaland are rich in the growth of natural vegetation. 8, 62,930 hectares of land or 20.00 per cent of the total land area of the state is covered with the evergreen tropical and sub-tropical forest that are endowed with rich flora and fauna and agro climatic conditions favourable for agriculture (Anonymous, 2020).

Nagaland is predominantly an agrarian state with 70.00 per cent of the population engaged in agricultural sector. Traditional Jhum/shifting cultivation is popular in the state sue to topographical terrain. Rice is the staple food and covers about 70.00 per cent of the total area under cultivation and constitutes about 75.00 per cent of the total food production in the state. Mixed cropping pattern is practiced incorporating cereals, pulses, oilseeds, tuber crops, condiments and spices using local cultivars which are organic in nature. Area under agriculture is 440,990 ha (26.6% of land area) of which 22.00 per cent is under horticulture crops. Spices contribute around 13.00 per cent to the total production of horticultural crops. Spices are one of the main cash crop of the state. Major spices crops are ginger, garlic, turmeric, chili and large cardamom. Within the spices category Naga king chili is a crop of economic importance and considered as the most unique spice of Nagaland (YES BANK Ltd. and IDH, 2018).Therefore, the state of Nagaland was selected purposively for the present study.

3.3 Sampling procedure

Sampling procedure for selection of respondents has been displayed in Fig 3.3.1.

3.3.1 Selection of district

Naga king chilli is one of the most valued spices grown in almost all the districts of the state Nagaland, covering an area of 1385 ha with a total production of 7739 MT(Statistical Handbook of Nagaland, 2017). The top three districts leading in area and production under Naga king chilli (*Naga Mircha*) are Peren (230 ha, 1564 MT), Dimapur (200 ha, 930 MT) and Mon (150 ha) district (Statistical Handbook of Nagaland, 2017).Therefore, the above three districts were purposively selected for the present study (Fig 3.3.1.1).

Peren District

Peren is the eleventh district of Nagaland and was formed by the partition of Kohima district in the year 2003. It covers an area of 2300sq km and lies between 25º3´N 93º44´E with an altitude between 800-2500 meters above the sea level. It is bound by Dima Hasao and Karbi Anglong districts of Assam in the west and Dimapur district to the north-east. Kohima district in the east

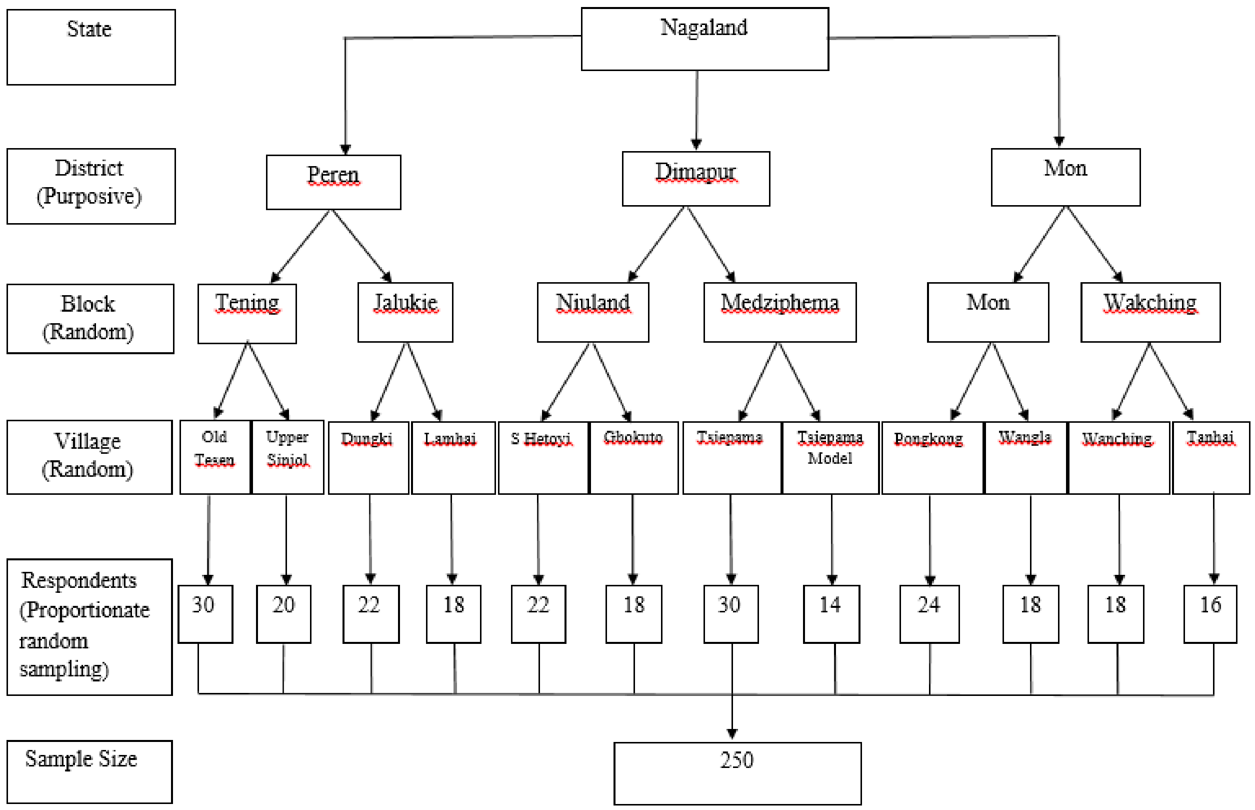

Fig 3.3.1: Sampling design

and Tamenglong district of Manipur in the south are the other boundaries. Peren District is inhabited by the Zeliangs. The district is divided into four blocks *viz.*, Ahthibung, Jalukie, Tening and Peren.

The principal rivers and important rivulets that flow through Peren district include Tepuiki, Mbeiki(Barak), Ntanki, Mungleu, Tesanki, Nguiki, Nk wareu, Techauki, Ngungreu, Tahaiki and Duilumreu. The highest mountain peak in the district is Mt. Paona measuring 2500 meters high which is also the third highest in Nagaland. Peren District enjoys Monsoon type of climate with the rest of the country. Owing to the elevation of the area and rich vegetation, Peren District enjoys salubrious climate - of temperate type. Winters are cold but pleasant and summers are warm and tolerable. The mean annual temperature in the hill sector ranges from 18° C to 26° C (approximately) and in the valley sector, from 18°C to 35°C (approximately). The mean temperature in December and January in the hill sector ranges from 2° to 4°C to 10°C to 15°C (approximately) and in the valley sector from 10°C to 20°C (approximately). Frost occurs at selected places in the hill sector during December and January. The mean annual rainfall ranges from 1500mm to 3000 mm with a one average of about 2000 mm, approximately. The number of rainy days ranges from 95 to 108 days, mostly during the month of July to September, while the time number of months with rainfall less than 50mm is for 3 to 5 months - December to April. Peren District receives the Bay of Bengal Monsoon. The soil type in the District is reddish-yellow type topped by a varying depth of black soil rich in humus.

Peren district is a strip of mountainous territory having fertile foothill valley plains and popularly known as "the Green District of Nagaland," with the highest concentration of Flora and Fauna (Forest both reserve and unreserved Belt) of all districts in Nagaland, lies at the extreme South-West of Nagaland, is 100 kms from the capital of Nagaland Kohima and 95 kms from Dimapur the Commercial hub and Gateway of Nagaland. The land is fertile for Agro base production and the people of Peren district are mainly agrarian (80%) by occupation and paddy is the livelihood of the populace, and Jalukie Valley known as the "Rice Bowl" of Nagaland. Besides paddy, of late the people have taken up crops like Naga king chilli, pineapple, yam, beans, ginger, banana, and other Horticulture products, which supplement the crops. The popular Naga king chilli is a translation of the words Chaibe Rachi meaning Chaibe = King's + Rachi = chilly, both the name and the Chilies originated from Peren district (Anonymous. 2023b).

Dimapur District

Dimapur is the eighth district of Nagaland established in December 1997 and lies between 250 48´ and 260 00´ North latitude and 930 30´ and 930 54´ East longitude. The altitude of district ranges from 160 - 350 meters above the mean sea level. The district is bounded by Kohima in East, Peren in South, Karbi Anglong district of Assam in the West and Golaghat district of Assam in the North. The district comprises of 4 (four) blocks and 11 agricultural circles with an area of 927 Sq. km. Dimapur town is the commercial hub of the state and is the magnet around which the economic and developmental activities of the district are centered; it is one of the fastest developing townships of the North East. The town is also a gateway to Nagaland and Manipur state. It is important rail head and also has airport. The National Highway 39 that connects Kohima, Imphal and Myanmar border of Moreh runs through Dimapur District. The district has a heterogeneous population with majority comprising of Naga tribes from all over Nagaland. The district is divided into eight tehsil *viz.*, Aghunaqua, Chumukedima, Dhansiripar, Dimapur sadar, Kuhuboto, Medziphema, Nihokhu and Niuland. The Niuland, Kuhuboto blocks are dominated by Sumi tribe, and Dhansiripar by different group of people like Chakesang, Sumi, Angami, Nepalese, Ao etc. Medziphema block is dominated by Angamis and kukis. The main factor contributing to large increase in population of the district is migration from other parts of state.

Dimapur district falls under humid Subtropical Agro-climate zone. In summer it is hot reaching a maximum of 36 °C, with humidity up to 93.00 per cent while the winter is cool and pleasant. The district receives rains in two spells- South-West monsoon in summer and Northeast monsoon in winter. The South-West monsoon sets normally in the first week of May and extent up to October and the North-East monsoon normally sets in the month of November and extent till December. The major shares of the rains were received during June to August. The average rainfall is about 1000 mm-1500 mm. Dhansiri and Diphu are two major rivers flowing through district. A number of other rivers like Langlong, Amaluma flow down from Jalukie hills in the Dhansiripar/ Chumukedima plains. However, none of them are navigable. The district is blessed with numerous perennial sources consist of the tributary network of Chathe River, Zubza River, Diphu and Dhansiri River.

Agriculture in Dimapur is rainfed. Dimapur district has warm humid climate, soil type is loamy to sandy loam mostly agricultural practices are concentrated in the jhum and plain areas of the district. Farming population in Dimapur is nearly 46.00 per cent. A portion of Medziphema block is hilly where jhuming is practice. The major crops grown under jhum are paddy, maize, colocassia, chillies, french beans, cucumber etc. Nearly 800ha area is covered under pineapple cultivation. Other fruits trees like guava, banana, citrus, papaya and litchi find the place in the kitchen gardens of the Nagas. In the plains the major crop is paddy nearly 11.00 per cent area is under mixed cropping. The other crops grown are Maize, mustard, linseed, pea, beans, all type of vegetables, tapioca, banana, jackfruit, papaya, mango, arecanut, guava etc. Dimapur district has lots of marshy land that could be converted into ponds and there is a great scope for fish farming. Backyard poultry and piggery is very common in the district. Farm mechanization is very limited among the farm machineries used in the field are tractors and power tillers, ploughing by bullock is the common practice being followed by cultivators (Bangladeshi, Nepali, Manipuri, Karbi migrants). Shared cropping with cultivators is very common in Dimapur where 50.00 share is being distributed between the land owner and the cultivator (Anonymous. 2023a).

Mon District

The District of Mon was carved out of the Tuensang district on 21st December 1973, which covers an area of 1786 Sq.km. and is bounded on the North by Sibsagar District of Assam, on the South by Tuensang District of Nagaland and on the East by Myanmar (Burma) and on the West by Tuensang and Mokokchung Districts of Nagaland. On her Northeast lies the Tirap District of Arunachal Pradesh. There are a total of eight Rural Development (RD) blocks *viz.* Aboi, Angjangyang, Chen, Phomching, Tizit, Tobu And Wakching. The altitude of Mon district headquarters is 897.64 meters above sea level. The District, with the exception of the foothills, is hilly with steep slopes. Low-lying areas with undulating hills characterize the foothills. The District can be divided into two regions topographically, namely the Upper Region comprising Longching, Chen, Mopong and Tobu areas and the Lower Region comprises Mon, Tizit and Naginimora area. The foothills that lie adjacent to the plains of Assam are the Tizit and Naginimora areas. The hill ranges extend from the foothills to the slopes of Naga Hills and Patkai Range in the Eastern side of the District.

The Mon District has a fairly moderate climate. Days are warm and nights are cool. Rainy season sets in the month of May and lasts till October. From November to April, the District has dry weather with relatively cool nights and bright and sunny days. The average relative humidity is 76.00 per cent and the average temperature is 24.4 ºC. In the higher altitude, summers are pleasantly warm while winter is quite cold. The lower altitude especially those adjoining the plains of Assam experience hot summers but pleasant winters. The average annual rainfall ranges from 2000 mm to 3000mm, mostly occurring between May and October.

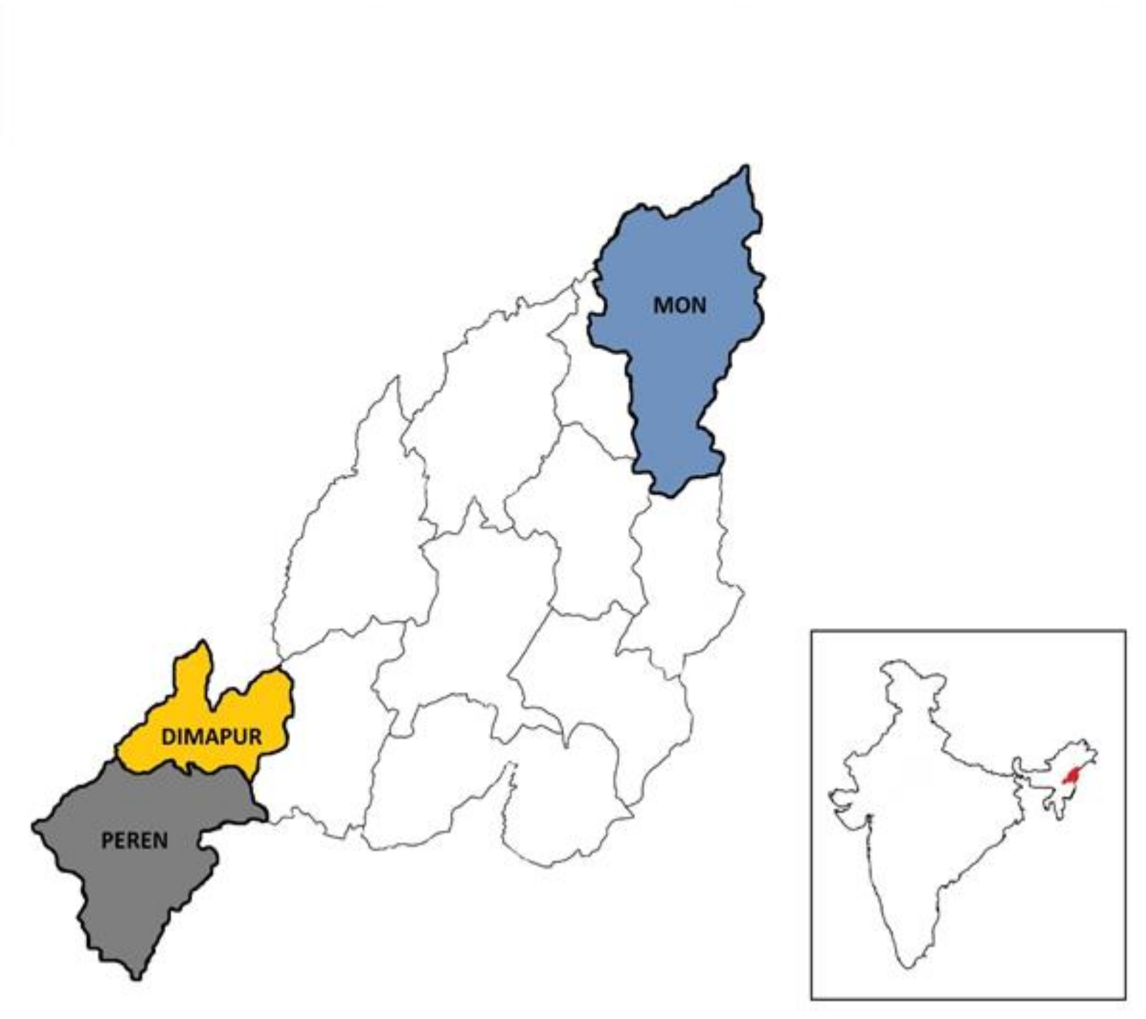

Fig 3.3.1.1 Selection of districts

The main occupation of the people of this district is agriculture with nearly 90.00 per cent of the work force engaged in it. The economic condition of the people lags behind when compared to the living conditions of the people of other districts in Nagaland. As it is located in the remotest part of Nagaland, its economic development has not been satisfactory. Mon has great potentialities for economic development if her forest resources, human resources, water resources etc. can be re-generated. Due to ignorance, lack of capital, scientific and technical know-how, infrastructure inadequacies, the Mon District has failed to lift her up to the level of other districts. The recent trend in the District is tea-cultivation by the local people. The gentle slopes of Mon provide ample scope for developing the Mon District for the cultivation with all modern techniques (Anonymous. 2023c).

3.3.2 Selection of Rural Development (RD) Blocks

From each of the selected districts, two Rural Development (RD) Blocks were randomly selected for the present study. Thus, twelve Rural Development (RD) Blocks *viz.*, Tening and Jalukie block of Peren district (Fig 3.3.2a), Niuland and Medziphema block of Dimapur district (Fig 3.3.2b) and Mon and Wakching block of Mon district (Fig 3.3.2c) were selected for the present study.

3.3.3 Selection of Villages

A list of Naga king chilli growing villages were prepared under each of the selected blocks and two villages were selected randomly from each of the selected blocks. Thus, a total of twelve villages were selected for the present study, namely Old Tesen, Upper Sinjol, Dungki, Lamhai, S. Hetoyi, Ghokuto, Tsiepama, Tsiepama Model, Pongkong, Wangla, Wanching and Tanhai as shown below:

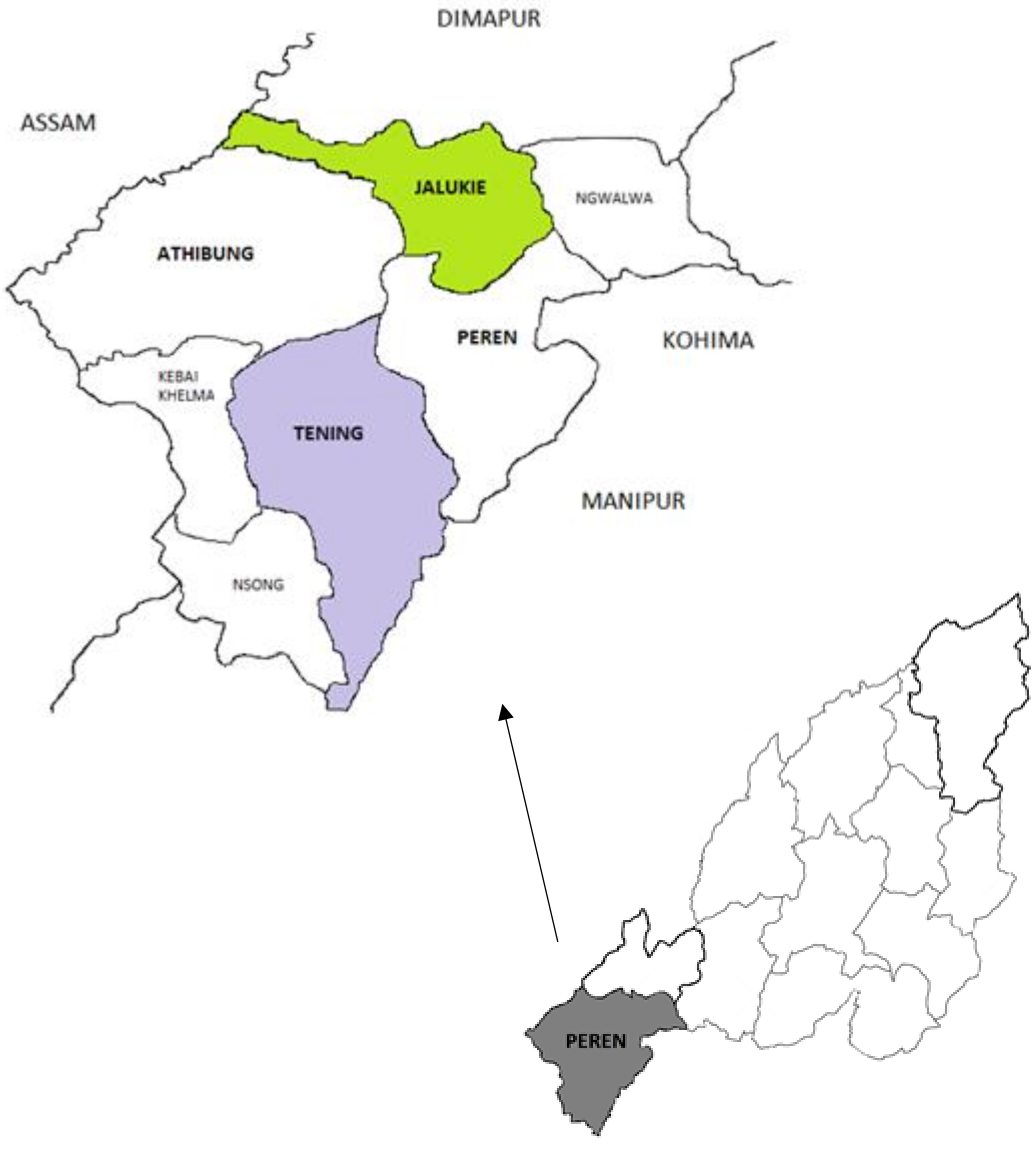

Fig 3.3.2a Selection of Rural Development (RD) blocks

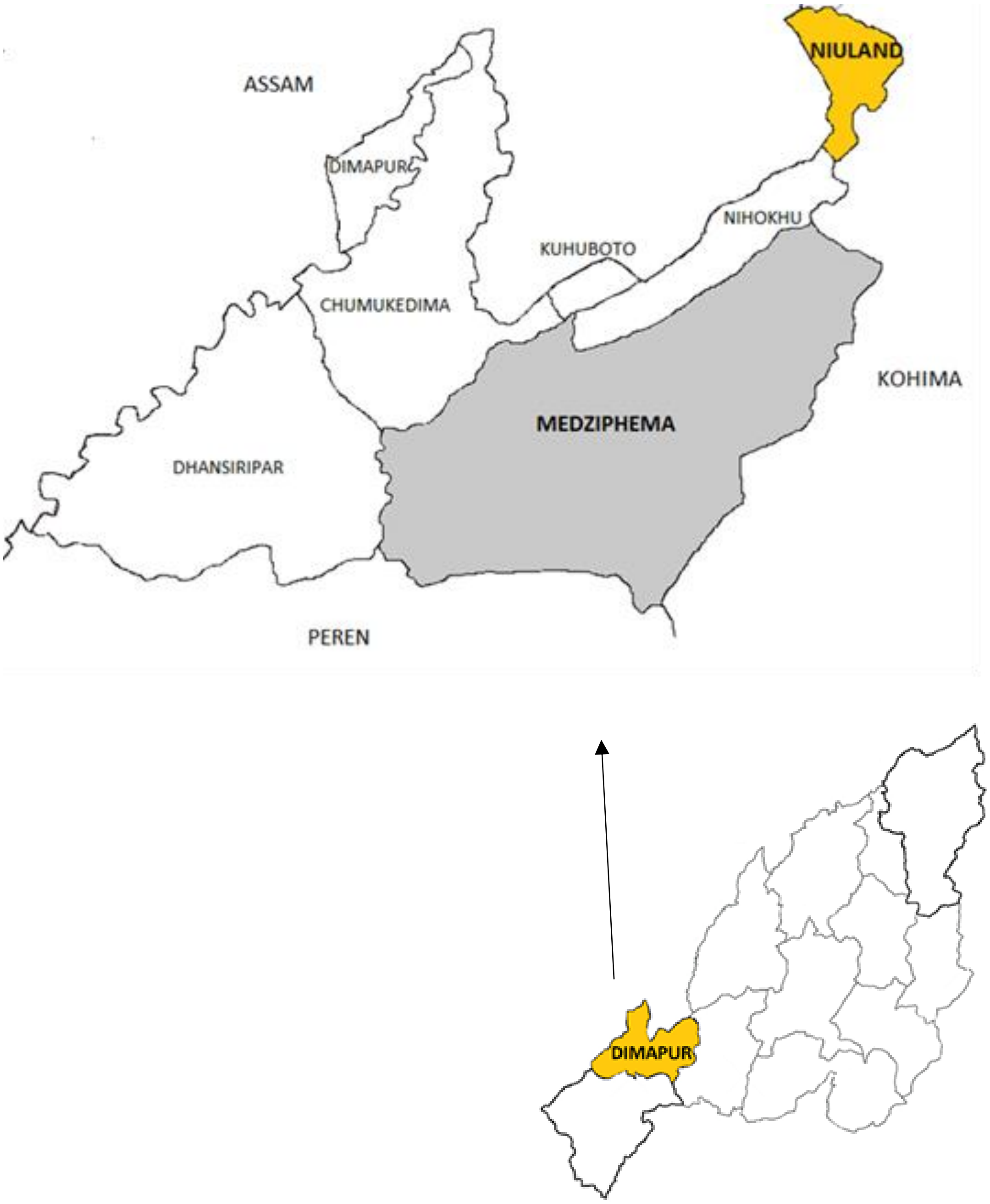

Fig 3.3.2b Selection of Rural Development (RD) blocks

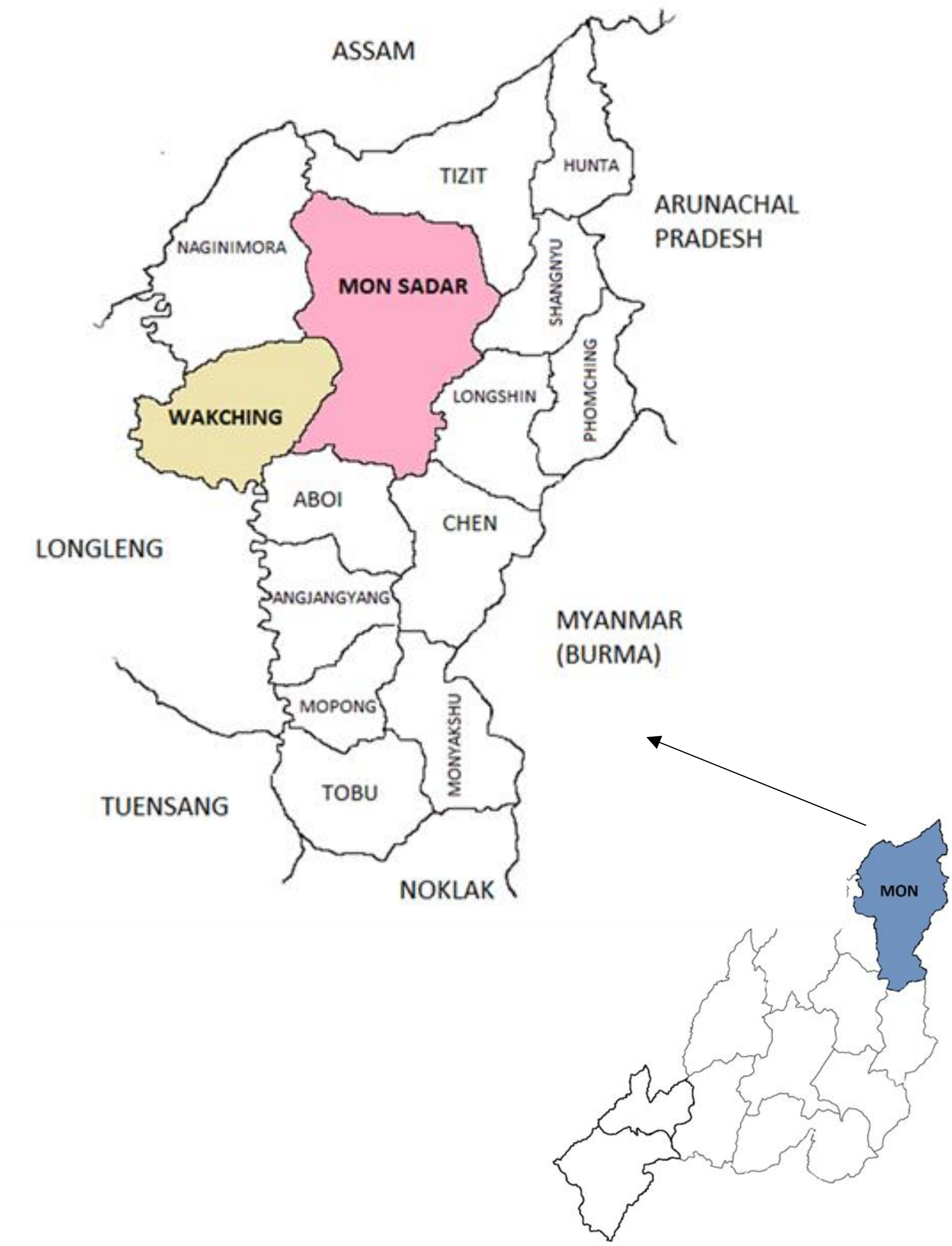

Fig 3.3.2c Selection of Rural Development (RD) blocks

Table 3.3.3.1 Number of respondents selected from each villages

Sl. No.	District	Block	Village	No. of respondents
1.	Peren	Tening	Old Tesen	30
			Upper Sinjol	20
		Jalukie	Dungki	22
			Lamhai	18
2.	Dimapur	Niuland	S. Hetoyi	22
			Ghokuto	18
		Medziphema	Tsiepama	30
			Tsiepama Model	14
3.	Mon	Mon	Pongkong	24
			Wangla	18
		Wakching	Wanching	18
			Tanhai	16
Total respondents				**250**

3.3.4 Selection of respondents

A list of all household engaged in Naga king chilli cultivation from the selected villages was prepared and out of this, a total of 250 respondents were selected for the present study, using proportionate random sampling procedure (Table 3.3.3.1).

3.4 Selection of variables and their empirical measurements

Variables were selected based on the objectives of the study, extensive literature review and consultation with the subject experts. A total of sixteen independent variables and two dependent variables were selected for the present study. The selected variables and their measurement technique used are given below:

Table 3.4.1: List of variables and their empirical measurements

Sl. No.	Variables	Empirical measurements
I	**Independent variables**	
1.	Age	Chronological age in years
2.	Family size	Number of members in a family
3.	Education	Schedule Developed
4.	Size of total land holding under agriculture	acre
5.	Size of land holding under Naga king chilli	acre
6.	Total annual income	Rs.
7.	Annual income from Naga king chilli	Rs.
8.	Training exposure	Number of days exposed for training
9.	Experience in Naga king chilli cultivation	Completed years of Naga king chilli farming
10.	Information sources utilization	Scale developed by Ramchandran (1974)
11.	Marketing orientation	Scale developed by Samanta (1977)
12.	Economic motivation	Scale developed by Supe (1969)
13.	Social participation	Modified scale of Belli (2008)
14.	Productivity of Naga king chilli	q/acre
15.	Adoption	Adoption Index
16.	Entrepreneurial behaviour	Entrepreneurial behavioural Index
II	**Dependent variables**	
1.	Knowledge	Knowledge Index
2.	Attitude	Likert based scale was developed

3.5 Empirical measurement of the variables

3.5.1 Independent variables

3.5.1.1 Age

Age was operationalized as the number of completed years of the respondents at the time of conducting the interview. The respondents were grouped under the following categories as follows:

Sl. No.	Category of age	Range in years
1.	Young	Less than 35 years
2.	Middle Age	35-55 years
3.	Old	More than 55 years

3.5.1.2 Family size

Family size was conceptualized as the total number of members in the family. Respondents were categorized into three sub-categories (small, medium and large family size) based on the mean ($\bar{\chi}$) and standard deviation (σ):

Sl. No.	Family size	Criteria
1.	Less than 5 members	Below ($\bar{\chi} - \sigma$)
2.	5 to 8 members	Between ($\bar{\chi} - \sigma$) and ($\bar{\chi} + \sigma$)
3.	More than 8 members	Above ($\bar{\chi} + \sigma$)

3.5.1.3 Education

Education was conceptualized as the ability of the respondents to read and write or the extent of formal education possessed by them. A schedule consisting of six categories was developed to quantify the education of the respondents. Respondents were classified into six categories and their percentage and frequency was calculated as follows:

Sl. No.	Category	Score
1.	Illiterate	0
2.	Primary	1
3.	Middle school	2
4.	High school	3
5.	P.U.C	4
6.	Graduate & above	5

3.5.1.4 Size of total land holding under agriculture

Total land holding under agriculture was referred as the total farm size owned and rented by the respondents in acres. The respondents were categorized into three groups as follows:

Sl. No.	Category	Criteria of land
1.	Marginal	<2.50 acre
2.	Small	2.50-5.0 acre
3.	Semi-medium	5.01-10.00 acre

3.5.1.5 Size of total landholding under Naga king chilli cultivation

Total landholding under Naga king chilli cultivation referred to the total land utilized for Naga king chilli cultivation, owned and rented by the respondents in acres. The respondents were categorized into three groups as follows:

Sl. No.	Category	Score
1.	Less than 1.00 acre	1
2.	1.00-2.00 acre	2
3.	More than 2.00 acre	3

3.5.1.6 Annual income

Annual income was calculated as the total income in rupees obtained by a respondent's family from different sources like crops, animal husbandry enterprises, wages, salary, business and other sources for a period of last one year. The total income obtained from all the sources by the respondent was considered. The respondents were categorized in to three groups based on the mean ($\overline{\chi}$) and standard deviation (σ) of the score obtained as follows:

Sl. No.	Category of income	Score
1.	Less than 50,000	1
2.	50,000 to 1,00,000	2
3.	1,00,000 to 1,50,000	3
4.	> 1,50,000	4

Further,'Z' value was also calculated to know the significant difference of annual income among the selected three districts of Nagaland.

3.5.1.7 Annual income from Naga king chilli

It referred to the earnings obtained by the respondents in terms of rupees in a year from Naga king chilli cultivation. The respondents were categorized in to three groups based on the mean ($\overline{\chi}$) and standard deviation (σ) of the score obtained as follows:

Sl. No.	Level of income	Criteria
1.	Low	Less than Rs.19,294
2.	Medium	Rs.19,294 to Rs.59,145
3.	High	More than Rs.59,145

Further, 'Z' value was also calculated to know the significant difference of annual income from Naga king chilli among the selected three districts of Nagaland.

3.5.1.8 Training exposure

Training is one of the means by which farmers acquire new knowledge and skill. It was measured in terms of total number of training received on Naga king chilli cultivation by the farmers in the last five years. The respondents who attended training related to Naga king chilli cultivation during the last five years were assigned a score of '1' for each number of days of training attended and those who didn't receive any training were assigned '0'. The respondents were categorized in to following groups based on the mean ($\bar{\chi}$) and standard deviation (σ) of the score obtained as follows:

Sl. No.	Level of training exposure	Criteria	Range
1.	Low	Below $(\bar{\chi} - \sigma)$	<10 days
2.	Medium	Between $(\bar{\chi} - \sigma)$ and $(\bar{\chi} + \sigma)$	10-20 days
3.	High	Above $(\bar{\chi} + \sigma)$	>20 days

Further, frequency and percentage was calculated for training need areas of Naga king chilli cultivation by assigning score of '2' to most needed areas, score of '1' to to needed areas and score of '0' to not needed areas of training. Training need among the respondents on sustainable Naga king chilli cultivation practices was also calculated. The respondents were categorized in to three groups based on the mean ($\bar{\chi}$) and standard deviation (σ) of the score obtained as follows:

Sl. No.	Level of training need	Criteria
1.	Low	Below $(\bar{\chi} - \sigma)$
2.	Medium	Between $(\bar{\chi} - \sigma)$ and $(\bar{\chi} + \sigma)$
3.	High	Above $(\bar{\chi} + \sigma)$

3.5.1.9 Experience

Experience referred to the number of years of Naga king chilli cultivation practiced by the respondents for their livelihood. Farmers with higher farm experience appear to have often full information and better knowledge and are able to evaluate the advantage of the technology in question (Chilot *et al.,* 1996). Respondents were categorized into three groups based on mean ($\bar{\chi}$) and standard deviation (σ) of the score obtained out of scored experience in Naga king chilli cultivation as follows:

Sl. No.	Category	Criteria
1.	Low	Below $(\bar{\chi} - \sigma)$
2.	Medium	Between $(\bar{\chi} - \sigma)$ and $(\bar{\chi} + \sigma)$
3.	High	Above $(\bar{\chi} + \sigma)$

Further, 'Z' value was also calculated to know the significant difference of experience in Naga king chilli cultivation among the selected three districts of Nagaland.

3.5.1.10 Information sources utilization

Information source utilization referred to the various sources of information utilized by the respondents for Naga king chilli cultivation. Information source utilization was classified based on the use of informal information sources, formal information sources, and mass-media sources. It was quantified by Ramchandran scale (1974).

a) Informal information sources

Under informal information sources four sources of information (friends, relatives, neighbours and progressive farmers) were included and their frequency of use was scored as Most often (2), Sometimes (1) and Never (0). Further mean score and rank was calculated for the informal information sources.

b) **Formal information sources:**

Under formal information sources six sources of information (VEW, AO/DAO/ HO/ SDHO, KVK, ATMA, ICAR, NGOs, NSRLM) were included and their frequency of use was scored as Most often (2), Sometimes (1) and Never (0). Further mean score and rank was calculated for the formal information sources.

c) **Mass-media information sources:**

Under mass- media sources, five sources of information (radio, television, newspaper, exhibition, print media and mobile phones were included and their frequency of use was scored as Most often (2), Sometimes (1) and Never (0). Further mean score and rank was calculated for the mass media information sources.

Based on the total score obtained with respect to all the three types of information sources, respondents were classified into three categories using mean ($\bar{\chi}$) and standard deviation (σ) as follows:

Sl. No.	Level of information source utilization	Criteria
1.	Low	Below ($\bar{\chi} - \sigma$)
2.	Medium	Between ($\bar{\chi} - \sigma$) and ($\bar{\chi} + \sigma$)
3.	High	Above ($\bar{\chi} + \sigma$)

3.5.1.11 Marketing orientation

Market orientation is organizational wide generation of market intelligence pertaining to current and future customer's needs, dissemination of the intelligence across departments and organizational wide responsiveness to it (Kohli and Jaworski, 1990).Marketing orientation included six statements. All the positive statements were assigned the score of 4, 3, 2, and 1 for Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SDA) and vice versa for negative statements.

After obtaining the total scores, the respondents were classified into three categories based on mean ($\bar{\chi}$) and standard deviation (σ) as follows:

Sl. No.	Level of Marketing orientation	Criteria
1.	Low	Below ($\bar{\chi} - \sigma$)
2.	Medium	Between ($\bar{\chi} - \sigma$) and ($\bar{\chi} + \sigma$)
3.	High	Above ($\bar{\chi} + \sigma$)

3.5.1.12 Economic motivation

Economic motivation was operationally defined as the degree to which a farmer was oriented towards profit maximization in farming and the relative value placed by the farmer on economic ends (Supe, 1969). Economic motivation included six statements. All the positive statements were assigned the score of 4, 3, 2, and 1 for Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SDA) and vice versa for negative statements.

After obtaining the total scores, the respondents were classified into three categories based on mean ($\bar{\chi}$) and standard deviation (σ) as follows:

Sl. No.	Level of Economic motivation	Criteria
1.	Low	Below ($\bar{\chi} - \sigma$)
2.	Medium	Between ($\bar{\chi} - \sigma$) and ($\bar{\chi} + \sigma$)
3.	High	Above ($\bar{\chi} + \sigma$)

3.5.1.13 Social participation

It refers to the degree of participation or involvement of the respondents in formal and informal organizations either as member or as an office bearer. The procedure followed by Belli (2008) with slight modification was adopted for measuring social participation.

For each positive answer, a score of '1' was given and a score of '0' was assigned for every negative answer. Based on the total score, the respondents were classified into three categories using mean ($\bar{\chi}$) and standard deviation (σ) as follows:

Sl. No.	Level of Social participation	Criteria
1.	Low	Below ($\bar{\chi} - \sigma$)
2.	Medium	Between ($\bar{\chi} - \sigma$) and ($\bar{\chi} + \sigma$)
3.	High	Above ($\bar{\chi} + \sigma$)

3.5.1.14 Productivity

According to Mali (as cited by Muhammad, 2004), productivity is the measure of how well resources are brought together in organizations and utilized for accomplishing a set of results. Productivity is the name of reaching the higher level of performance with the least expenditures of resources. Productivity was measured in terms of quintals per acre. Productivity of Naga king chilli cultivation in the study area was calculated for five consecutive years from 2018 to 2022.

Sl. No.	Observations	2018	2019	2020	2021	2022
1.	Average area under Naga king chilli cultivation (acres)					
2.	Average yield (q)					
3.	Average productivity (q/ac)					

3.5.1.15 Adoption

To find out the status of adoption of the recommended practices, adoption index was calculated. For each question, a score of '2' was assigned in case of full adoption, a score of '1' was assigned in case of 'partial adoption' and '0' for 'no adoption'. Full adoption was categorized among the respondents who have adopted the recommended practices within their respective village and is still continuing; partial adoption was categorized among those respondents who adopted the activities but in the later years discontinued it; and no adoption were categorized among those respondents who has not adopted particular activities.

The following method was adopted to calculate adoption index for measuring the adoption of the respondents about improved king chilli cultivation.

$$\text{Adoption Index (AI)} = \frac{\text{Total score obtained by the respondents}}{\text{Maximum obtainable score}} \times 100$$

Based on the score obtained, the respondents were classified into three categories using mean ($\overline{\chi}$) and standard deviation (σ) as follows:

Sl. No.	Adoption level	Criteria
1.	Low	Below $(\bar{\chi} - \sigma)$
2.	Medium	Between $(\bar{\chi} - \sigma)$ and $(\bar{\chi} + \sigma)$
3.	High	Above $(\bar{\chi} + \sigma)$

3.5.1.16 Entrepreneurial behavior

Entrepreneurial behaviour was studied in terms of ten components viz., economic motivation, innovativeness, achievement motivation, decision making ability, risk taking ability, leadership ability, management orientation, production orientation, marketing orientation and entrepreneurial competencies.

1. Economic motivation: Economic motivation was operationally defined as the degree to which a farmer was oriented towards profit maximization in farming and the relative value placed by the farmer on economic ends (Supe, 1969). Economic motivation included six statements. All the positive statements were assigned the score of 3, 2, and 1 for Agree (A), Undecided (UD) and Disagree (D) and vice versa for negative statements.

After obtaining the total scores, the respondents were classified into three categories based on mean $(\bar{\chi})$ and standard deviation (σ) as follows:

Sl. No.	Level of Economic motivation	Criteria
1.	Low	Below $(\bar{\chi} - \sigma)$
2.	Medium	Between $(\bar{\chi} - \sigma)$ and $(\bar{\chi} + \sigma)$
3.	High	Above $(\bar{\chi} + \sigma)$

2. Innovativeness: Innovativeness refers to the behaviour pattern of a respondent who had interest in and desire to seek changes in farming technologies and to introduce such changes in to his operations which were practical and feasible. It was measure by using the scale developed by Sakharkar (1995) with some modifications. The scale consisted of five statements. All the positive statements were assigned the score of 3, 2, and 1 for Agree (A), Undecided (UD) and Disagree (D) and vice versa for negative statements.

After obtaining the total scores, the respondents were classified into three categories based on mean ($\bar{\chi}$) and standard deviation (σ) as follows:

Sl. No.	Level of innovativeness	Criteria
1.	Low	Below ($\bar{\chi} - \sigma$)
2.	Medium	Between ($\bar{\chi} - \sigma$) and ($\bar{\chi} + \sigma$)
3.	High	Above ($\bar{\chi} + \sigma$)

3. Achievement motivation: It is the desire to do well, not so much for the sake of social recognition or prestige, but to attain an inner feeling or personal accomplishment. It was measured with the help of procedure adopted by Chandrapaul (1998). The scale consisted of six statements. All the positive statements were assigned the score of 3, 2, and 1 for Agree (A), Undecided (UD) and Disagree (D) and vice versa for negative statements.

After obtaining the total scores, the respondents were classified into three categories based on mean ($\bar{\chi}$) and standard deviation (σ) as follows:

Sl. No.	Level of achievement motivation	Criteria
1.	Low	Below ($\bar{\chi} - \sigma$)
2.	Medium	Between ($\bar{\chi} - \sigma$) and ($\bar{\chi} + \sigma$)
3.	High	Above ($\bar{\chi} + \sigma$)

4. Decision making ability: The decision making ability of a farmer is operationally defined as the degree of weighing the available alternatives in terms of their desirability and their likelihoods and choosing the most appropriate one for achieving maximum profit on his farming. The scale developed by Supe (1969), and as adopted by Nagesha (2006) with suitable modifications. The scale consisted of six statements. The response given by the respondents in terms of their choice as considered independently, considered after consultation with others and not considered were scored as 2,1 and 0.

After obtaining the total scores, the respondents were classified into three categories based on mean ($\bar{\chi}$) and standard deviation (σ) as follows:

Sl. No.	Level of decision making ability	Criteria
1.	Low	Below ($\bar{\chi}$ – σ)
2.	Medium	Between ($\bar{\chi}$ – σ) and ($\bar{\chi}$ + σ)
3.	High	Above ($\bar{\chi}$ + σ)

5. Risk taking ability: It referred to the degree to which the respondents oriented towards risk and uncertainty in adopting new ideas or technologies in farming. Risk orientation scale developed by Supe (1969) with some modifications. The scale consisted of six statements. All the positive statements were assigned the score of 3, 2, and 1 for Agree (A), Undecided (UD) and Disagree (D) and vice versa for negative statements.

After obtaining the total scores, the respondents were classified into three categories based on mean ($\bar{\chi}$) and standard deviation (σ) as follows:

Sl. No.	Level of risk taking ability	Criteria
1.	Low	Below ($\bar{\chi}$ – σ)
2.	Medium	Between ($\bar{\chi}$ – σ) and ($\bar{\chi}$ + σ)
3.	High	Above ($\bar{\chi}$ + σ)

6. Leadership ability: Yuki (2006) defines leadership as "the process of influencing others to understand and agree about what needs to be done and how to do it, and the process of facilitating individual and collective efforts to accomplish shared objectives". The scale developed by Nandapurkar (1980) was used to determine the leadership ability of Naga king chilli farmers. The scale consisted of five statements. The responses were obtained on a three-point continuum namely 'always', 'sometimes' and 'never'. A weightage of 2, 1 and 0 respectively were assigned to response categories respectively.

After obtaining the total scores, the respondents were classified into three categories based on mean ($\bar{\chi}$) and standard deviation (σ) as follows:

Sl. No.	Level of risk taking ability	Criteria
1.	Low	Below ($\bar{\chi} - \sigma$)
2.	Medium	Between ($\bar{\chi} - \sigma$) and ($\bar{\chi} + \sigma$)
3.	High	Above ($\bar{\chi} + \sigma$)

7. Management orientation: It refers to the degree to which a farmer is oriented towards scientific farm management comprising of planning, production and marketing functions on his farm. Management orientation consisted of six statements. The scale developed by Samanta (1977) with some modifications was used in this study to quantify the management orientation of farmers. All positive statements were assigned the score of 4, 3, 2 and 1 for Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) and vice versa for negative statements.

After obtaining the scores comprising all three sections of Management Orientation, the respondents were classified into three categories based on mean ($\bar{\chi}$) and standard deviation (σ) as follows:

Sl. No.	Level of Management orientation	Criteria
1.	Low	Below ($\bar{\chi} - \sigma$)
2.	Medium	Between ($\bar{\chi} - \sigma$) and ($\bar{\chi} + \sigma$)
3.	High	Above ($\bar{\chi} + \sigma$)

8. Production orientation: Product orientation is the degree to which the organization focuses on understanding of the product. In a product-oriented organization, product is the reason for being (Houston 1986) and success requires superior product technology (Hayes and Abernathy 1980). Productorientation consisted of six statements. All positive statements were assigned the score of 4, 3, 2 and 1 for Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) and vice versa for negative statements.

After obtaining the scores comprising all three sections of Management Orientation, the respondents were classified into three categories based on mean ($\bar{\chi}$) and standard deviation (σ) as follows:

Sl. No.	Level of Management orientation	Criteria
1.	Low	Below ($\bar{\chi}$ – σ)
2.	Medium	Between ($\bar{\chi}$ – σ) and ($\bar{\chi}$ + σ)
3.	High	Above ($\bar{\chi}$ + σ)

9. Marketing orientation: Market orientation is organizational wide generation of market intelligence pertaining to current and future customer's needs, dissemination of the intelligence across departments and organisational wide responsiveness to it (Kohli and Jaworski, 1990). Marketing orientation included six statements. All the positive statements were assigned the score of 4, 3, 2, and 1 for Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SDA) and vice versa for negative statements.

After obtaining the total scores, the respondents were classified into three categories based on mean ($\bar{\chi}$) and standard deviation (σ) as follows:

Sl. No.	Level of Marketing orientation	Criteria
1.	Low	Below ($\bar{\chi}$ – σ)
2.	Medium	Between ($\bar{\chi}$ – σ) and ($\bar{\chi}$ + σ)
3.	High	Above ($\bar{\chi}$ + σ)

10. Entrepreneurial competencies: It is one's ability to take advantage of an idea and to create an entrepreneurial initiative, not only for making personal profit but also social and development one. According to Bolzani and Luppi (2021), entrepreneurial competence is essential in developing entrepreneurial attitudes and behavioral skills, which are the foundation for economic growth and social employability. Entrepreneurial competence scale was developed using Likert (1932) technique to measure the entrepreneurial competence of Naga king chilli farmers of the region.

Construction of entrepreneurial competence scale

The entrepreneurial competence scale was developed following standard research procedure. A list of statements with regard to entrepreneurial behaviours of Naga king chilli farmers was prepared through exhaustive review of relevant literatures and discussing with academicians, subject matter specialists, researchers, and scientists who were directly or indirectly exposed to such knowledge system. To check the relevancy of the 45 items included, the test was administered to a host of judges having expertise in the field. The judges were asked to indicate their degree of agreement against each item in three point continuum (MR-Most Relevant, R- Relevant and LR-Less Relevant) assigning a score of 3, 2, and 1 respectively and vice versa for negative items. The mean relevancy score was obtained by applying the following formula:

$$\text{MRS} = \frac{\text{Total obtained scores by particular statement}}{\text{Number of judges}}$$

Statements with mean relevancy score of 2 or higher were selected. A total of 30 statements were found relevant after the relevancy test.

Item analysis

Item analysis is an important step in the construction of a valid and reliable scale. The purpose of item analysis is to find those items that form an internally consistent scale and to eliminate from other inconsistent items. 30 items statements were subjected to item analysis to delineate the items that discriminate between persons having favourable and unfavourable responses.

The response of the respondents for each statements were obtained on a five point continuum ranging from, ‘strongly agree’, ‘agree’, ‘undecided’, ‘disagree’ and ‘strongly disagree’ with scores of 5, 4, 3, 2 and 1 respectively for positive statements and vice versa for negative statements. The total score of each individual was computed by summing up the scores for all the items.

Computation of 't' value

For computation of t value, all 30 scale items were administered to a random sample of 20 farmers from non-sampled areas. Total scores were obtained for each of the respondents were arrange in ascending order. The top 25 per cent of the respondents having high total score (high group) and the bottom 25 per cent of the respondents having low total score (low group), were used as criterion group to evaluate individual scale items. The critical ratio (t-value) for each item was calculated using the formula given by Edwards (1957) as follows:

$$t = \frac{\bar{X}_H - \bar{X}_L}{\sqrt{\frac{\sum(X_H - \bar{X}_H)^2 + \Sigma(X_L - \bar{X}_L)^2}{n(n-1)}}}$$

Where,

$$\sum(X_H - \bar{X}_H)^2 = \sum(X_H)^2 - \frac{(\Sigma X_H)^2}{n}$$

$$\sum(X_L - \bar{X}_L)^2 = \sum(X_L)^2 - \frac{(\Sigma X_L)^2}{n}$$

$\bar{X}_H$= Mean score of given statement of high group

$\bar{X}_L$= Mean score of given statement of low group

$\Sigma (X_H)^2$= Sum of squares of individual score on a given statement for high group

$\Sigma (X_L)^2$= Sum of squares of individual score on a given statement for low group

ΣX_H= Summation of scores on given statement for high group

ΣX_L= Summation of scores on given statement for low group

n= Number of respondents in each group

Critical ratio ('t' value) for all the scale statements was used for final selection of statements. Items or statements were selected on the basis of 't' value equal to or greater than 1.75. Statements were arranged in descending order based on their 't' values. Finally 10 statements (5 positive and 5 negative) were selected as follows:

Sl. No.	Statements	t-value
1.	One should take up less risky business which is already in practice.	3.16
2.	I do not make plans for starting a business because I do not have enough capital.	2.78
3.	Interacting with people with more experience and seeking for their advice is a must in any start-up.	2.44
4.	I see myself as a proficient farmer in treating problems as opportunities.	2.44
5.	Maintaining a good marketing network is not necessary as long as one have good relation with the farmers.	2.23
6.	One can start his own enterprise no matter the circumstances if he is passionate.	2.14
7.	Being an effective leader is not important as long as you are effective in your personal work.	2.13
8.	I've the ability to generate new and innovative ideas.	2.12
9.	I see myself as a successful businessman after 10 years.	2.09
10.	It is not necessary to keep up-to-date agriculture information in relation to setting up new entrepreneurial ventures.	1.89

Reliability and validity of the scale

The reliability of the scale was determined by split -half method. The scale was administered to 20 respondents in a non-sampled area. The scale was divided into two halves based on odd- even numbers of the statement. The scores on the odd numbered items as well as the scores of the even numbered items of same respondents were correlated using the Pearson's product moment correlation coefficient and was found to be 0.70. Spearman-Brown (1910) prophecy formula was used to calculate the reliability coefficient (R) of the whole scale as follows:

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

Where,

R= reliability coefficient of the whole scale.

r= estimated correlation between two halves (Pearson r)

The test reliability was found to be 0.82 which was significant at 1 per cent level of probability. Standard version of (0 to 1 scale) of Cronbach alpha (1946) was use for more stability and accuracy.

$$\alpha_{\text{standardized}} = \frac{K_r}{[1+(K-1)r]}$$

Where,

K = number of items in scale

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

The calculated value of Cronbach alpha was found to be 0.96. Thus, the result indicated that the entrepreneurial competence scale has excellent reliability and suitable for administration to the farmers as the scale was consistent and dependable in its measurement. Thus, the test is reliable to measure the entrepreneurial competence of farmers towards sustainable cultivation practices of Naga king chilli.

The validity of the entrepreneurial competence scale was examined for its content validity by determining how well the content of the scale represented the domain subject matter under study. The statements of the scale were derived from relevant literatures and consultation with concerned experts in the field. The ‘t’ values were significant for all the 10 statements indicating high discriminating values. It inferred that the scores obtained by utilising the present scale would measure the intended items under the present study. Thus, the scale was considered valid based on the content validity criterion.

The final scale consisted of ten statements. All the positive statements were assigned the score of 3, 2, and 1 for Agree (A), Undecided (UD) and Disagree (D) and vice versa for negative statements. After obtaining the total scores, the respondents were classified into three categories based on mean ($\overline{\chi}$) and standard deviation (σ) as follows:

Sl. No.	Level of entrepreneurial competencies	Criteria
1.	Low	Below $(\bar{\chi} - \sigma)$
2.	Medium	Between $(\bar{\chi} - \sigma)$ and $(\bar{\chi} + \sigma)$
3.	High	Above $(\bar{\chi} + \sigma)$

The overall level of entrepreneurial behaviour was measured by developing an entrepreneurial index as follows:

$$\text{Entrepreneurial index (EI)} = \frac{EBh}{n} X\ 100$$

Where,

$EBh = \sum_{i=1}^{n} Ei$

Ei= the ratio of the scores obtained by the respondents to the maximum obtainable score in a particular entrepreneurial behaviour component

n =the number of the entrepreneurial behaviour components

After obtaining the scores of "Entrepreneurial Index (EI)", the respondents were grouped in three categories based on mean $(\bar{\chi})$ and standard deviation (σ) as follows:

Sl. No.	Level of overall entrepreneurial behaviour	Criteria
1.	Low	Below $(\bar{\chi} - \sigma)$
2.	Medium	Between $(\bar{\chi} - \sigma)$ and $(\bar{\chi} + \sigma)$
3.	High	Above $(\bar{\chi} + \sigma)$

3.5.2 Dependent variables

3.5.2.1 Knowledge

Rogers (1983) defined knowledge as a function or stage of innovation-decision process when the individual (or other decision making unit) is exposed to an innovator's existence and joins some understanding of how it functions.

Knowledge level refers to the information process in respect of recommended farming practices.

In the present study, schedule of knowledge on sustainable Naga king chilli cultivation was prepared by following the recommended organic package and practices of king chilli (C*apsicum chinense* Jacq) by Sharma (2020) and improved production technology of king chilli and cardamom by Sachan and Mezhatsu (2018). It included 67 statements. For each correct response a score of '1' was awarded and for each wrong answer '0' was awarded. Based on the total score obtained, 'Knowledge Index' was developed using the formula given below:

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

Based on the extent of knowledge possessed, the respondents were classified into three categories using mean ($\bar{\chi}$) and standard deviation (σ) as follows:

Sl. No.	Knowledge level	Criteria
1.	Low	Below ($\bar{\chi} - \sigma$)
2.	Medium	Between ($\bar{\chi} - \sigma$) and ($\bar{\chi} + \sigma$)
3.	High	Above ($\bar{\chi} + \sigma$)

3.5.2.2 Attitude

Attitude refers to the degree of positive or negative affect associated with some psychological object, Thurstone (1946).Therefore, the psychological object in the present study is the sustainable cultivation practices of Naga king chilli. Attitude scale was developed using Likert (1932) technique to measure the attitude of Naga king chilli farmers of the region.

Construction of attitude scale

The attitude scale was developed following standard research procedure. A list of statements on sustainable cultivation practices of Naga king chilli was prepared through exhaustive review of relevant literatures and discussing with academicians, subject matter specialists, researchers, and scientists who were directly or indirectly exposed to such knowledge system. To check the relevancy of the 70 items included, the test was administered to a host of judges having expertise in the field. The judges were asked to indicate their degree of agreement against each item in three point continuum (MR-Most Relevant, R-Relevant and LR-Less Relevant) assigning a score of 3, 2, and 1 respectively and vice versa for negative items. The mean relevancy score was obtained by applying the following formula:

$$\text{MRS} = \frac{\text{Total scores obtained by particular statement}}{\text{Number of judges}}$$

Statements with mean relevancy score of 2 or higher were selected. A total of 40 statements were found relevant after the relevancy test.

Item analysis

Item analysis is an important step in the construction of a valid and reliable scale. The purpose of item analysis is to find those items that form an internally consistent scale and to eliminate from other inconsistent items. 40 items statements were subjected to item analysis to delineate the items that discriminate between persons having favourable and unfavourable responses.

The response of the respondents for each statements were obtained on a five point continuum ranging from, 'strongly agree', 'agree', 'undecided', 'disagree' and 'strongly disagree' with scores of 5, 4, 3, 2 and 1 respectively for positive statements and vice versa for negative statements. The total score of each individual was computed by summing up the scores for all the items.

Computation of 't' value

For computation of t value, all 40 scale items were administered to a random sample of 20 farmers from non-sampled areas. Total scores were obtained for each of the respondents were arrange in ascending order. The top 25 per cent of the respondents having high total score (high group) and the bottom 25 per cent of the respondents having low total score (low group), were used as criterion group to evaluate individual scale items. The critical ratio (t-value) for each item was calculated using the formula given by Edwards (1957) as follows:

$$t = \frac{\bar{X}_H - \bar{X}_L}{\sqrt{\frac{\sum(X_H - \bar{X}_H)^2 + \Sigma(X_L - \bar{X}_L)^2}{n(n-1)}}}$$

Where,

$$\sum(X_H - \bar{X}_H)^2 = \sum(X_H)^2 - \frac{(\Sigma X_H)^2}{n}$$

$$\sum(X_L - \bar{X}_L)^2 = \sum(X_L)^2 - \frac{(\Sigma X_L)^2}{n}$$

$\bar{X}_H$=mean score of given statement of high group

$\bar{X}_L$= mean score of given statement of low group

$\Sigma (X_H)^2$= sum of squares of individual score on a given statement for high group

$\Sigma (X_L)^2$= sum of squares of individual score on a given statement for low group

ΣX_H= summation of scores on given statement for high group

ΣX_L= summation of scores on given statement for low group

n= number of respondents in each group

Critical ratio ('t' value) for all the scale statements was used for final selection of statements. Items or statements were selected on the basis of 't' value equal to or greater than 1.75. Statements were arranged in descending order based on their ‘t’ values. Finally 20 statements (9 positive and 10 negative) were selected as follows:

Sl. No.	Statements	t-value
1.	Since my farm is situated in upland conditions and fragmented also, I cannot follow sustainable farming.	6
2.	Sustainable Naga king chilli farming is helpful to increase my standard of living.	4
3.	Sustainable Naga king chilli farming is uneconomical in the long run.	4
4.	One should not worry about the excessive use of chemicals in Naga king chilli farming as long as it is profitable.	3.79
5.	Sustainable Naga King Chilli farming is very laborious and stressful.	3.53
6.	I would like to gain more knowledge and skills in sustainable Naga king chilli farming.	2.86
7.	There is less opportunity for income and livelihood improvement by following sustainable Naga king chilli farming.	2.68
8.	If one chooses sustainable Naga king chilli farming, he has to be ready to face the adverse effects.	2.68
9.	Inability to access the necessary inputs may prove a hindrance for sustainable Naga king chill farming.	2.68
10.	I prefer to be a Naga king chilli farmer than going for a white- collar job.	2.68
11.	Sustainable Naga king chilli farming may prove a boon for the farmers and the earth as well.	2.52
12.	Crop rotations and diversifications are not important for sustainable Naga king chilli farming.	2.35
13.	I don’t want to adopt sustainable Naga king chill farming as it is input intensive.	2.23
14.	Farmers can use Indigenous Technical Knowledge to improve sustainable Naga King Chilli farming.	2.13
15.	Sustainable Naga king chilli farming has the potential to contribute towards a clean and safe environment.	2.13
16.	Farmers should only focus on one farm activity rather than crop diversification.	2.12
17.	Sustainable Naga king chilli farming can reduce the production cost in comparison to conventional farming.	1.98
18.	I feel that one should go for sustainable king chilli farming rather traditional farming for more profit.	1.89
19.	Advanced technologies are capable to attract younger generation’s interest towards sustainable Naga king chilli farming.	1.89
20.	There is a great scope for sustainable Naga king chilli farming as people are becoming more concerned about one’s health.	1.87

Reliability and validity of the scale

Reliability was carried out to know the consistency, stability and accuracy of the scale. The reliability of the scale was determined by split -half method. The scale was administered to 20 respondents in a non-sampled area. The scale was divided into two halves based on odd- even numbers of the statement. The scores on the odd numbered items as well as the scores of the even numbered items of same respondents were correlated using the Pearson's product moment correlation coefficient and was found to be 0.74. Spearman-Brown (1910) prophecy formula was used to calculate the reliability coefficient (R) of the whole scale as follows:

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

Where,

R= reliability coefficient of the whole scale.

r= estimated correlation between two halves (Pearson r)

The test reliability was found to be 0.85 which was significant at 1 per cent level of probability. Standard version of (0 to 1 scale) of Cronbach alpha (1946) was use for more stability and accuracy.

$$\alpha_{\text{standardized}}=\frac{K_r}{[1+(K-1)r]}$$

Where,

K = number of items in scale

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

The calculated value of Cronbach alpha was found to be 0.98. Thus, the result indicated that the attitude scale has excellent reliability and suitable for administration to the farmers as the scale was consistent and dependable in its measurement. Thus, the test is reliable to measure the attitude of farmers towards sustainable cultivation practices of Naga king chilli.

The validity of the scale was examined for its content validity by determining how well the content of the scale represented the domain subject matter under study. The statements of the attitude scale were derived from relevant literatures and consultation with concerned experts in the field. The 't'values were significant for all the 20 statements indicating high discriminating values. It inferred that the scores obtained by utilising the present scale would measure the intended items under the present study. Thus, the scale was considered valid based on the content validity criterion.

The final attitude scale developed for measuring the attitude of farmers towards sustainable cultivation practices of Naga king chilli was administered to all the respondents under the present study. The response of respondents for each statements were obtained on a five point continuum ranging from, 'strongly agree', 'agree', 'undecided', 'disagree' and 'strongly disagree' with the scores of 5, 4, 3, 2 and 1 respectively for positive statements and vice versa for negative statements. Based on the total scores obtained, the respondents were classified into three categories based on mean ($\bar{\chi}$) and standard deviation (σ) values as follows:

Sl. No.	Level of attitude	Criteria
1.	Less favourable	Below ($\bar{\chi} - \sigma$)
2.	Favourable	Between ($\bar{\chi} - \sigma$) and ($\bar{\chi} + \sigma$)
3.	Highly favourable	Above ($\bar{\chi} + \sigma$)

3.5.2.2 Sustainability

MacRae *et al.* (1989**)** stated that sustainable agriculture comprises "management procedures that work with natural processes to conserve all resources, minimize waste and environmental impact, prevent problems and promote agro ecosystem resilience, self-regulation, evolution and sustained production for the nourishment and fulfilment of all. While, Schroter (2010) proposed economic, social, human and environmental sustainability to assess sustainable performance. Accordingly, the study had been performed using four dimensions of sustainability viz., economic sustainability, social sustainability, environmental sustainability and institutional sustainability to analyze the sustainable performance of Naga king chilli in the region.

The respondents were categorized in to three groups based on the mean ($\bar{\chi}$) and standard deviation (σ) of the score obtained as follows:

Sl. No.	Level of sustainability	Criteria
1.	Low	Below ($\bar{\chi} - \sigma$)
2.	Medium	Between ($\bar{\chi} - \sigma$) and ($\bar{\chi} + \sigma$)
3.	High	Above ($\bar{\chi} + \sigma$)

Sustainability was measured by developing a sustainability index. Each of the four dimensions of sustainability viz., economic sustainability, social sustainability, environmental sustainability and institutional sustainability were measured on the basis of indicators. Finally sustainability index was calculated using the following formula as follows:

$$\sum_{i=1}^{4} \frac{\sum_{j=1}^{n} w_1, w_2, \dots w_n}{\sum_{j=1}^{n} a_1, a_2, \dots a_n}, \frac{\sum_{k=1}^{n} x_1, x_2, \dots x_n}{\sum_{k=1}^{n} b_1, b_2, \dots b_n}, \frac{\sum_{l=1}^{n} y_1, y_2, \dots y_n}{\sum_{l=1}^{n} c_1, c_2, \dots c_n}, \frac{\sum_{m=1}^{n} z_1, z_2, \dots z_n}{\sum_{m=1}^{n} d_1, d_2, \dots d_n} \times 100$$

Where,

$w_1, w_2, \dots w_n$ = Scores obtained by individual farmers in economic sustainability

$a_1, a_2, \dots a_n$ = Maximum possible score obtained by the farmers in economic sustainability

$x_1, x_2, \dots x_n$ = Scores obtained by individual farmers in social sustainability

$b_1, b_2, \dots b_n$ = Maximum possible score obtained by the farmers in social sustainability

$y_1, y_2, \dots y_n$ = Scores obtained by individual farmers in environmental sustainability

$c_1, c_2, \dots c_n$ = Maximum possible score obtained by the farmers in environmental sustainability

$z_1, z_2, \dots z_n$ = Scores obtained by individual farmers in institutional sustainability

$d_1, d_2, \dots d_n$ = Maximum possible score obtained by the farmers in institutional sustainability

i= Economic sustainability, Social sustainability, Environmental sustainability and Institutional sustainability

j= Total number of farmers in economic sustainability

k= Total number of farmers in social sustainability

l= Total number of farmers in environmental sustainability

m= Total number of farmers in institutional sustainability

3.6 Formulation of Hypothesis:

Following null hypothesis were formulated to test the relationship between the variable *viz.,* 'knowledge of sustainable cultivation practices of Naga king chilli', 'attitude towards sustainable cultivation practices of Naga king chilli' and the selected personal, socio-economic and psychological variables specified earlier under the heading selection and measurement of variables:

Null Hypothesis $H_0$1: There is no significant association between the selected personal, socio-economic and psychological characteristics of the farmers with 'knowledge of sustainable cultivation practices of Naga king chilli'.

Alternate Hypothesis $H_0 1_a$: There exists a significant association between the selected personal, socio-economic and psychological characteristics of the farmers with 'knowledge of sustainable cultivation practices of Naga king chilli'.

Null Hypothesis $H_0$2: There is no significant association between the selected personal, socio-economic and psychological characteristics of the farmers with 'attitude towards sustainable cultivation practices of Naga king chilli'.

Alternate Hypothesis $H_0 2_a$: There exists a significant association between the selected personal, socio-economic and psychological characteristics of the farmers with 'attitude towards sustainable cultivation practices of Naga king chilli'.

3.7 Tools and techniques used for data collection

An interview schedule directed towards the objectives of the study was developed to be used as the tool for data collection. The schedule was prepared with reference from similar research materials from within and outside the institution.

3.7.1 Development of interview schedule

Interview schedule was prepared in consultation with the experts in the field of agricultural extension keeping in view the objectives of the study. The schedule was divided into four parts. The first part consisted of the general information of the respondents and socio- economic, personal and psychological characteristics of the respondents. Followed by the status of Naga king chilli cultivation practices followed by the respondents, entrepreneurial behavior of the respondents, sustainability of Naga king chilli cultivation and constraints faced by the respondents in adoption of sustainable cultivation practices of Naga king chilli.

3.7.2 Pre-testing of interview schedule

Before the actual interview, a preliminary interview was conducted in the selected villages, where a sample of 20 respondents which did not constitute the respondents sample was selected for pre-testing the schedule. Based on the pre-tested results, few difficulties and ambiguous questions were deleted from the draft schedule.

3.7.3 Method of data collection

For the present study two types of data *viz.* primary and secondary data were collected. The primary data was collected through personal interview by the researcher through personal interview and group discussions with the help of pre-tested schedule. The Secondary data was collected from relevant literatures and other sources.

3.8 Analysis of data

The data collected from the respondents were scored, tabulated and analysed to calculate frequency, percentage, mean, standard deviation, correlation, ‘Z’ test, factor and path analysis. Statistical analysis was done using SPSS software.

3.8.1 Percentage

Percentages were calculated for making comparisons of the sub components of the selected attributes.

$$\boldsymbol{Percentage = \frac{number\ of\ observations}{total\ number\ of\ observations} X\ 100}$$

3.8.2 Mean and standard deviation

According to Chandra *et al.* (2013) the Mean or Arithmetic mean is generally known as the average. It is simplest of all averages and it is also known as true average. It was calculated as follows:

$$\bar{\chi} = \frac{\sum Xi}{n}$$

Where,

$\bar{\chi}$= sample mean

ΣXi= sum of each of the score in turn, and

n= total number of scores in the distribution

According to Pearson (1923), standard deviation is defined as the square root of the average of squared deviations of the frequency distribution.

Means and standard deviations were used to classify the respondents into the categories based on scores obtained through Mean ±SD values.

$$\sigma = \sqrt{\sum_{i=1}^{n} \frac{(X_i - \bar{\chi})^2}{n}}$$

Where,

Σ= standard deviation,

X_i= each score in turn,

$\bar{\chi}$= mean of the sample and

n = total number of scores in the distribution

3.8.3 Z test

Z-test is a statistical test used to determine whether the mean of two underlying population are different when the variances are known and the sample size is large. It is based on the normal distribution and is used for judging the significance of several statistical measures, particularly the mean (Aslam, 2023). It is denoted as,

$$Z=\frac{\bar{\chi}-\mu}{\sigma/\sqrt{n}}$$

Where,
$\bar{\chi}$ = sample mean

μ=population mean

σ = standard deviation

n= sample size

3.8.4 Correlation

If the change in one variable affects the change in the other variable, the variables are said to be correlated (Sahu, 2018). In other words, the systematic interrelationship between the variables is termed as correlation. The index of the degree of relationship between two continuous variables is known as correlation coefficient. The correlation coefficient, *r* is known as Pearson's Correlation coefficient since it was developed by Karl Pearson.

The correlation coefficient, *r* is given as the ratio of covariance of the variables *x* and *y* to the product of the standard deviations of *x* and *y*. symbolically, it can be simplified as:

$$r = \frac{N\sum xy - \sum(x)(y)}{\sqrt{[N\sum X^2 - \sum(\mathrm{x})^2]\ [N\sum \mathrm{y}2 - \sum(\mathrm{y})^2]}}$$

Where,
r= Pearson *r* correlation coefficient

N= number of value in each data set

$\sum x$= sum of x scores

$\sum y$= sum of y scores

$\sum xy$=sum of the products of paired scores

$\sum x^2$= sum of squared x scores

$\sum y^2$= sum of squared y scores

Correlation was used to calculate ‘r’ value in order to know the strength of the association between dependent and independent variables.

3.8.5 Path analysis

Path analysis is a statistical technique for examining and testing relationships among a set of observed variables. Furthermore, these relationships or paths may be described as representing direct or indirect associations. The sum of all direct and indirect relationships, in turn, yields a variable’s total association. Path analysis combines qualitative cause–effect information with empirical data to provide a quantitative assessment of causal relations (Beaujean, 2019). According to Walker *et al.* (2008), path analysis allows the simultaneous estimation of multiple regression equations and provides estimates of direct and indirect impact of these variables on stipulated other variables in a model. Furthermore, path analysis allows the separation of direct and indirect associations between the dependent and independent variables.

3.8.6 Factor analysis

Factor analysis is a multivariate technique which allows the researcher to simplify a set of complex variables or items using statistical procedures to explore the underlying dimensions that explain the relationships between different variables under study (observable variables) with new variables called factors (Alkarkhi and Alqaraghuli, 2019). This technique works efficiently by extracting maximum common variance from all variables so as to produces fewer factors to describe the relationship if the variables under study are highly correlated.The component model is expressed as follows:

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

Where,

Z_i = magnitude of 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 components matrix (Varimax rotation method) from respective dimensions were selected.

3.8.7 Henry Garrett ranking technique

The Henry Garrett Ranking Technique was employed to evaluate the constraints faced by Naga king chilli growers in sustainable cultivation of Naga king chilli in Nagaland. 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 (Ao and Jamir, 2020).In this method, the respondents were asked to rank the given constraints according to the magnitude of the problem. Constraints faced by the respondents were categorized under nine main heads such as, biotic & abiotic constraints, technical constraints, extension constraints, post-harvest constraints, input supply constraints, marketing constraints, land/soil related constraints, economic constraints and social constraints.The orders of merit given by the respondents were converted into ranks by using the following formula:

$$\text{Percent position} = \frac{100(\text{Rij } - 0.5)}{\text{NJ}}$$

Where,

$R_{ij=}$ Rank given for $_i^{th}$ constraints by j^{th} individual and

N_i= Number of constraints ranked by j^{th} individual

The percentage position of each rank thus obtained was converted into scores by referring to the table given by Garrett (1979). Then for each factor the scores of individual respondents were added together and divided by the total number of the respondents for whom the scores was added. These mean scores for all the factors were arranged in the order of their ranks and inferences were drawn. The factors having highest mean value is considered to be the most important factor.

CHAPTER-IV

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

Results of the present study with pertinent discussion are exhibited in this chapter. The data were tabulated, analyzed and organized in line with the study objectives. The results and discussion of the study has been displayed under the following sub-head:

4.1 Personal, socio-economic and psychological characteristics of Naga king chilli growers

4.1.1 Age

It was revealed from Table 4.1.1.1 and Fig 4.1.1.1 that a larger part (68.42%) of the farmers of Mon district were under the age category of 35 to 55 years, following that under the age group of more than 55 years (18.42%) and less than 35 years (13.16%). Similarly, Dimapur district also reported that more than (69.05%) of the farmers were under the age group of 35 to 55 years, following that, 25.00 per cent of the respondents belonged to the age group of less than 35 years and only a minimal (5.95%) number was recorded for the age category of more than 55 years. Almost three quarter (70.00%) of the farmers of Peren district were between 35 to 55 years, following that a marginal (18.42%) number of the farmers were more than 55 years and 13.16 per cent with age less than 35 years. The overall distribution of respondents (Fig 4.1.1.1b) revealed that the majority (69.20%) of the respondents belonged to the age category of 35 to 55 years, following that, 19.20 per cent with age less than 35 years and 11.60 per cent with age more than 55 years. Thus, it may be inferred that the bulk of the farmers in the study area were middle-aged. This age group has more involvement in the sustainable Naga king chilli cultivation as they are more enthusiastic and energetic, have more responsibilities than the other age group and may be considered as the economically active population. Sravani *et al*.

(2021), Lama and Ghosh (2022) and Lalhlimpuii and Bose (2023) exhibited similar findings from their study.

Table 4.1.1.1: Distribution of respondents based on age

N=250

Sl. No.	Category of Age	Mon	Dimapur	Peren	Total
		Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
1.	Less than 35 years	10(13.16)	21(25.00)	17(18.89)	48(19.20)
2.	35 to 55 years	**52(68.42)**	**58(69.05)**	**63(70.00)**	**173(69.20)**
3.	More than 55 years	14(18.42)	5(5.95)	10(11.11)	29(11.60)
4.	Total farmers	76(100.00)	84(100.00)	90(100.00)	250(100.00)
5.	Mean	45.75	40.07	42.91	42.76
6.	SD	9.15	8.05	9.20	9.07

Table 4.1.1.2: Comparative account of age of respondents

Sl. No.	Name of the district	Mean Age (μ) of farmers	z value	Prob.
1.	Mon	45.75	3.85**	<0.01
	Dimapur	40.07		
2.	Mon	45.75	1.85	>0.05
	Peren	42.91		
3.	Dimapur	40.07	-2.00*	<0.05
	Peren	42.91		

* significant at 5% level of probability ** significant at 1% level of probability

Table 4.1.2, revealed that mean age of the respondents of Mon and Dimapur district showed statistical significance at 1 per cent level of significance (p-value <0.01) while Dimapur and Peren district showed statistical significance at 5 per cent level of significance (p-value <0.05). This explains that

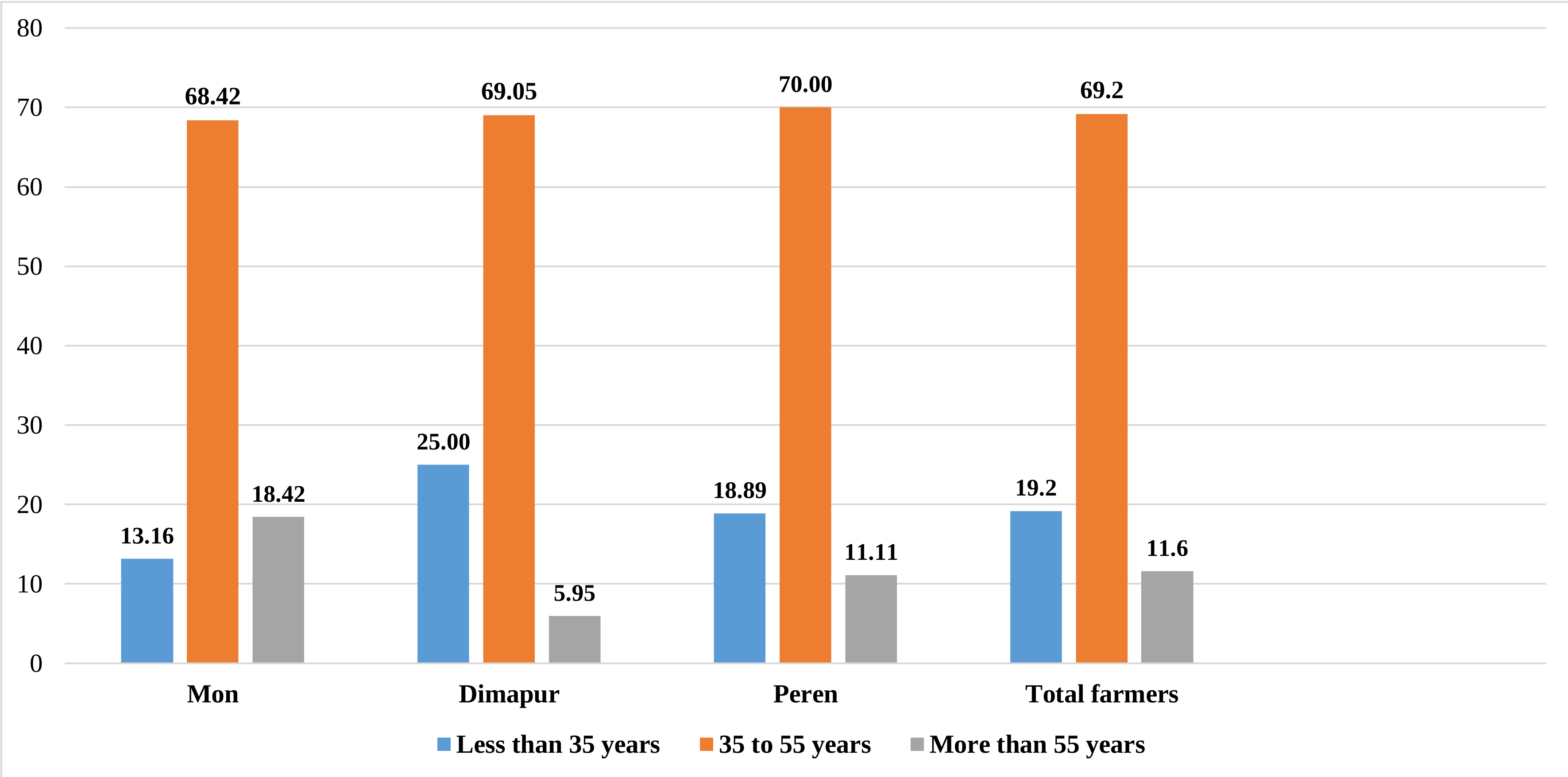

Fig 4.1.1.1a: Distribution of respondents based on age

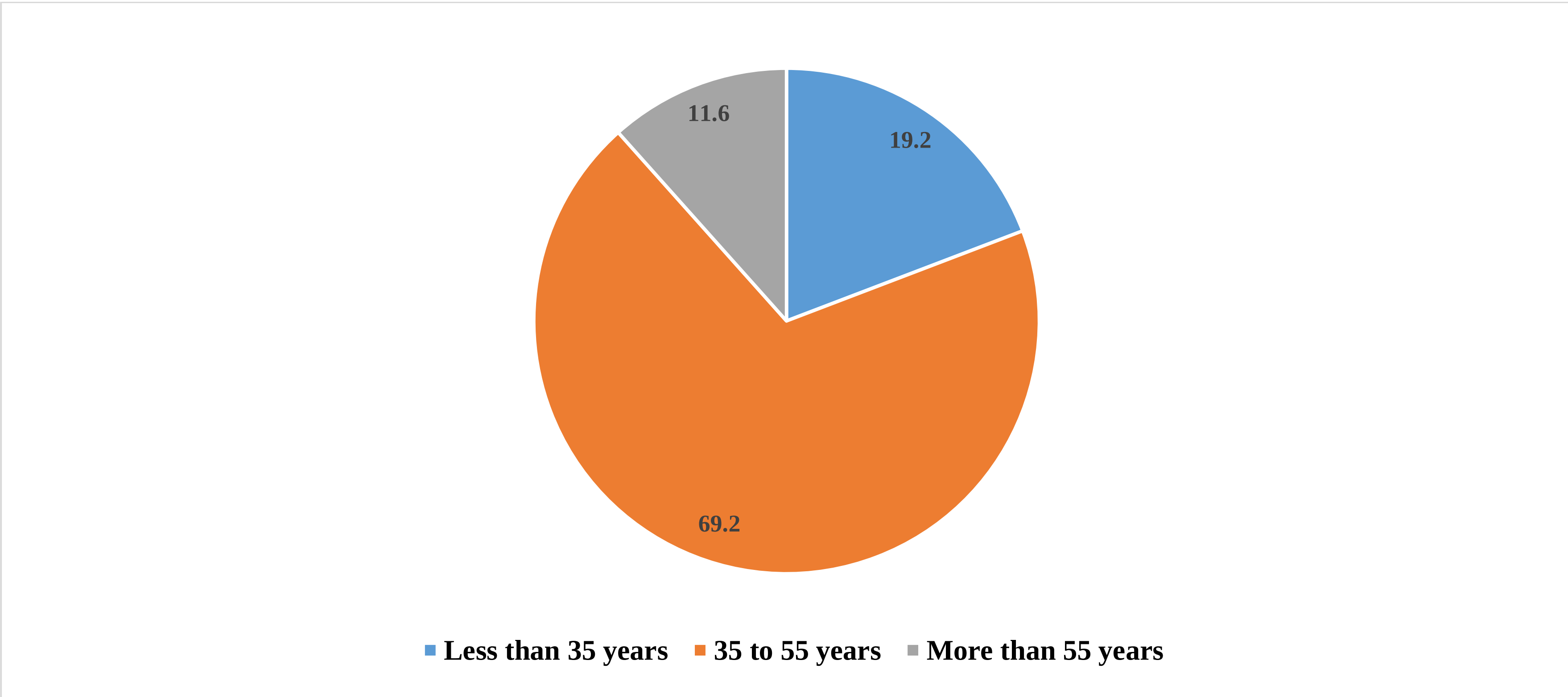

Fig 4.1.1.1b: Distribution of overall farmers based on age

Naga king chilli growers of Mon and Dimapur as well as Dimapur and Peren districts differed significantly with respect to their age.

4.1.2 Family size

Table 4.1.2.1: Distribution of respondents based on family size

N=250

Sl. No.	Members in the family	Mon	Dimapur	Peren	Total
		Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
1.	Less than 5 members	4(5.26)	37(44.05)	31(34.44)	72(28.80)
2.	5 to 8 members	**66(86.85)**	**44(52.38)**	**55(61.11)**	**166(66.40)**
3.	More than 8 members	6(7.89)	3(3.57)	4(4.45)	12(4.80)
4.	Total farmers	76(100.00)	84(100.00)	90(100.00)	250(100.00)
5.	Mean	6.83	4.80	5.28	5.59
6.	SD	1.40	1.52	1.74	1.76

Table 4.1.2.2: Comparative account of family size of respondents

Sl. No.	Name of the district	Mean Family size (μ)	z value	Prob.
1.	Mon	6.83	1.98*	<0.05
	Dimapur	4.80		
2.	Mon	6.83	1.09	>0.05
	Peren	5.28		
3.	Dimapur	4.80	-0.34	>0.05
	Peren	5.28		

* significant at 5% level of probability

From Table 4.1.2.1 and Fig 4.1.2.1 it can be confirmed that majority (86.85 %) of the respondents from Mon district had medium family size with 5 to 8 members followed by 7.89 per cent and 5.26 per cent of them with family size of more than 8 members and less than 5 members respectively. In case of

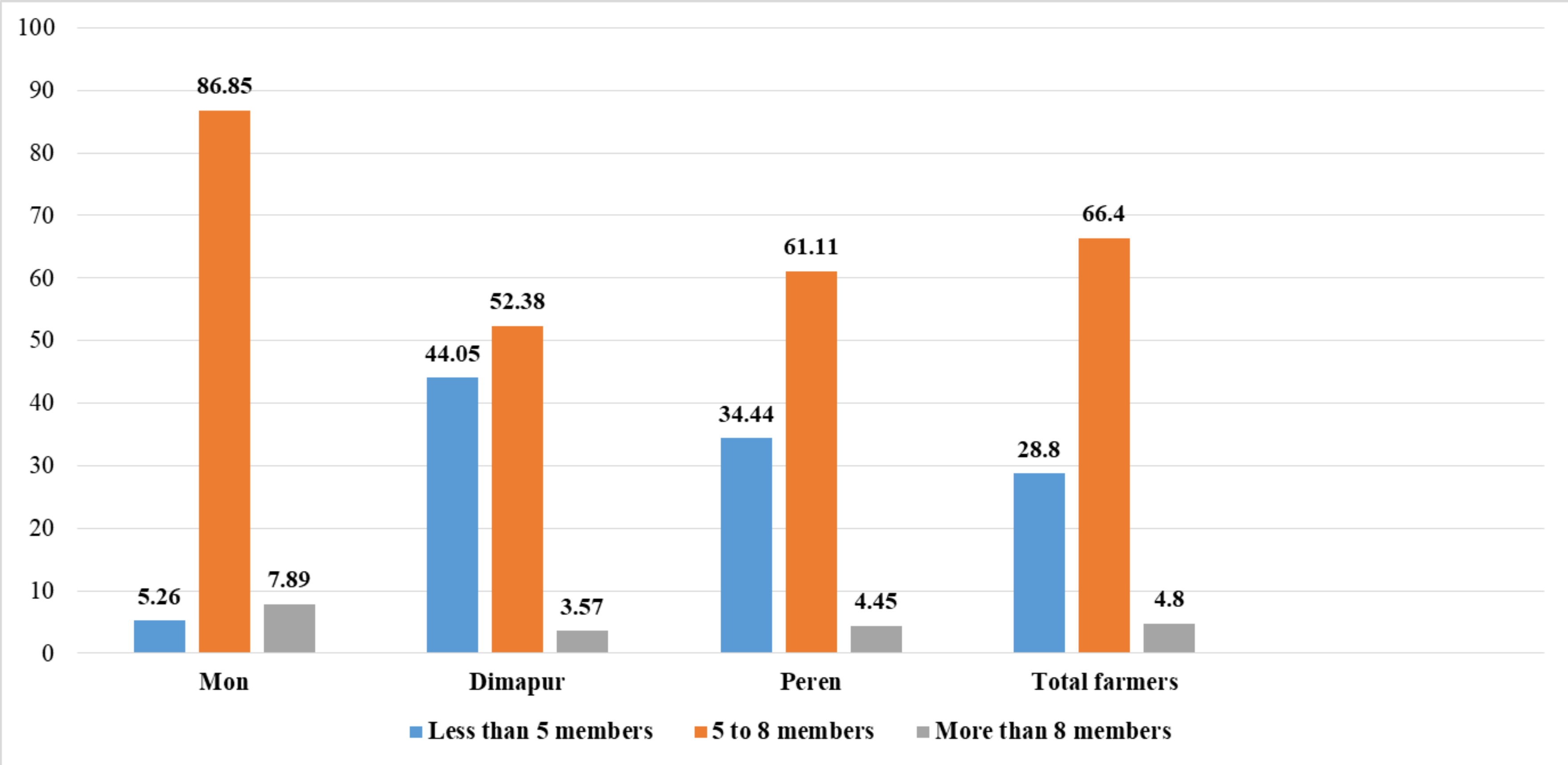

Fig 4.1.2.1: Distribution of respondents based on family size

Dimapur district it was revealed that a larger part (52.38%) of the farmers had family size between 5 to 8 members, following that almost half (44.05%) with less than 5 members and only 3.57 per cent with more than 8 members. While, Peren district also revealed that majority (61.11%) of the respondents had family size with 5 to 8 members followed by less than 5 members (34.44%) and more than 8 members (4.45%). The overall distribution of respondents revealed that majority (66.40%) of the respondents had medium family size with 5 to 8 members followed by less than 5 members (28.80%) and more than 8 members (4.80%). This might be because of the cultural expectations of the rural communities to have larger families to realize their need for extra labour on the farm and at home. These results are in accordance with that of Peter and Maruthi (2021), Bharti *et al*. (2022) and Lalhlimpuii and Bose (2023).

From Table 4.1.2.2, it can be observed that mean family size of the respondents of Mon and Dimapur district differed significantly at 5 per cent level of significance (p-value <0.05).

4.1.3 Education level

Table 4.1.3.1 and Fig 4.1.3.1 revealed that the highest (53.35%) percentage of respondents with education up to primary level was observed in Peren district followed by 51.19 per cent in Dimapur district. While, 46.05 per cent of the respondents from Mon district had education level up to middle school. The overall distribution of respondents also showed that 44.40 per cent had education up to primary school level, following that middle school (25.20%), high school (14.40%), Pre-University Course (PUC) (8.00%) and graduate (2.40%). The study revealed that the literacy rate was high with just a fraction (5.60%) of the respondents with no formal education. This might be because of the realization of the importance of education among farmers of the region. The findings are in line with the findings of Lama and Ghosh (2022), Hota and Tirkey (2023) and Lalhlimpuii and Bose (2023).

Table 4.1.3.1: Distribution of respondents based on their education level

N=250

Sl. No.	**Education level**	**Mon**	**Dimapur**	**Peren**	**Total**
		Frequency (%)	**Frequency (%)**	**Frequency (%)**	**Frequency (%)**
1	Illiterate	6(7.89)	3(3.57)	5(5.55)	14(5.60)
2	Primary school	20(26.32)	43(**51.19**)	48(**53.35**)	**111(44.40)**
3	Middle school	35(**46.05**)	17(20.24)	11(12.22)	**63(25.20)**
4	High school	8(10.53)	9(10.72)	19(21.11)	36(14.40)
5	P.U.C	6(7.89)	10(11.90)	4(4.44)	20(8.00)
6	Graduate	1(1.32)	2(2.38)	3(3.33)	6(2.40)
7	Total Farmers	76(100.00)	84(100.00)	90(100.00)	250(100.00)

4.1.4 Size of total land holding under agriculture

Table 4.1.4.1 and Fig 4.1.4.1a disclosed that majority (84.21%) of the respondents from Mon district were found to be small farmers with total land holding of 2.50 to 5.0 acres under agriculture followed by 15.79 per cent under marginal (<2.50 acre) category of farmers. Further, it was revealed that a major part (71.11%) of the respondents from Peren district were under small (2.50-5.0 acre) category of farmers while 28.89 per cent under marginal (<2.50 acre) category of farmers. It was also observed that over half (53.57%) of the respondents from Dimapur district were under small (2.50 - 5.0 acre) category of farmers followed by 46.43 per cent under marginal category of farmers. The overall distribution (Fig 4.1.4.1b) revealed that larger part (69.20%) of the respondents were found under small category of farmers with land holding of 2.50 to 5.0 acres under agriculture followed by 30.80 per cent under marginal (<2.50 acre) category of farmers. The

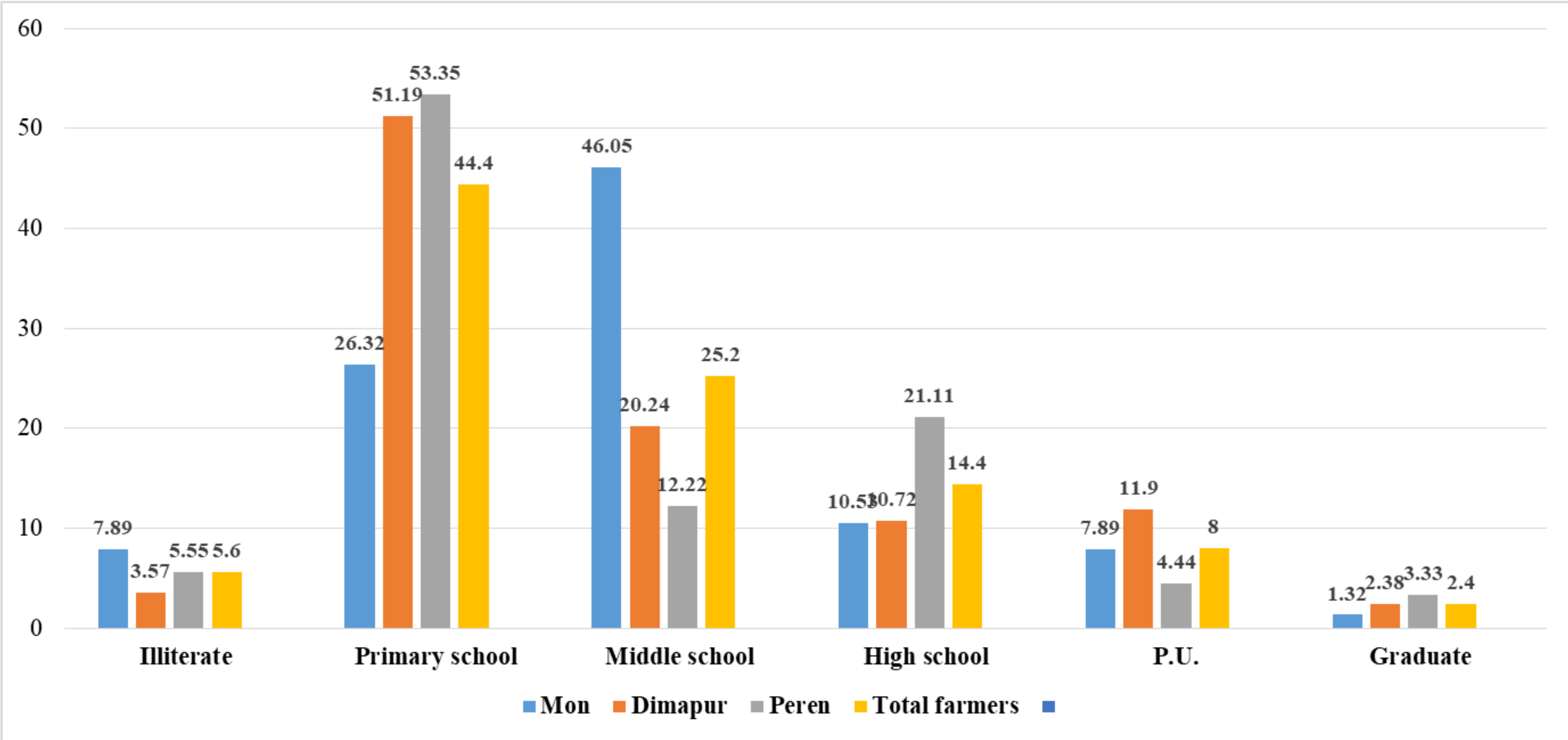

Fig 4.1.3.1: Distribution of respondents based on education level

average land under agriculture was 2.06 acres and 3.35 acres for marginal and small category of farmers respectively. While, the overall average landholding under agriculture was recorded at 2.96 acres. The small landholding among the respondents could be because of the law of inheritance where the farm land usually gets divided and sub-divided with each generations and slowly leads to fragmented small land holdings. The findings are in conformity with that of Sundresha *et al.* (2020) and Khose *et al.* (2022).

Table 4.1.4.1: Distribution of respondents based on the size of total land holding under agriculture

N=250

Sl. No.	**Category of farmers**	**Mon**	**Dimapur**	**Peren**	**Total**	**Average land holding size (acre)**
		Frequency (%)	**Frequency (%)**	**Frequency (%)**	**Frequency (%)**	
1.	Marginal (<2.50 acre)	12(15.79)	39(46.43)	26(28.89)	77(30.80)	2.06
2.	Small (2.50-5.0 acre)	**64(84.21)**	**45(53.57)**	**64(71.11)**	**173(69.20)**	3.35
3.	Total farmers	76(100.00)	84(100.0)	90(100.00)	250(100.0)	2.96
4.	Mean	3.20	2.75	2.94	2.96	-
5.	SD	0.79	0.83	0.77	0.82	-

4.1.5 Size of total land under Naga king chilli cultivation

Table 4.1.5.1 and Fig 4.1.5.1 displayed that an appreciable amount (93.42%) of the respondents from Mon district had 1 to 2 acre of land under Naga king chilli cultivation followed by 85.56 per cent from Peren district and 67.86 per cent from Dimapur district. In addition, the overall division of farmers based on the proportion of land under Naga king chilli showed that majority (82.00%) of the farmers had one to two acre of land under Naga king chilli cultivation followed by less than 1 acre of land (12.80%) and more than two acre of land (20.00%).

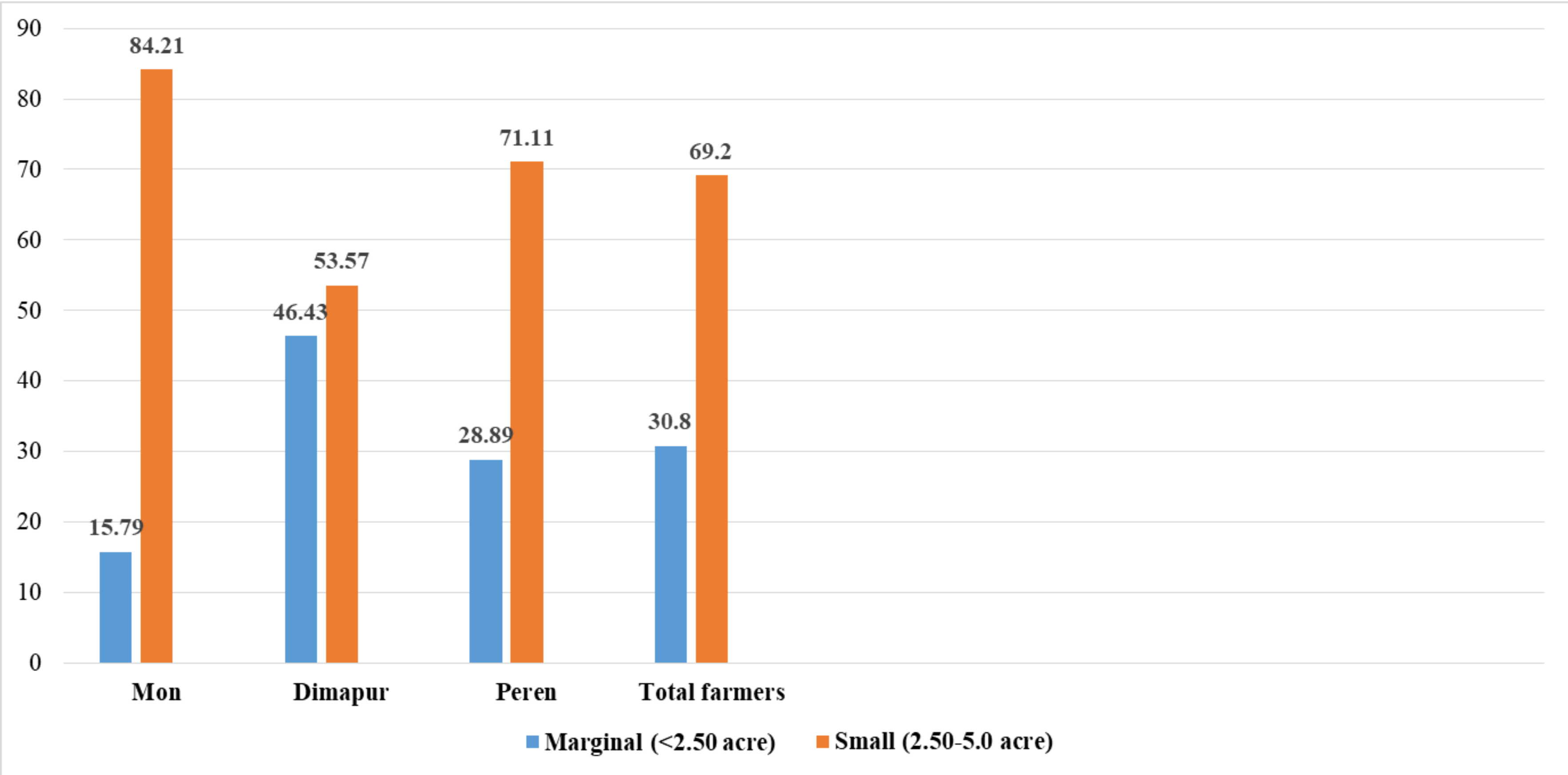

Fig 4.1.4.1a: Distribution of respondents based on the size of total land holding under agriculture

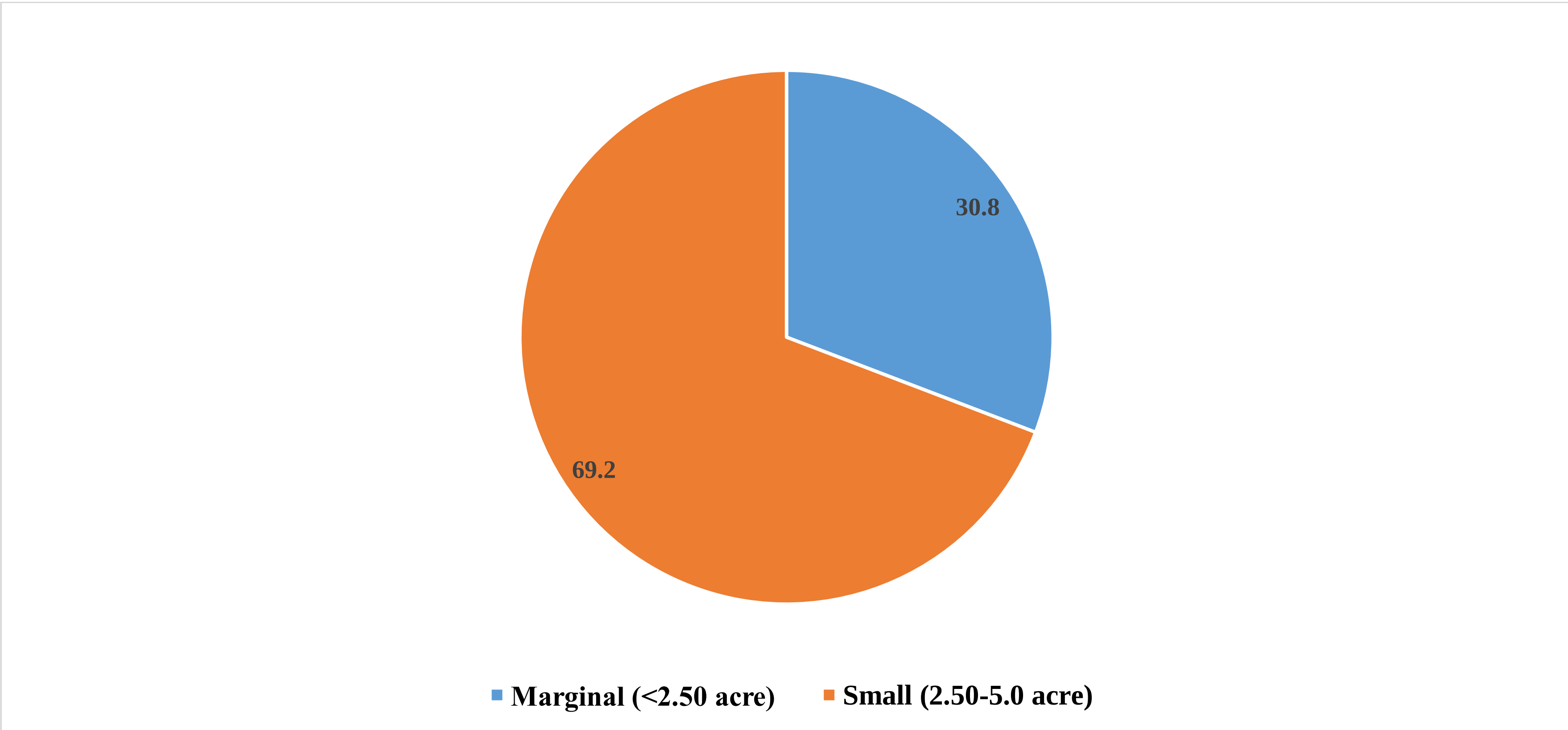

Fig 4.1.4.1b: Distribution of overall respondents based on the size of total land holding under agriculture

The mean land under Naga king chilli cultivation for farmers having less than 1.00 acre of land was average land holding size under agriculture was 2.06 acres and 3.35 acres for marginal 0.58 acre, while 1.37 acre and 2.52 acre was recorded for farmers having land in the range of 1.00-2.00 acre and more than 2.00 acre land category of farmers. The overall mean land holding under Naga king chilli cultivation was recorded at 1.32 acre which may be considered as very small land size under Naga king chilli cultivation despite being a crop of economic value in the region. This could be attributed to the fact that the farmers are resource poor and Naga king chilli cultivation requires high labour during the process of cultivation, harvesting and post-harvest management. Moreover, unavailability of storage facilities in the region make the farmers to think twice while considering to expand the area for Naga king chilli cultivation. The results are in agreement with that of Kassem *et al.* (2021), Jha (2023) and Kumar *et al.* (2023).

Table 4.1.5.1: Distribution of respondents based on the size of land under Naga king chilli cultivation

N=250

Sl. No.	**Land under Naga king chilli**	**Mon**	**Dimapur**	**Peren**	**Total**	**Average size of land under Naga king chilli cultivation (acre)**
		Frequency (%)	**Frequency (%)**	**Frequency (%)**	**Frequency (%)**	
1.	Less than 1.00 acre	3(3.95)	25(29.79)	4(4.44)	32(12.80)	0.58
2.	1.00-2.00 acre	**71(93.42)**	**57(67.86)**	**77(85.56)**	**205(82.00)**	**1.37**
3.	More than 2.00 acre	2(2.63)	2(2.38)	9(10.00)	13(5.20)	2.52
4.	Total Farmers	76(100.00)	84(100.00)	90(100.00)	250(100.00)	1.32
5.	Mean	1.34	1.05	1.53	1.32	-
6.	SD	0.47	0.48	0.56	0.55	-

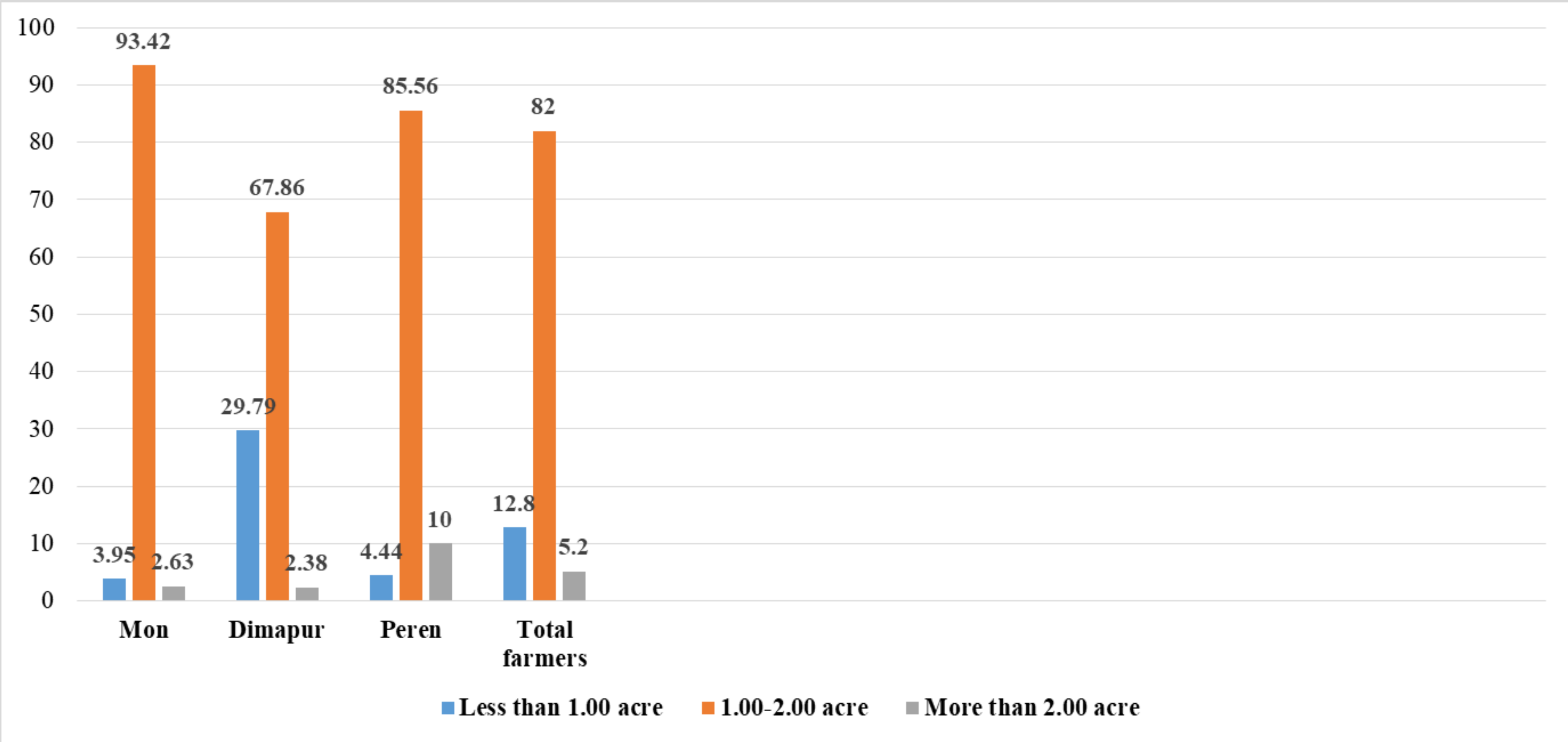

Fig 4.1.5.1: Distribution of respondents based on the size of land holding under Naga king chilli cultivation

4.1.6 Annual income

Table 4.1.6.1: Distribution of respondents based on annual income

N=250

Sl. No.	Category of income (Rs)	Mon	Dimapur	Peren	Total
		Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
1.	Less than 50,000	14(18.42)	**39(46.43)**	11(12.22)	64(25.60)
2.	50,000 to 1,00,000	**35(46.05)**	28(33.33)	**48(53.34)**	**111(44.40)**
3.	1,00,000 to 1,50,000	16(21.05)	9(10.72)	20(22.22)	45(18.00)
4.	> 1,50,000	11(14.48)	8(9.52)	11(12.22)	30(12.00)
5.	Total Farmers	76(100.00)	84(100.00)	90(100.00)	250(100.00)
6.	Mean	99,904.93	74,688.63	1,01,260.19	91,920.15
7.	SD	68,056.72	60,548.36	67,052.35	66,146.04

From Table 4.1.6.1 and Fig 4.1.6.1a, it is reflected that just about half (46.05%) of the farmers from Mon district had yearly income between Rs.50, 000 to Rs.1, 00,000 and 21.05 per cent between Rs.1, 00,000 to Rs.1, 50,000. While, 18.42 per cent and 14.48 per cent of the farmers were found under the category of less than Rs.50, 000 and more than Rs.1, 50,000 respectively. The respondents of Dimapur district unveiled that a little under half (46.43%) of the farmers had yearly income under that Rs.50, 000 followed by farmers with yearly income between Rs.50, 000 to Rs.1, 00,000 (33.33%), between Rs.1, 00,000 to Rs.1, 50,000 (10.72%) and finally with more than Rs.1, 50,000 per annum (9.52%). Further, it was revealed that majority (53.34%) of the respondents from Peren district had annual income between Rs.50, 000 to Rs.1, 00,000, following that 22.22 per cent between Rs.1, 00,000 to Rs.1, 50,000. While an equivalent percentage of (12.22%) of the respondents were reported with an annual income of less that Rs.50, 000 and more than Rs.1, 50,000 respectively. The overall distribution of respondents

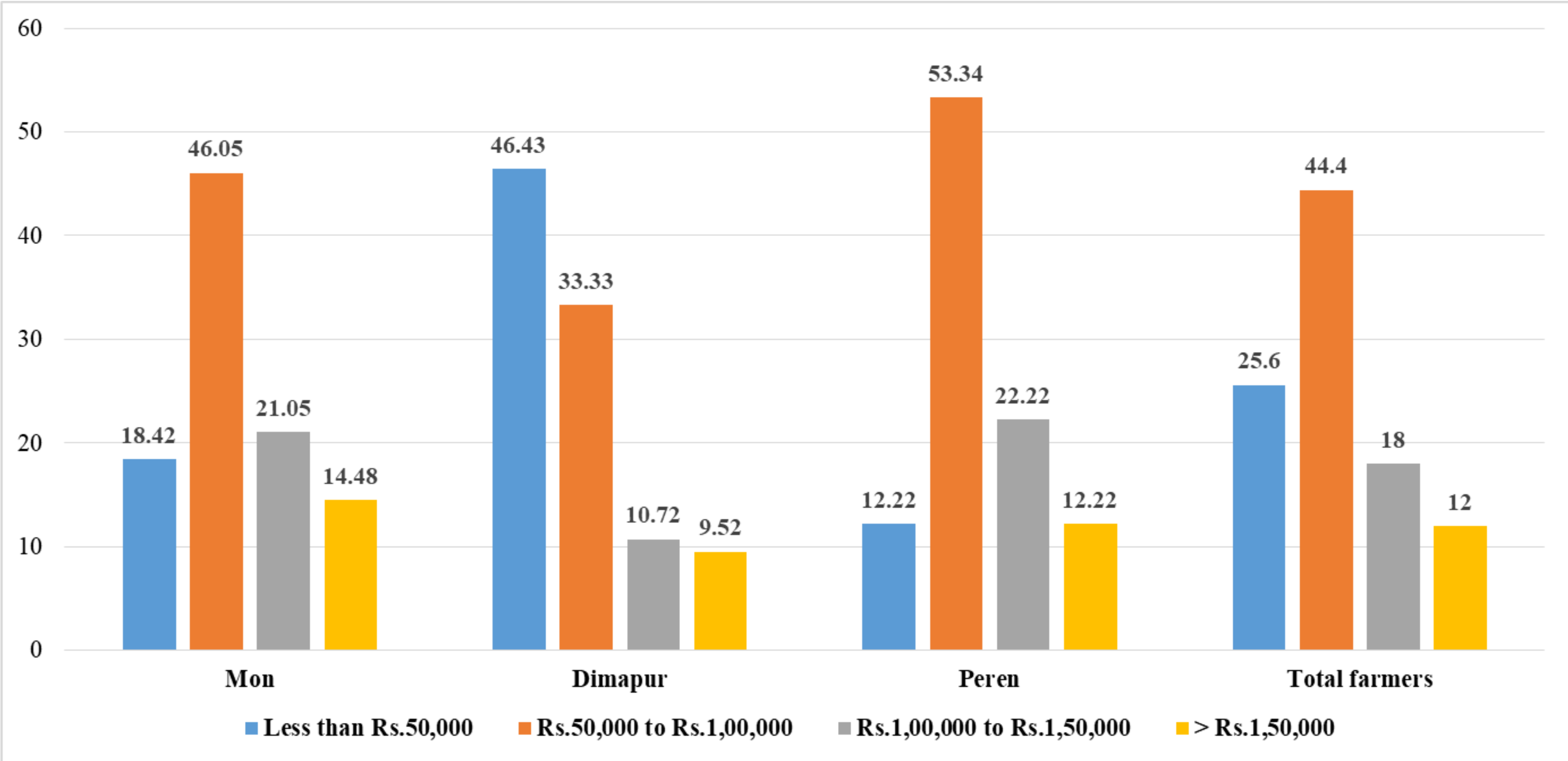

Fig 4.1.6.1a: Distribution of respondents based on annual income

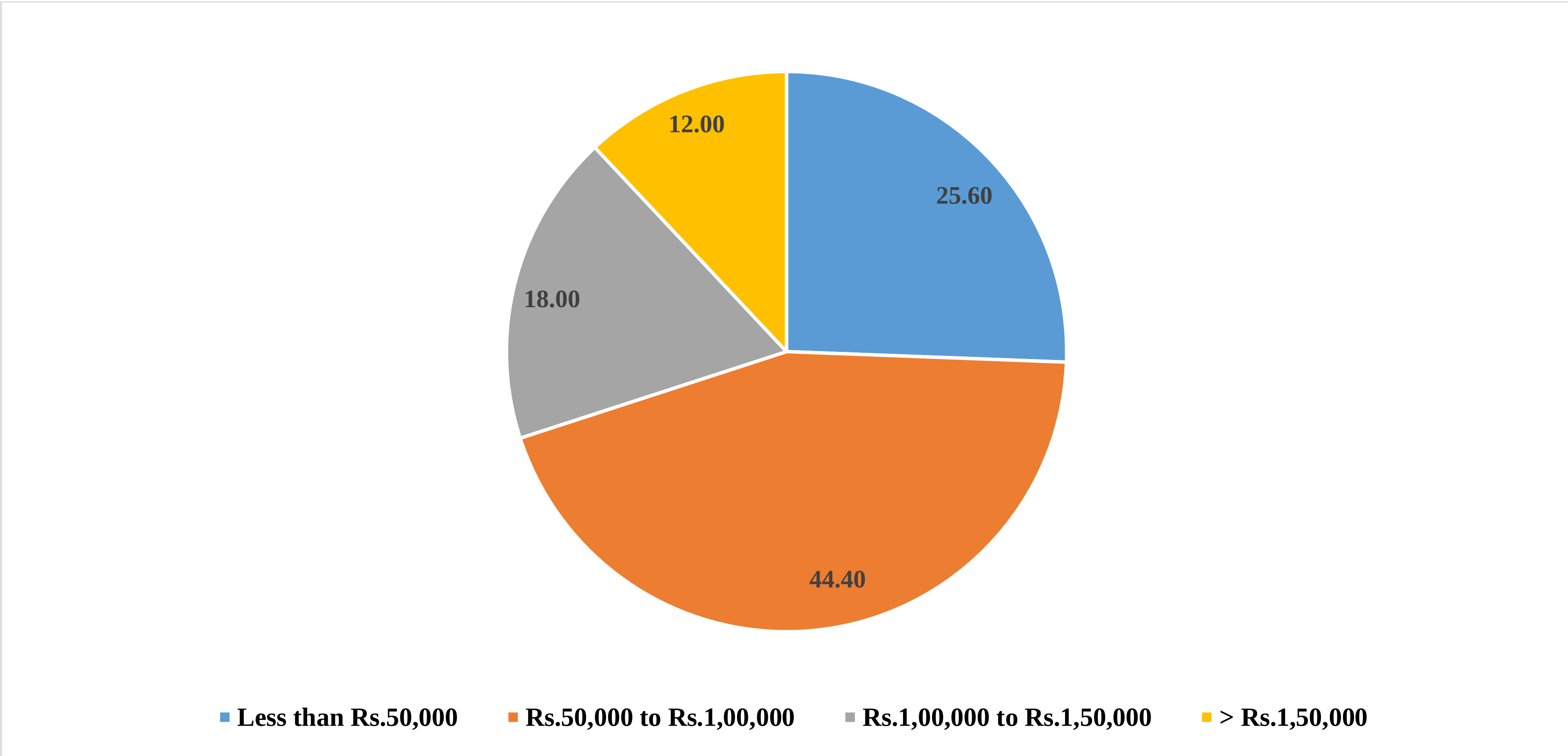

Fig 4.1.6.1b: Distribution of overall respondents based on annual income

revealed (Fig 4.1.6.1b) that a greater segment (44.44%) of the farmers had yearly earnings between Rs.50, 000 to Rs.1, 00,000 and a quarter (25.60%) under Rs.50, 000 per annum. While, a small portion (18.00%) of the farmers were found to have yearly earnings between Rs.1, 00,000 to Rs.1, 50,000 followed by more than Rs.1, 50,000 per annum (12.00%). The low annual income could be because majority of the farmers practice subsistence farming on smallholdings to satisfy the needs of the farm families, leaving very little for the market. The results were in supportive to that of Sundresha *et al.* (2020).

Table 4.1.6.2: Mean annual income of respondents

Sl. No.	Land holding size	Mean annual income (Rs)				Min. annual income (Rs)	Max. annual income (Rs)
		Mon	Dimapur	Peren	overall		
1.	<2.50 acre	64,304.17	53,087.31	78,843.94	63,532.44	29,678	2,52,835
2.	2.50-3.50 acre	85,037.88	79,233.06	87,546.46	84,549.87	34,375	3,39,075
3.	>3.50 acre	1,50,808.24	1,24,801.07	1,79,070.94	1,52,535.75	58,795	4,48,200

Based upon the land holding size under agriculture, respondents were categorized accordingly and mean annual income of the farmers were calculated. Table 4.1.6.2 and Fig 4.1.6.2 revealed that respondents of Peren district having farm size more than 3.50 acre received the highest mean annual income of Rs.1, 79,070.94 followed by Rs.87, 546.46 and Rs.78, 843.94 in case of respondents having farm size ranging from 2.50 to 3.50 acre and less than 2.50 acre respectively. While, in case of respondents from Mon district, the mean annual income of Rs.1, 50,808.24 was highest for respondents with farm size of more than 3.50 acre followed by Rs.85, 037.88 with farm size ranging from 2.50 to 3.50 acre and mean annual income of Rs.64, 304.17 for respondents having farm size of less than 2.50 acre. Mean annual income of Dimapur district also revealed

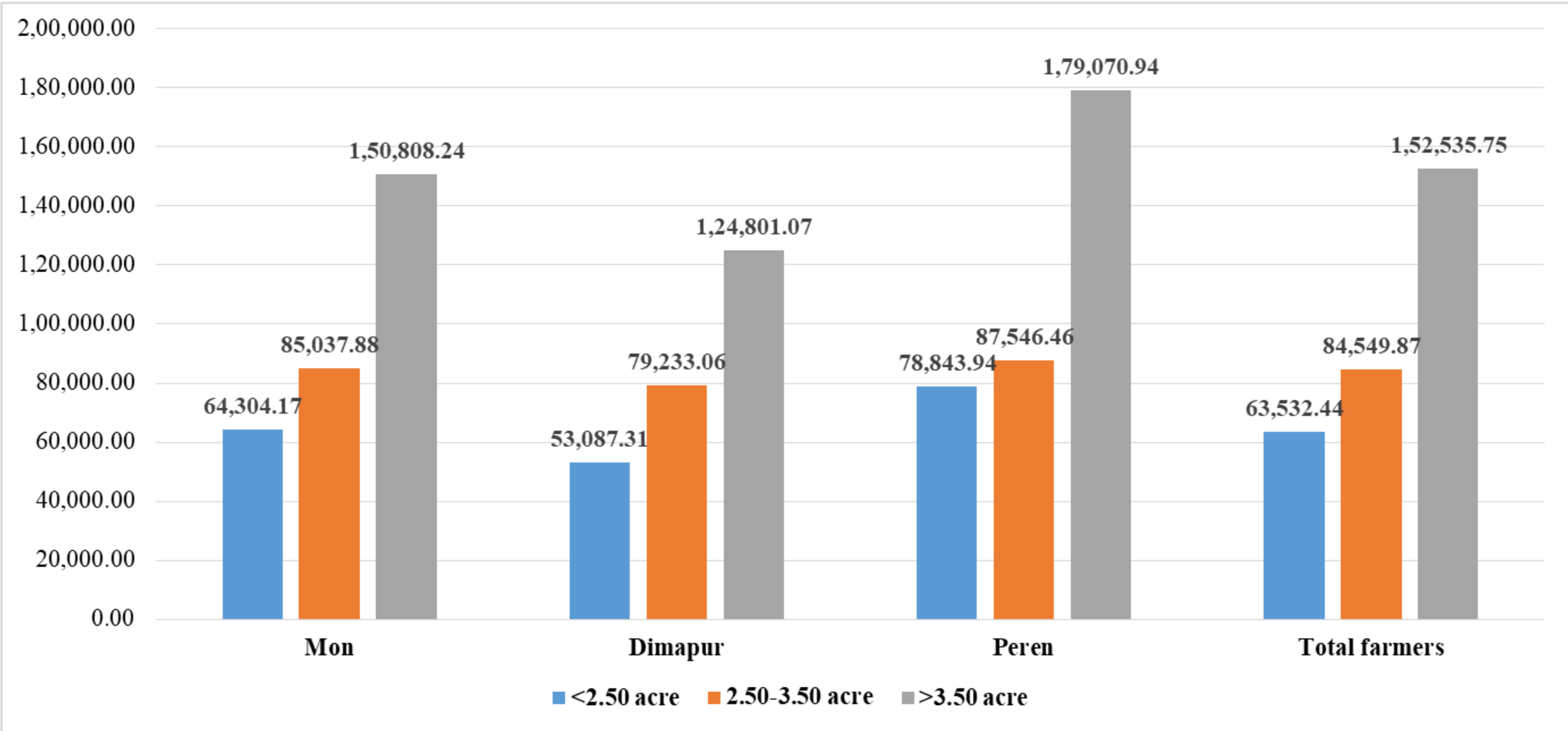

Fig 4.1.6.2 Distribution of respondents based on mean annual income (Rs.) of respondents

that respondents with farm size of more than 3.50 acre achieved the highest mean annual income of Rs.1, 24,801.07 followed by respondents having farm size ranging from 2.50 to 3.50 acre with mean annual income of Rs.79, 233.06 and the least mean annual income of Rs.53, 087.31 was obtained by respondents with farm size of less than 2.50 acre. Minimum annual income of respondents was reported highest (Rs.58, 795) in case of respondents with farm size of more than 3.50 acre followed by respondents having farm size ranging from 2.50 to 3.50 acre with mean annual income of Rs.34, 375 and the least annual income of Rs.29, 678 was recorded for farmers with farm size of less than 2.50 acres. Further, the highest maximum annual income of Rs.4, 48,200 was obtained by the respondents with farm size of more than 3.50 acre followed by Rs.3, 39,075 for respondents having farm size ranging from 2.50 to 3.50 acre and the least annual income of Rs.2, 52,835 was reported from respondents having farm size of less than 2.50 acre. The findings indicated that larger the farm size higher the annual income of the respondents. This might be because larger farm size provide farmers with an opportunity to diversify the choice of crops on a single farm land which tend to be more productive and efficient while increasing farmers' income and protecting their livelihood in times of crop failures. Similar findings were observed by Akter and Akram (2020).

Table 4.1.6.3: Comparative account of annual income of respondents

Sl. No.	Name of the district	Mean annual income (μ)	z value	Prob.
1.	Mon	99,677.67	18324.93**	<0.01
	Dimapur	73,598.37		
2.	Mon	99,677.67	-1326.68**	<0.01
	Peren	1,01,565.37		
3.	Dimapur	73,598.37	-19661.53**	<0.01
	Peren	1,01,565.37		

* significant at 5% level of probability ** significant at 1% level of probability

Table 4.1.6.3 revealed that annual income of the respondents differed significantly among all the selected districts.

4.1.7 Annual income from Naga king chilli cultivation

Table 4.1.7.1: Distribution of respondents based on annual income from Naga king chilli cultivation

N=250

Sl. No.	Category of income	Mon	Dimapur	Peren	Total
		Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
1.	(Less than Rs.19,294)	10(13.16)	19(22.62)	2(2.22)	31(12.40)
2.	(Rs.19,294 to Rs.59,145)	**55(72.37)**	**64(76.19)**	**62(68.89)**	**181(72.40)**
3.	(More than Rs.59,145)	11(14.47)	1(1.19)	26(28.89)	38(15.20)
4.	Total Farmers	76(100.00)	84(100.00)	90(100.00)	250(100.00)
5.	Mean	40,694.41	25,760.06	50,537.97	39,220.15
6.	SD	18,760.04	9,391.11	20,725.66	19,925.35

From Table 4.1.7.1 and Fig 4.1.7.1, it was revealed that majority (76.19%) of the farmers of Dimapur district were found to have yearly earnings ranging between Rs.19, 294 to Rs.59, 145 from Naga king chilli cultivation followed by Mon district (72.37%) and Peren district (68.89%). However, under high category of annual income, the highest percentage was reported from the respondents (28.89%) of Peren district with an annual income of more than Rs.59, 145 from Naga king chilli cultivation. While, 22.62 per cent of the farmers of Dimapur district were found to be under low category of annual income having less than Rs.19, 294 from Naga king chilli cultivation. The overall distribution of respondents revealed that majority (72.40%) of the respondents had annual income ranging between Rs.19, 294 to Rs.59, 145 followed by more than Rs.59, 145 (15.20%) and less than Rs.19, 294 (12.40%). Low annual income from Naga king chilli cultivation could be thw result ofsmall landholdings, lack of innovative technologies, and uncertainty of biotic and

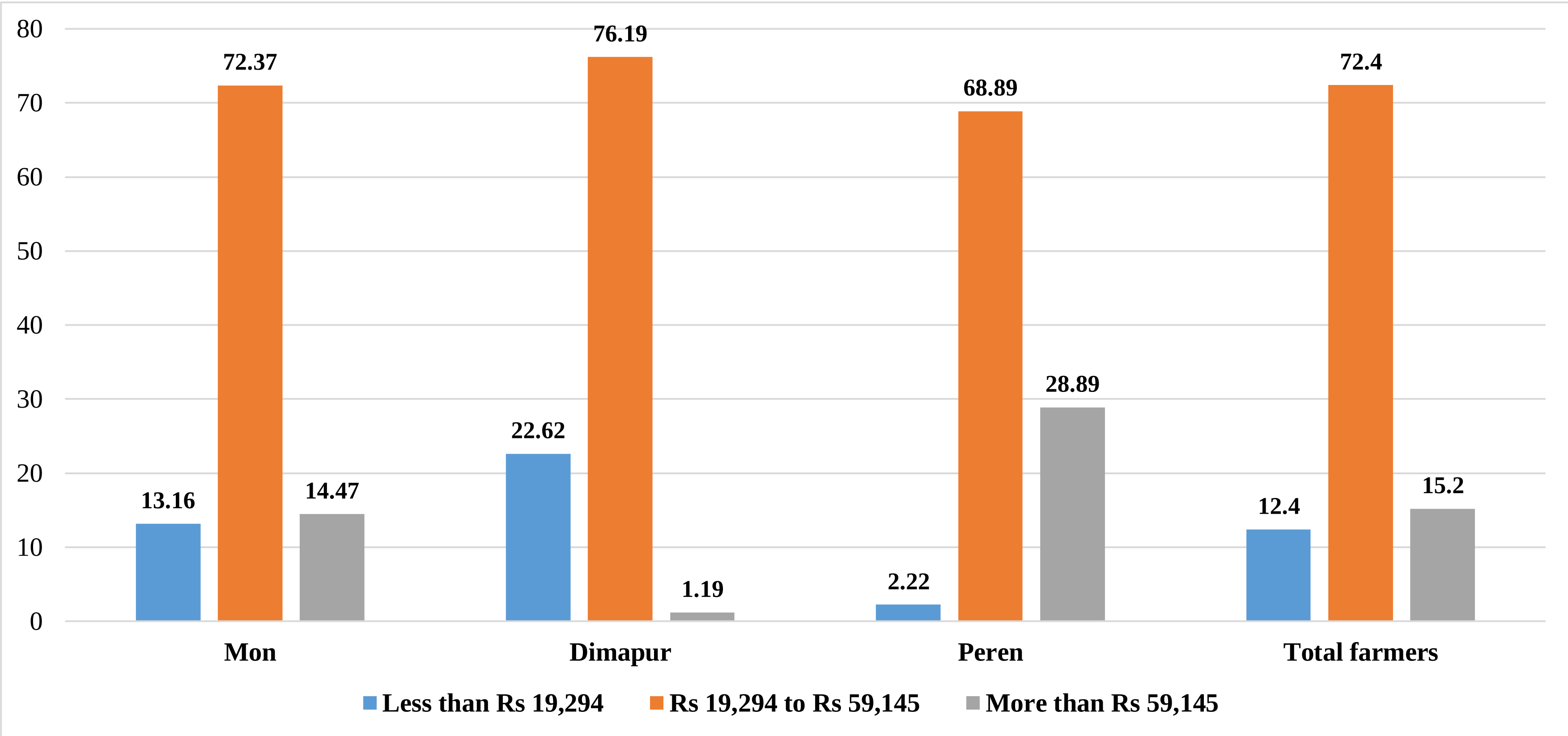

Fig 4.1.7.1: Distribution of respondents based on annual income from Naga king chilli cultivation

abiotic components which scale down the productivity and income of the farmers. The findings are in accordance with that of Bharti *et al.* (2022).

Table 4.1.7.2: Mean annual income from Naga king chilli cultivation

N=250

Sl. No.	Land under Naga king chilli	Mean annual income (Rs.)				Min. annual income (Rs.)	Max. annual income (Rs.)
		Mon	Dimapur	Peren	Overall		
1.	Less than 1.00 acre	21,017.43	19,565.71	**25,112.50**	20,576.63	14,498	38,845
2.	1.00-2.00 acre	41,204.93	27,174.51	**46,654.32**	39,076.87	14,553	98,800
3.	More than 2.00 acre	93,700.00	47,660.00	**95,497.22**	87,861.15	45,400	1,16,650

Table 4.1.7.2 and Fig 4.1.7.2 revealed that the respondents of Peren district had the highest mean annual income of Rs.95,497.22 from the category of farmers with more than 2 acre of land under Naga king chilli cultivation followed by Mon district (Rs.93,700.00) and Dimapur district (Rs.47,660.00). Similarly, in case of respondents with one to two acres of land under Naga king chilli cultivation, Peren district had the highest (Rs.46,654.32) mean annual income from Naga king chilli followed by Mon district (Rs.41,204.93) and Dimapur district (Rs.27,174.51). In addition Peren district was recorded with the highest (Rs.25,112.50) mean annual income from Naga king chilli cultivation in case of farmers with less than 1.00 acre of land followed by Mon district (Rs.21,017.43) and Dimapur district (Rs.19,565.71). Further, minimum annual income was observed highest in case of respondents with more than 2 acres of land under Naga king chilli cultivation followed by 1 to 2 acres of land (Rs.14, 553) and less than 1 acre of land (Rs.14, 498). While, maximum mean annual

income from Naga king chilli was recorded highest in case of respondents with more than 2 acres of land under Naga king chilli cultivation followed by 1 to 2 acres (Rs.98,800) of land and less than 1 acre of land (Rs.38,845).

Table 4.1.7.3: Comparative account of annual income from Naga king chilli cultivation

Sl. No.	Name of the District	Mean annual income from Naga King chilli cultivation (µ)	z value	Prob.
1.	Mon	40,344.33	10200.58**	<0.01
	Dimapur	25,827.29		
2.	Mon	40,344.33	7135.99**	<0.01
	Peren	50,497.95		
3.	Dimapur	25,827.29	17344.12**	<0.01
	Peren	50,497.95		

** significant at 1% level of probability

It may be inferred from Table 4.1.7.3 that, mean annual income of the respondents from Naga king chilli were significantly different in all the selected districts.

4.1.8. Training exposure

The variable training exposure was concerned with training related to sustainable Naga king chilli cultivation during the last five years. Table 4.1.8.1 and Fig 4.1.8.1 revealed that majority (60.53%) of the respondents from Mon district had not received any training on sustainable Naga king chilli cultivation followed by Dimapur district with 51.19 per cent and Peren district with 46.67 per cent. Despite the low attendance from other districts, it was noteworthy to mention that over half (51.11%) of the growers from Peren district had received training related to sustainable Naga king chilli cultivation for less than 10 days followed by 48.81 per cent and 18.42 per cent from Dimapur and Mon district respectively. It was also disclosed that a small portion (21.05%) of the farmers from Mon district had attended training related to sustainable Naga king chilli cultivation for more than 20 days. Characteristically, none of

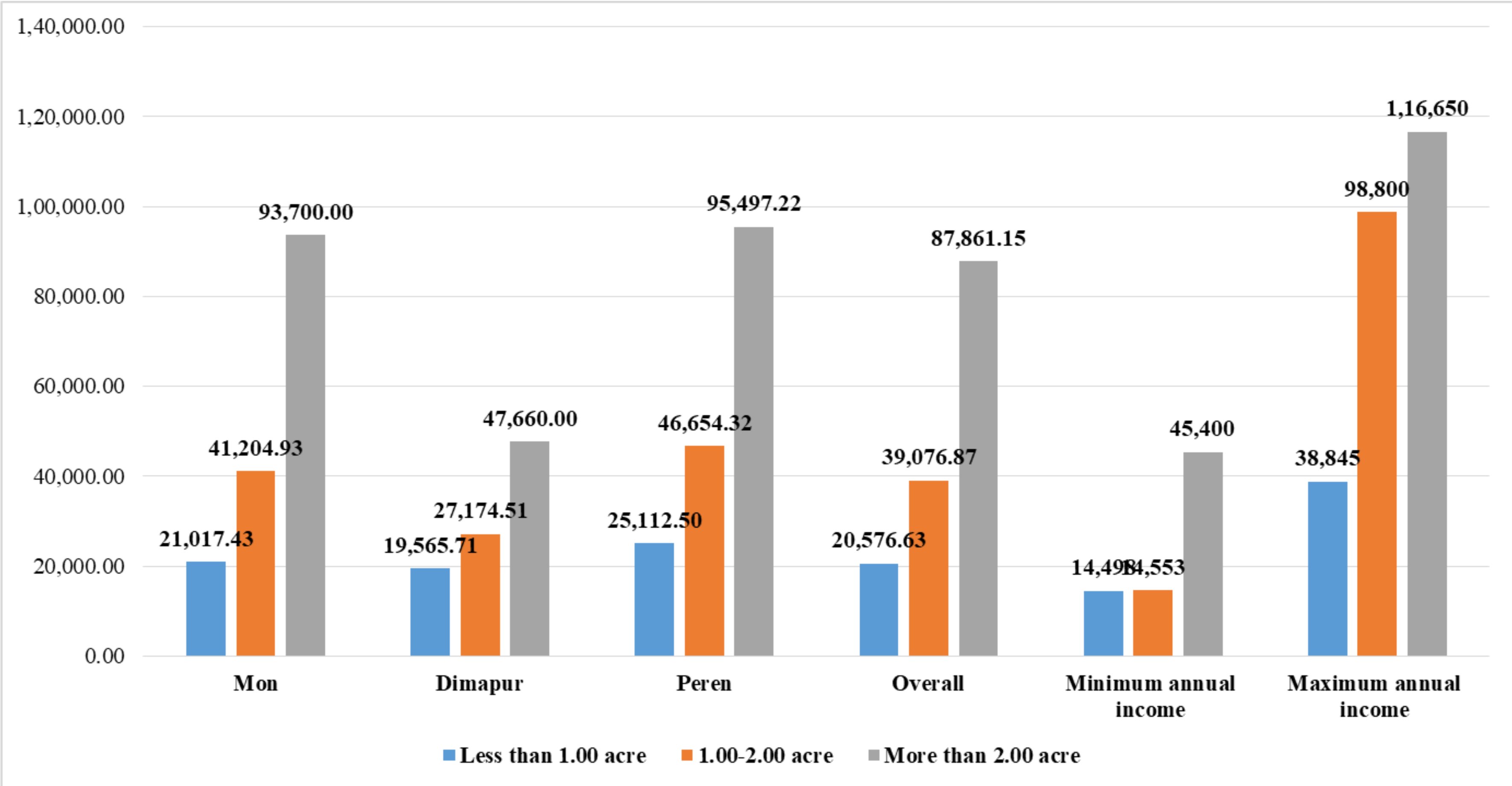

Fig 4.1.7.2: Distribution of respondents based on mean annual income (in Rs.) from Naga king chilli cultivation

the respondents from Dimapur and Peren district had attended training related to sustainable Naga king chilli cultivation for more than 20 days. The overall training exposure revealed that a major section (52.40%) of the respondents had not attended any training related to sustainable Naga king chilli cultivation, while under half (47.60) of the farmers had received training related to sustainable Naga king chilli cultivation. The results might be due to poor extension services and lack of communication between the farmers/village leaders and the extension functionaries of the concerned departments which deprive them from accessing the benefits of innovative practices and technologies. The findings are in support to that of Farouque and Sarker (2018).

Table 4.1.8.1: Distribution of respondents based on training exposure

N=250

Sl. No.	Number of days of training received	Mon	Dimapur	Peren	Total
		Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
1.	No training received	46(60.53)	43(51.19)	42(46.67)	**131(52.40)**
2.	<10 days	14(18.42)	41(48.81)	46(51.11)	**101(40.40)**
3.	10-20 days	00(00)	00(00)	02(2.22)	02(0.80)
4.	>20 days	16(21.05)	00(00)	00(00)	16(6.40)
5.	Total farmers	76(100.00)	84(100.00)	90(100.00)	250(100.00)
6.	Mean	0.39	0.48	0.53	0.47
7.	SD	0.49	0.50	0.50	0.50

Table 4.1.8.2 represents the distribution of respondents based on the areas of training needs for sustainable Naga king chilli cultivation in Mon district. Training needs were studied under sixteen areas of sustainable cultivation practices of Naga king chilli. All of the respondents (100.00%) expressed the most needed trainings in the areas of Integrated Pest Management (IPM) and Integrated Plant Disease Management (IDM) followed by seed treatment

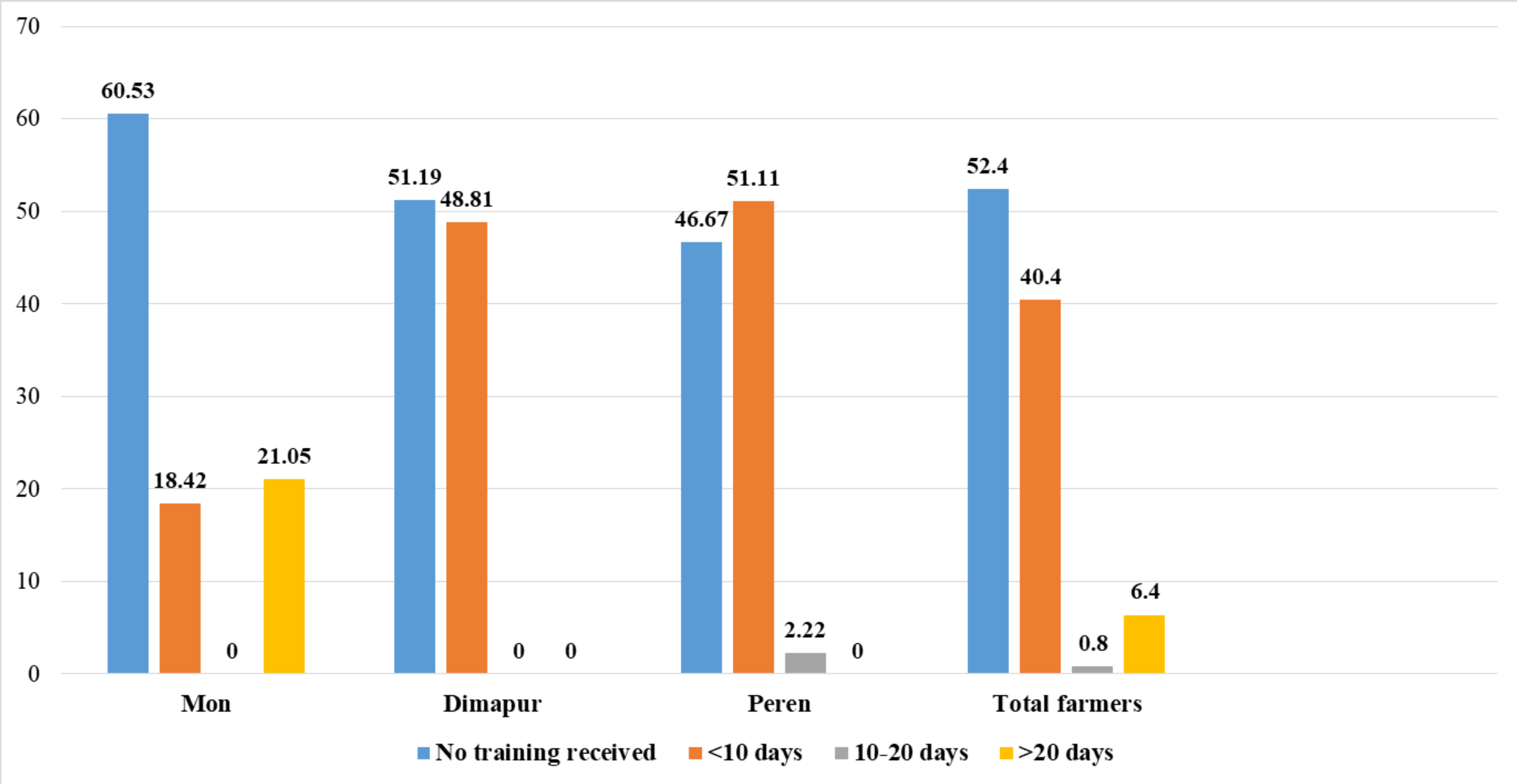

Fig 4.1.8.1: Distribution of respondents based on number of days of training received for sustainable Naga king chilli cultivation for the last 5 years

Table 4.1.8.2: Distribution of respondents based on the areas of training needs on sustainable Naga king chilli cultivation in Mon district of Nagaland

n=76

Sl. No.	**Areas of training needs**	**Levels of training needs**			**Mean Score**	**Priority of training needs**
		Most needed	**Needed**	**Not needed**		
		f (%)	**f (%)**	**f (%)**		
1.	IPM	**76(100.00)**	0(00)	0(00)	2.00	I
2.	IDM	**76(100.00)**	0(00)	0(00)	2.00	I
3.	Seed treatment	**46(60.53)**	30(39.47)	0(00)	1.77	II
4.	Packaging	39(51.32)	31(40.79)	6(7.89)	1.71	III
5.	Curing	**46(60.53)**	23(30.26)	7(9.21)	1.64	IV
6.	Nursery management	17(22.37)	41(53.95)	18(23.68)	1.28	V
7.	Main field preparation	8(10.53)	22(28.95)	46(60.53)	0.69	VI
8.	Soil mixture	11(14.47)	20(26.32)	45(59.21)	0.64	VII
9.	Sowing	9(11.84)	19(25.00)	48(63.16)	0.61	VIII
10.	Irrigation	16(21.05)	41(53.95)	19(25.00)	0.58	IX
11.	Harvest time interval and stage	0(00)	27(35.53)	49(64.47)	0.56	X
12.	Grading	1(1.32)	17(22.36)	58(76.32)	0.56	X
13.	Intercultural operations	0(00)	25(32.89)	51(67.10)	0.49	XI
14.	Mulching	0(00)	18(23.68)	58(76.32)	0.42	XII
15.	Transplanting	0(00)	40(52.63)	36(47.37)	0.25	XIII
16.	Storage practices	0(00)	14(24.42)	62(75.58)	0.24	XIV

(60.53%), curing (60.53%), packaging (51.32%), nursery management (22.37), irrigation (21.05), soil mixture (14.47) and sowing (11.84). The priority of training needs among Naga king chilli growers of Mon district was Integrated Pest Management (IPM) and Integrated Plant Disease Management (IDM) followed by seed treatment, packaging, curing and nursery management.

Table 4.1.8.3 represents the distribution of respondents based on the areas of training needs for sustainable Naga king chilli cultivation in Dimapur district. It was revealed that all of the respondents (100.00%) needed training in the areas of integrated pest management and integrated disease management followed by seed treatment (78.57%), packaging (75.00%), curing (70.24%), nursery management (34.52), main field preparation (16.67) and soil mixture (15.48). The priority of training needs among Naga king chilli growers of Dimapur district was Integrated Pest Management (IPM) and Integrated Plant Disease Management (IDM) followed by seed treatment, curing, packaging, nursery management and irrigation.

Table 4.1.8.4 represents the distribution of respondents based on the areas of training needs for sustainable Naga king chilli cultivation in Peren district. It was revealed that all of the respondents (100.00%) needed training in the areas of integrated pest management and integrated plant disease management followed by curing (82.23%), seed treatment (66.67%), packaging (62.22%), nursery management (30.00), main field preparation (12.22) and irrigation (11.11). The priority of training needs among Naga king chilli growers of Peren district was Integrated Pest Management (IPM) and Integrated Plant Disease Management (IDM) followed by curing, seed treatment, packaging and nursery management. The respondents' top priority in case of all the districts towards training need on Integrated Pest Management and Integrated Plant Disease Management might be because of the significant crop damage caused by pest and other diseases linked to biotic and abiotic components. While, interest shown towards curing and packaging of Naga king chilli might ascribed to the crop wastage faced by the farmers during peak season as a result of the perishable nature of the fruit and the lack of proper storage facilities in the region. The results are in accordance with that of Banu and Yashoda (2018), Elakkiya and Karthikeyan (2020), Hasan *et al.* (2021) and Diawo (2022).

Table 4.1.8.3: Distribution of respondents based on the areas of training needs for sustainable Naga king chilli cultivation in Dimapur district of Nagaland

n=84

Sl. No.	Areas of training needs	Levels of training needs			Mean	Priority of training needs
		Most needed	Needed	Not needed		
		f (%)	f (%)	f (%)		
1.	IPM	**84(100.00)**	0(00)	0(00)	2.00	**I**
2.	IDM	**84(100.00)**	0(00)	0(00)	2.00	**I**
3.	Seed treatment	**66(78.57)**	18(21.43)	0(00)	1.61	II
4.	Curing	59(70.24)	20(23.81)	5(5.95)	1.53	III
5.	Packaging	**63(75.00)**	18(21.43)	3(3.57)	1.43	IV
6.	Nursery management	29(34.52)	50(59.52)	5(5.96)	0.99	V
7.	Irrigation	9(10.71)	31(36.90)	44(52.38)	0.96	VI
8.	Soil mixture	13(15.48)	28(33.33)	43(51.19)	0.55	VII
9.	Transplanting	0(00)	21(25.00)	63(75.00)	0.52	VIII
10.	Main field preparation	14(16.67)	30(35.71)	40(47.62)	0.50	IX
11.	Sowing	9(10.71)	33(39.28)	42(50.00)	0.49	X
12.	Harvest time interval and stage	0(00)	46(54.76)	38(45.23)	0.36	XI
13.	Intercultural operations	0(00)	41(48.80)	43(51.19)	0.33	XII
14.	Grading	6(7.14)	34(40.48)	44(52.38)	0.25	XIII
15.	Mulching	0(00)	35(41.67)	49(58.33)	0.24	XIV
16.	Storage practices	0(00)	20(23.81)	64(76.19)	0.18	XV

Table 4.1.8.4: Distribution of respondents based on the areas of training needs for sustainable Naga king chilli cultivation in Peren district of Nagaland **n=90**

Sl. No.	Areas of training needs	Levels of training needs			Mean	Priority of training needs
		Most needed	Needed	Not needed		
		f (%)	f (%)	f (%)		
1.	IPM	**90(100.00)**	0(00)	0(00)	2.00	**I**
2.	IDM	**90(100.00)**	0(00)	0(00)	2.00	**I**
3.	Curing	**74(82.23)**	12(13.33)	4(4.44)	1.79	II
4.	Seed treatment	**60(66.67)**	30(33.33)	0(00)	1.67	III
5.	Packaging	**56(62.22)**	31(34.45)	3(3.33)	1.59	IV
6.	Nursery management	27(30.00)	46(51.11)	17(18.89)	1.11	V
7.	Main field preparation	11(12.22)	39(43.33)	40(44.44)	0.68	VI
8.	Sowing	14(15.56)	21(23.33)	55(61.11)	0.54	VII
9.	Irrigation	10(11.11)	26(28.89)	54(60.00)	0.51	VIII
10.	Intercultural operations	0(00)	43(47.78)	47(52.22)	0.48	IX
11.	Soil mixture	5(5.56)	25(27.78)	60(66.67)	0.39	X
12.	Harvest time interval and stage	0(00)	32(35.56)	58(64.44)	0.36	XI
13.	Grading	4(4.44)	24(26.67)	62(68.89)	0.36	XI
14.	Mulching	0(00)	26(28.89)	64(71.11)	0.29	XII
15.	Storage practices	0(00)	24(26.67)	66(73.33)	0.27	XIII
16.	Transplanting	0(00)	20(22.22)	70(77.78)	0.22	XIV

Table 4.1.8.5: Distribution of respondents based on overall training needs on sustainable Naga king chilli cultivation

N=250

Sl. No.	**Level of training needs**	**Mon**	**Dimapur**	**Peren**	**Total**
		Frequency (%)	**Frequency (%)**	**Frequency (%)**	**Frequency (%)**
1.	Low (Less than 11)	19(14.47)	8(9.52)	14(15.56)	41(16.40)
2.	Medium (11 to 18)	**46(60.53)**	**58(69.05)**	63(**70.00**)	**167(66.80)**
3.	High (More than 18)	11(25.00)	18(21.43)	13(14.44)	42(16.80)
4.	Total farmers	76(100.00)	84(100.00)	90(100.00)	250(100.00)
5.	Mean	13.95	15.44	14.23	14.55
6.	SD	4.28	3.48	3.59	3.81

Table 4.1.8.5 and Fig 4.1.8.2 revealed that larger part (70.00%) of the respondents from Peren district had medium level of training needs on sustainable Naga king chilli cultivation followed by low (15.56%) and high (14.44%) level of training needs. While, a major section (69.05%) of the respondents from Dimapur district revealed medium level of training needs for sustainable Naga king chilli cultivation followed by high (21.43%) and low (9.52%). In the case of Mon district, major part (69.05%) of the respondents had medium level of training needs, following that high (25.00%) and low (14.47%) level of training needs. Overall distribution of respondents showed that 66.80 per cent of the respondents had medium level of training needs for sustainable Naga king chilli cultivation followed by high level of training needs (16.80%) and 16.40 per cent with low training needs. Similar findings were recorded by Borate *et al.* (2018) and Sravani *et al.* (2021).

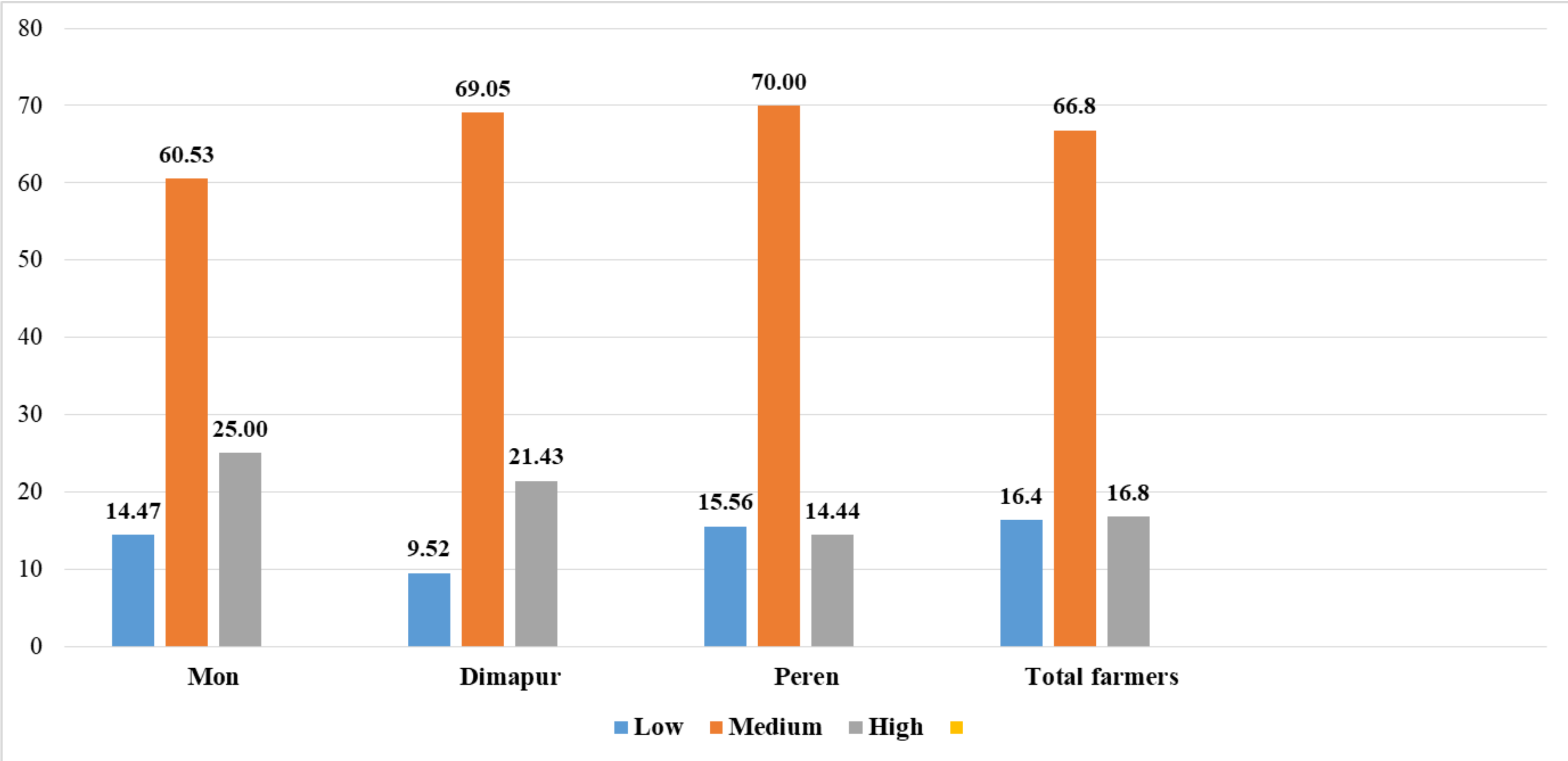

Fig 4.1.8.2: Distribution of respondents based on overall training needs for sustainable Naga king chilli cultivation

4.1.9 Experience in Naga king chilli cultivation

Table 4.1.9.1: Distribution of respondents based on experience in Naga king chilli cultivation

N=250

Sl. No.	**Level of experience**	**Mon**	**Dimapur**	**Peren**	**Total**
		Frequency (%)	**Frequency (%)**	**Frequency (%)**	**Frequency (%)**
1.	Low (Less than 10 years)	14(18.42)	22(26.19)	19(21.11)	18(7.20)
2.	Medium (10-19 years)	29(38.16)	45(**53.57**)	37(**41.11**)	108(43.20)
3.	High (More than 19 years)	33(**43.42**)	17(20.24)	34(37.78)	**124(49.60)**
4.	Total farmers	76(100.00)	84(100.00)	90(100.00)	250(100.00)
5.	Mean	18.22	13.84	16.29	16.06
6.	SD	7.67	6.47	7.34	7.35

From Table 4.1.9.1 and Fig 4.1.9.1 it can be observed that majority (53.57%) of the respondents from Dimapur district had medium (10-19 years) level of experience in Naga king chilli cultivation followed by Mon district (43.42%) with more than 19 years of experience and Peren district (41.11%) with 10-19 years of experience in Naga king chilli cultivation. While, the overall distribution of respondents revealed that 49.60 per cent of the farmers had more than 19 years of experience in Naga king chilli cultivation, following that a sizeable portion (43.20%) with 10-19 years of experience and a marginal section (7.20%) with less than 10 years of experience in Naga king chilli cultivation. This might be because Naga king chilli had been in cultivation since time immemorial and a good number of the respondents belonged to the age group of 35 to 55 years. Hence, the out come is reflected in the findings. Similar findings were obtained by Sundresha *et al*. (2020) and Jha (2023).

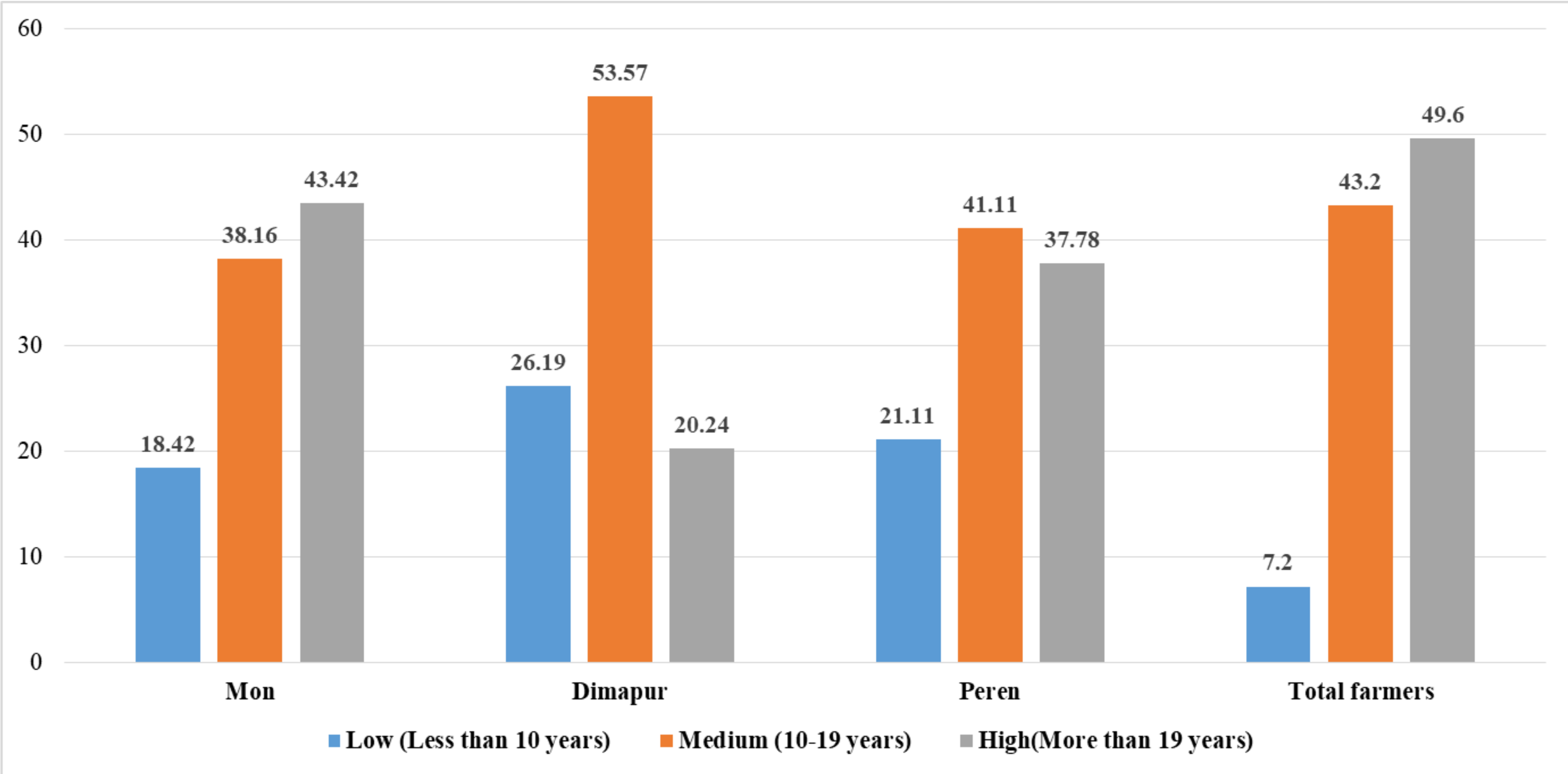

Fig 4.1.9.1: Distribution of respondents based on experience in Naga king chilli cultivation

Table 4.1.9.2: Comparative account of experience in Naga king chilli cultivation

Sl. No.	Name of the district	Mean experience (μ) Yrs	z value	Prob.
1	Mon	18.22	2.92**	<0.01
	Dimapur	13.84		
2	Mon	18.22	1.14	>0.05
	Peren	16.29		
3	Dimapur	13.84	1.76*	<0.05
	Peren	16.29		

* significant at 5% level of probability ** significant at 1% level of probability

From Table 4.1.9.2 it is clear that mean farming experience of the respondents in Naga king chilli cultivation were significantly different among the farmers of Mon and Dimapur district as well as Dimapur and Peren districts.

4.1.10 Information sources utilization

Table 4.1.10.1 disclosed the sources of information utilization by the Naga king chilli growers of Mon district for sustainable Naga king chilli cultivation in the region. The mean scores of different source of information revealed that informal sources of information ranked the highest followed by formal sources of information and mass media sources of information. In case of using informal sources of information only a small portion (13.16%) of the respondents frequently seek information from friends followed by 55.26 per cent who ocassionally seek information from friends. While, a larger section (76.32%) of the farmers never seek information from progressive farmers. Regarding formal sources of information only 22.37 per cent of the farmers most often look up for information related to sustainable Naga king chilli cultivation from NGO's followed by sometimes (22.37%). While, majority (92.11%) of the respondents never contacted or received information from AO/ DAO/ HO/ SDHO. Furthermore, it was revealed that none of the respondents had utilized radio and television for obtaining information related to sustainable Naga king chilli cultivation. Only 28.95 per cent of the respondents were found ocassionally utilizing mobile phones for availing information on sustainable Naga king chilli cultivation. It was ascertained that mass media sources of information was the least utilized form of sources of information among the farmers of the region. This might be because of socio-economic conditions of the farmers and the remoteness of the villages which make them unable to harness the potential of mass media for sustainable Naga king chilli cultivation in the region.

Table 4.1.10.1: Distribution of respondents based on information sources utilization for sustainable Naga king chilli cultivation in Mon district of Nagaland

n=76

Sl. No.	**Informal sources of information**	**Frequency of use (%)**			**Mean score**	**Rank**
		Most often	**Sometimes**	**Never**		
1.	Friends	**10(13.16)**	**42(55.26)**	24(31.58)	**2.07**	I
2.	Relatives	8(10.53)	31(40.79)	37(48.68)		
3.	Neighbours	2(2.63)	26(34.21)	48(63.16)		
4.	Progressive farmers	0(00)	18(23.68)	**58(76.32)**		
Sl. No.	**Formal sources of information**	**Frequency of use (%)**			**Mean score**	**Rank**
		Most often	**Sometimes**	**Never**		
1.	VEW	0(00)	14(18.42)	62(81.58)	1.11	II
2.	AO/ DAO/ HO/ SDHO	0(00)	6(7.89)	70(**92.11**)		
3.	KVK	0(00)	0(00)	76(100)		
4.	ATMA	0(00)	0(00)	76(100)		
5.	ICAR	0(00)	0(00)	76(100)		
6.	NGO’s	**17(22.37)**	17(**22.37)**	42(55.26)		
7.	NSRLM	0(00)	13(17.11)	63(82.89)		
Sl. No.	**Mass media sources of information**	**Frequency of use (%)**			**Mean score**	**Rank**
		Most often	**Sometimes**	**Never**		
1.	Radio	0(00)	0(00)	**76(100.00)**	0.49	III
2.	Television	0(00)	0(00)	**76(100.00)**		
3.	Newspaper	0(00)	10(13.16)	66(86.84)		
4.	Exhibition	0(00)	1(1.32)	75(98.68)		
5.	Print media	0(00)	4(5.26)	72(94.74)		
6.	Mobile phone	0(00)	**22(28.95)**	54(71.05)		

Table 4.1.10.2: Distribution of respondents based on information sources utilization for sustainable Naga king chilli cultivation in Dimapur district of Nagaland

n=84

Sl. No.	Informal sources of information	Frequency of use (%)			Mean score	Rank
		Most often	Sometimes	Never		
1.	Friends	**9(10.72)**	24(28.57)	51(60.71)	**1.46**	I
2.	Relatives	4(4.76)	**29(34.53)**	51(60.71)		
3.	Neighbours	0(00)	27(32.14)	57(67.86)		
4.	Progressive farmers	0(00)	17(20.24)	**67(79.76)**		
Sl. No.	**Formal sources of information**	**Frequency of use (%)**			**Mean score**	**Rank**
		Most often	**Sometimes**	**Never**		
1.	VEW	0(00)	**27(32.14)**	57(67.86)	0.92	II
2.	AO/ DAO/ HO/ SDHO	0(00)	16(19.05)	68(80.95)		
3.	KVK	0(00)	9(10.71)	75(89.29)		
4.	ATMA	3(3.57)	15(17.86)	66(78.57)		
5.	ICAR	0(00)	4(4.76)	80(95.24)		
6.	NGO's	0(00)	0(00)	**84(100.00)**		
7.	NSRLM	0(00)	0(00)	**84(100.00)**		
Sl. No.	**Mass media sources of information**	**Frequency of use (%)**			**Mean score**	**Rank**
		Most often	**Sometimes**	**Never**		
1.	Radio	0(00)	0(00)	**84(100.00)**	0.61	III
2.	Television	0(00)	0(00)	**84(100.00)**		
3.	Newspaper	0(00)	11(13.10)	73(86.90)		
4.	Exhibition	0(00)	3(3.57)	81(96.43)		
5.	Print media	0(00)	16(19.05)	68(80.95)		
6.	Mobile phone	0(00)	21(**25.00**)	63(75.00)		

Table 4.1.10.2 explained that among the mean score of the different sources of information utilized by the farmers of Dimapur district for sustainable Naga king chilli cultivation, informal sources of information ranked first followed by formal sources of information and mass media sources of

information. With regard to informal sources of information, a small portion (10.72%) of the farmers contacted their friends most often followed by farmers who reach out to their relatives sometimes (34.53%) in regard to information on sustainable Naga king chilli cultivation. While, majority (79.76%) of the respondents had never considered progressive farmers for information on sustainable Naga king chilli cultivation. While, for formal sources of information utilization, an insignificant (3.57%) section of the farmers were reported to acquire information most often from ATMA followed by sometimes (32.14%) from VEW. It was also exhibited that not a bit of the respondents had received information on sustainable Naga king chilli cultivation from NGO's and NSRLM. While, in case of mass media sources of information utilization, it was revealed that, none of the respondents had ever seek radio and television for information related to sustainable Naga king chilli cultivation. Although it was affirmed that a quarter (25.00%) of the respondents sometimes use mobile phones to obtain information on sustainable Naga king chilli cultivation.

Table 4.1.10.3 depicts the utilization of information sources by the respondents for sustainable Naga king chilli cultivation under Peren district. The mean score of different sources of information utilization unveiled that informal sources of information was the highest followed by formal and mass media sources of information. Under informal sources of information, a humble portion (18.88%) of the farmers were found depending on their friends most often for information on sustainable Naga king chilli cultivation followed by sometimes (36.67%) on relatives. While, majority (81.12%) never seek progressive farmers for information on sustainable Naga king chilli cultivation. With regard to formal sources of information, a negnigible (5.56%) part of the farmers were reported for utilizing NGO's most of the time for information on sustainable Naga king chilli cultivation, and thereafter over a quarter (30.00%) of the farmers who sometimes inquire from VEW for information. It was also revealed that none of the farmers had ever acquired information on sustainable Naga king chilli cultivation from ICAR and KVK. In case of mass media sources of information it was learned that not a bit of the respondents use radio and television as a source of information for sustainable Naga king chilli cultivation. However, a small section (22.22%) of the farmers were reported using mobile phones frequently, and therafter 20.00 per cent of the farmers who sometimes relay on newspapers to acquire information related to sustainable Naga king chilli cultivation.

Table 4.1.10.3: Distribution of respondents based on information sources utilization for sustainable Naga king chilli cultivation in Peren district of Nagaland

n=90

Sl. No.	**Informal sources of information**	**Frequency of use (%)**			**Mean score**	**Rank**
		Most often	**Sometimes**	**Never**		
1	Friends	**17(18.88)**	31(34.45)	42(46.67)	1.62	I
2	Relatives	4(4.44)	**33(36.67)**	53(58.89)		
3	Neighbours	0(00)	23(25.56)	67(74.44)		
4	Progressive farmers	0(00)	17(18.88)	**73(81.12)**		
Sl. No.	**Formal sources of information**	**Frequency of use (%)**			**Mean score**	**Rank**
		Most often	**Sometimes**	**Never**		
1	VEW	0(00)	**27(30.00)**	63(70.00)	1.10	II
2	AO/ DAO/ HO/ SDHO	0(00)	12(13.33)	78(86.67)		
3	KVK	0(00)	0(00)	**90(100.00)**		
4	ATMA	3(3.33)	15(16.67)	72(80.00)		
5	ICAR	0(00)	0(00)	**90(100.00)**		
6	NGO's	**5(5.56)**	17(18.88)	68(75.56)		
7	NSRLM	0(00)	12(13.33)	78(86.67)		
Sl. No.	**Mass media sources of information**	**Frequency of use (%)**			**Mean score**	**Rank**
		Most often	**Sometimes**	**Never**		
1	Radio	0(00)	0(00)	**90(100.00)**	0.70	III
2	Television	0(00)	0(00)	**90(100.00)**		
3	Newspaper	0(00)	**18(20.00)**	72(80.00)		
4	Exhibition	0(00)	3(3.33)	87(96.67)		
5	Print media	0(00)	14(15.56)	76(84.44)		
6	Mobile phone	**20(22.22)**	10(11.11)	60(66.67)		

Table 4.1.10.4: Overall level of information sources utilization for sustainable Naga king chilli cultivation by the respondents

N=250

Sl. No.	**District**	**Information sources utilized by respondents**				
		Level	**Frequency**	**Percentage (%)**	**Mean**	**Rank**
1.	Mon	Low (<1.13)	6	7.89	3.67	I
		Medium (1.13-6.21)	59	**77.63**		
		High (>6.21)	11	14.48		
2.	Peren	Low (<1.15)	19	21.11	3.30	II
		Medium (1.15-5.44)	60	**66.67**		
		High (>5.44)	11	12.22		
3.	Dimapur	Low (<0.31)	11	13.10	3.01	III
		Medium (0.31-5.70)	60	**71.42**		
		High (>5.70)	13	15.48		
4	Overall	Low (<1.00)	22	8.80	3.35	-
		Medium (1.00-6.00)	184	**73.60**		
		High (>6.00)	44	17.60		

From Table 4.1.10.4 and Fig 4.1.10.4 it is apparent that larger part (77.63%) of the farmers from Mon district were under medium range of information source utilization for sustainable Naga king chilli cultivation followed by high (14.48%) and low (7.89%) level of information source utilization. In the case of Peren district major part (66.67%) of the farmers had medium range of information source utilization, followed by low (21.11%) and high (12.22%) range of information source utilization. Dimapur district also showed that majority (71.42%) respondent had medium level of information source utilization followed by high (15.48%) and low (13.10%) level of information source utilization. Similarly, the overall level of information sources utilization revealed that larger part (73.60%) of the respondents had medium range of information source utilization, following that high (17.60%) and low (8.80%) level of information source utilization. Thakur *et al*. (2020),

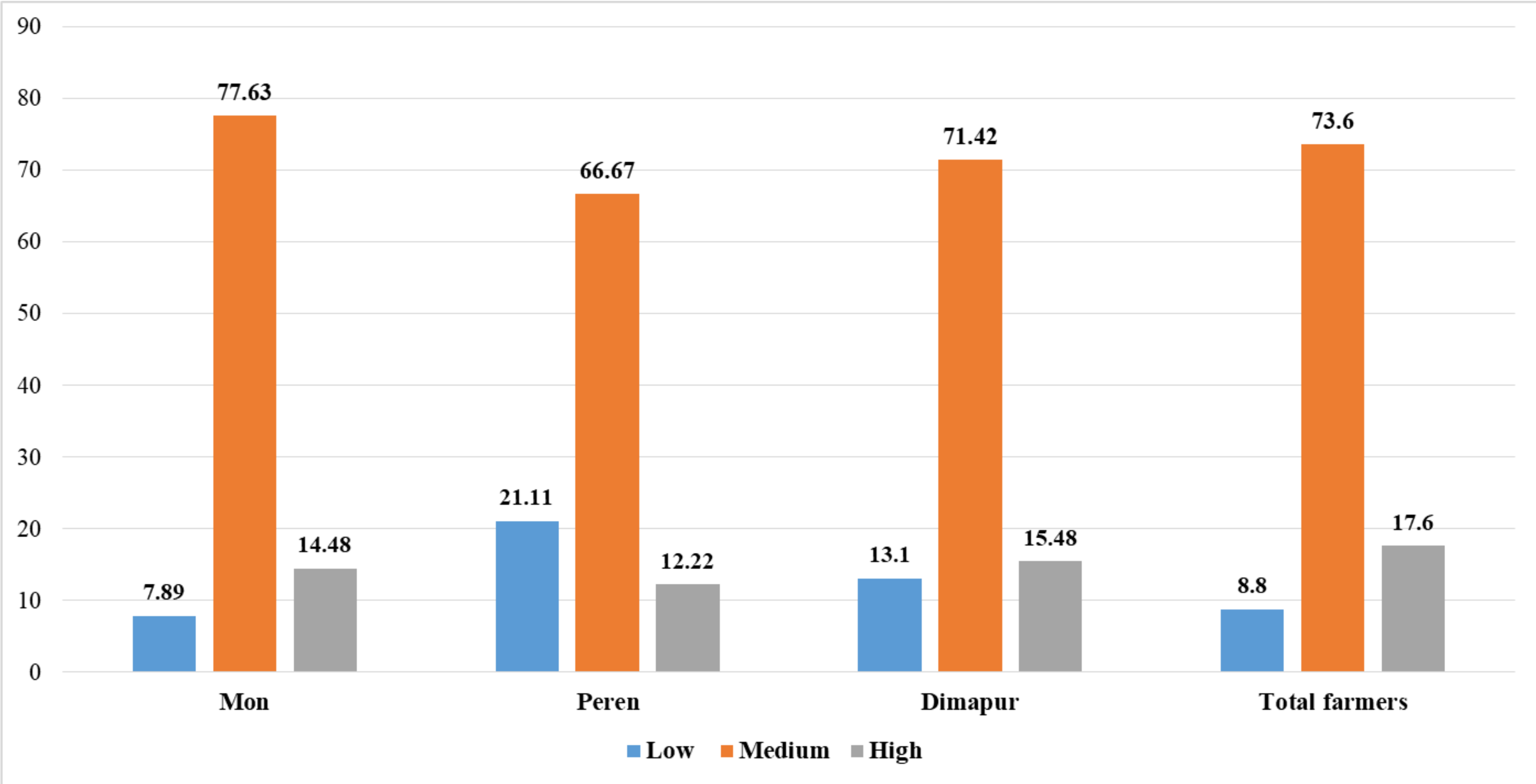

Fig 4.1.10.4: Overall level of information sources utilization for sustainable Naga king chilli cultivation by the respondents

Lalhlimpuii and Bose (2023) and Ram and Jahanara (2023) presented similar results from their findings.

4.1.11 Marketing orientation

Table 4.1.11.1: Distribution of respondents based on their level of marketing orientation

N=250

Sl. No.	Level of marketing orientation	Mon	Dimapur	Peren	Total
		Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
1	Low (< 2.24)	28(36.84)	19(22.62)	23(25.56)	70(28.00)
2	Medium (2.24-3.71)	**30(39.48)**	**45(53.57)**	**40(44.44)**	**115(46.00)**
3	High (> 3.71)	18(23.68)	20(23.81)	27(30.00)	65(26.00)
4	Total	76(100.00)	84(100.00)	90(100.00)	250(100.00)
5	Mean	2.86	3.00	3.04	2.98
6	SD	0.77	0.68	0.74	0.73

Table 4.1.11.1 and Fig 4.1.11.1 shows the distribution of respondents based on their level of marketing orientation toward sustainable Naga king cultivation. It was reported that a fair portion (39.48%) of the farmers from Mon district had medium extent of marketing orientation following that, low (36.84%) and high (23.68%) level of marketing orientations. With respect to Dimapur district majority (53.57%) of the growers had medium extent of marketing orientation thereafter high (23.81%) and low (22.62%) level of marketing orientation. Respondents from Peren district were recorded for a suitable portion (44.44%) with medium extent of marketing orientation, and thereafter high (30.00%) and low (25.56%) level of marketing orientation. The overall division of respondents exhibited that almost half (46.00%) had medium range of marketing orientation, and thereafter low (28.00%) and high (26.00%) level of marketing orientation. The basis for moderate range of marketing orientation could be the consequence of the traditional production system of Naga king chilli among the Naga king chilli growers of the region. Similar findings were reported by Khose *et al*. (2022) and Jha (2023).

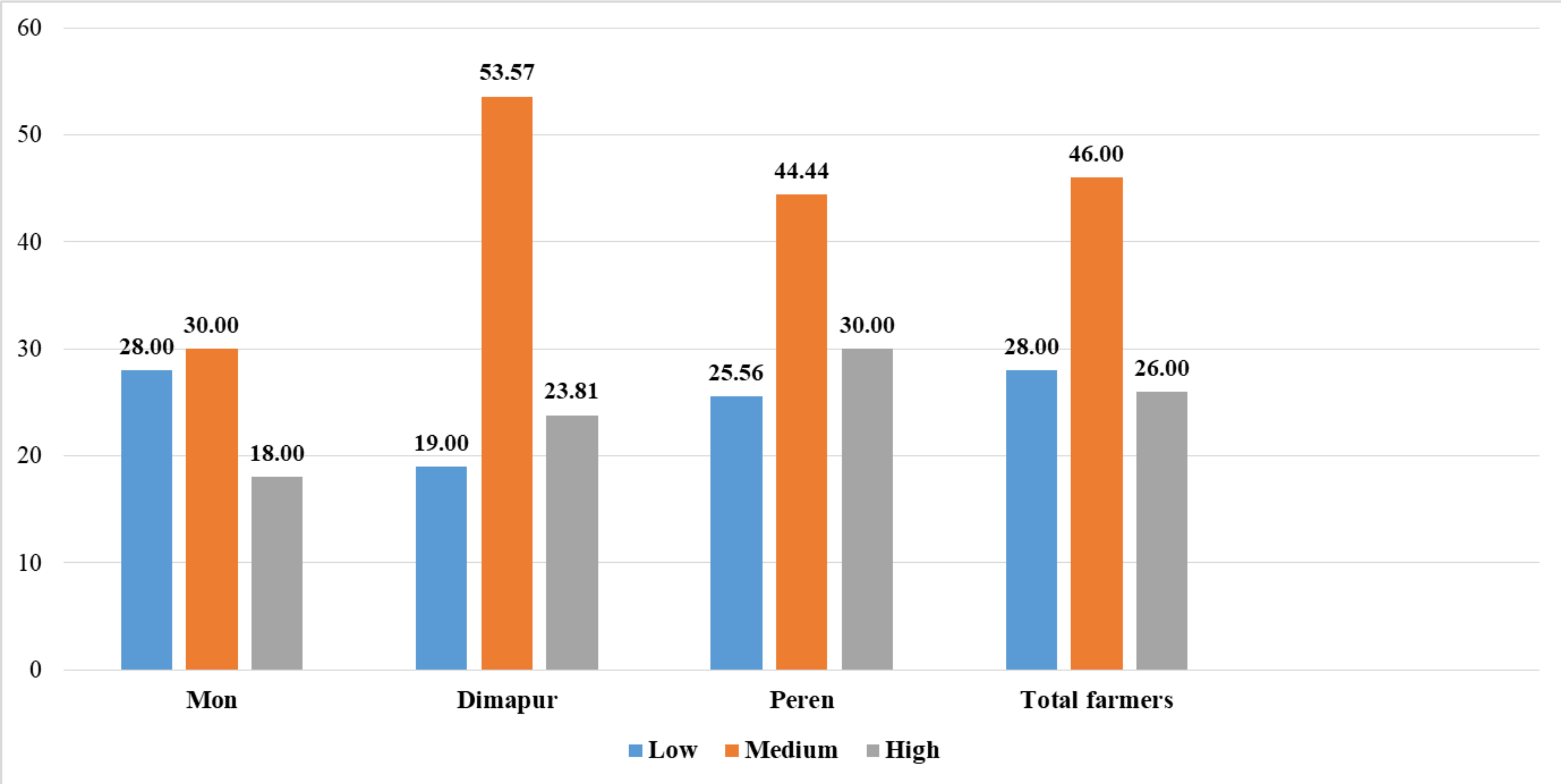

Fig 4.1.11.1: Distribution of respondents based on their level of marketing orientation

4.1.12 Economic motivation

Table 4.1.12.1: Distribution of respondents based on their level of economic motivation

N=250

Sl. No.	Level of marketing orientation	Mon	Dimapur	Peren	Total
		Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
1.	Low (< 11.07)	19(25.00)	30(35.71)	25(27.78)	74(29.60)
2.	Medium (11.07-14.12)	**46(60.53)**	**51(60.71)**	**50(55.55)**	**147(58.80)**
3.	High (> 14.12)	11(14.47)	3(3.58)	15(16.67)	29(11.60)
4.	Total	76(100.00)	84(100.00)	90(100.00)	250(100.00)
5.	Mean	12.85	12.21	12.75	12.60
6.	SD	1.55	1.19	1.71	1.53

Table 4.1.12.1 and Fig 4.1.12.1 represent the level of economic motivation among Naga king chilli growers of the region. The findings exposed that a major part (60.71%) of the farmers under Dimapur district had medium extent of economic motivation, and thereafter low (35.71%) and high (3.58%) level of economic motivation. The greater part (60.53%) of the growers of Mon district displayed medium range of economic motivation, following that low (25.00%) and high (14.47%) level of economic motivation. While, majority (55.55%) of the chilli growers from Peren district were reported with medium range of economic motivatiom, and thereafter low (29.60%) and high (11.60%) level of economic motivation. Finally, the overall distribution of respondents based on their level of economic motivation disclosed that more than half (58.80%) of the chilli growers were under medium range thereafter high (29.60%) and low (11.60%) level of economic motivation. Similar findings were observed by Bora *et al.* (2018), Bushetti and Krishnamurthy (2022) and Jha (2023).

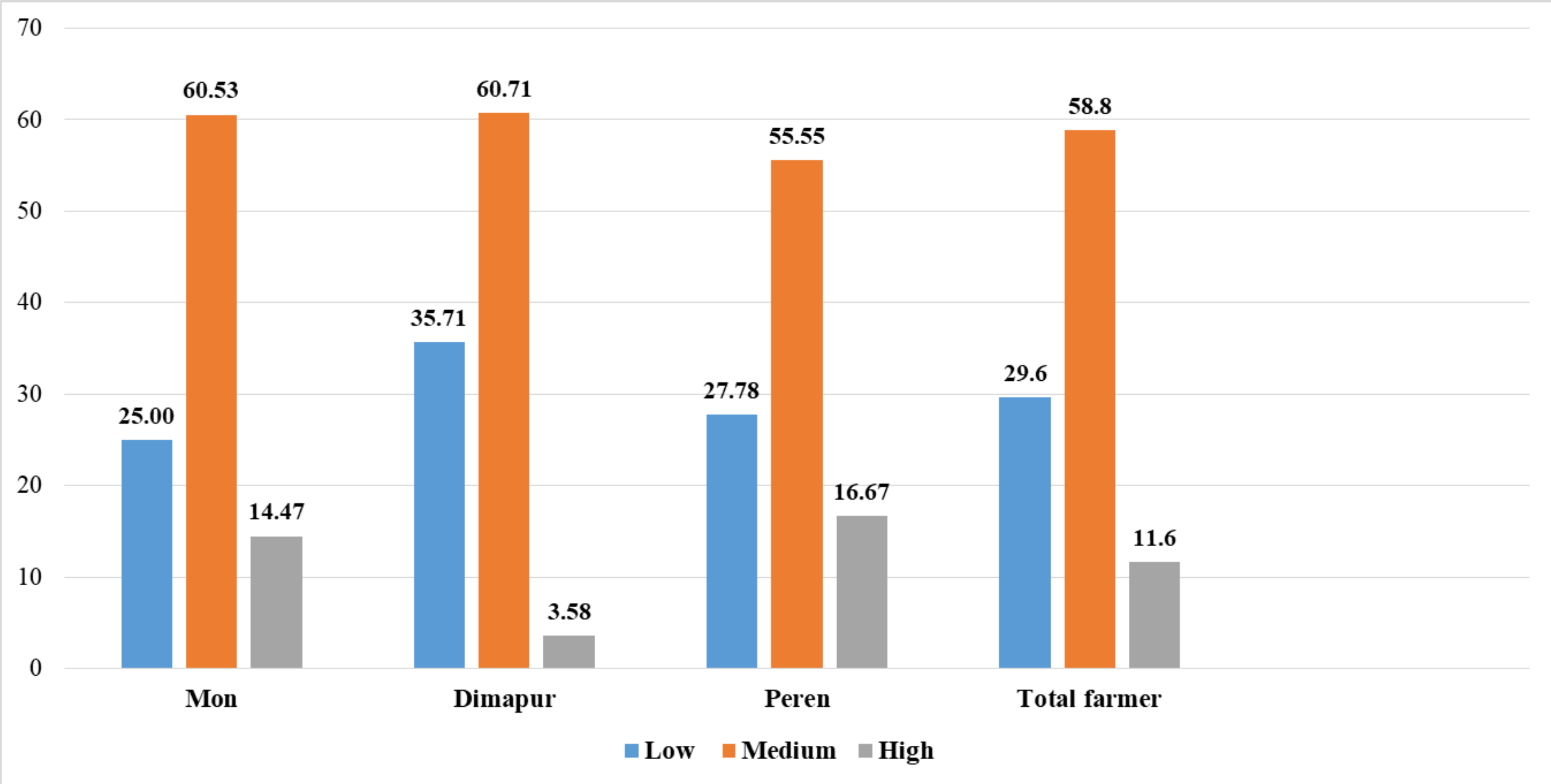

Fig 4.1.13.1: Distribution of respondents based on their level of social participation

4.1.13 Social participation

Table 4.1.13.1 and Fig 4.1.13.1 represents the distribution of respondents based on their level of social participation. The findings disclosed that majority (64.44%) of respondents from Peren district had high extent of social participation, following that low (20.00%) and medium (15.56%) status of social participation. Similarly, in the case of Dimapur district, majority (63.10%) of the chilli growers had higher status, while a small portion (29.76%) and (7.14%) had medium and low status of social participation. Further, majority (61.84%) of the farmers under Mon district had high status towards social participation, and thereafter low (34.21%) and medium (3.95%) extent of social participation. The overall distribution of chilli growers exhibited that major part (63.20%) had high extent of social participation, following that low (20.00%) and medium (16.80%) extent of social participation. The higher extent of social participation among the Naga king chilli farmers of the region could be the result of innate social qualities of mankind and the social responsibilities brought by the complex social system such as economies, culture and societies that we live in. The above findings have close similarities with that of Sundresha *et al*. (2020).

Table 4.1.13.1: Distribution of respondents based on their level of social participation

N=250

Sl. No.	Level of social participation	Mon	Dimapur	Peren	Total
		Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
1.	Low (< 0.80)	26(34.21)	6(7.14)	18(20.00)	50(20.00)
2.	Medium (0.80-4.51)	3(3.95)	25(29.76)	14(15.56)	42(16.80)
3.	High (> 4.51)	**47(61.84)**	**53(63.10)**	**58(64.44)**	**158(63.20)**
4.	Total	76(100.00)	84(100.00)	90(100.00)	250(100.00)
5.	Mean	2.03	3.21	2.66	2.66
6.	SD	1.70	1.85	1.84	1.86

4.1.14 Productivity of Naga king chilli

Table 4.1.14.1 and Fig 4.1.14.1 depicts the trend in area, production and productivity of Naga king chilli from 2018 to 2022 in Mon district of Nagaland. An increasing trend in the average area under Naga king chilli cultivation from 1.15 acre to 1.26 acre was observed with a percent change of 10.00 per cent during 2018 to 2022. While, in case of average production, a growth from 2.03 q to 2.36 q was recorded with a percent change of 16.00 per cent. Similar results were recorded in case of average productivity with an increase from 1.73 q/acre to 1.87 q/acre and percent change of 8.00 per cent during 2018 to 2022.

It was exhibited that an increase in average area of 0.69 acre to 0.94 acre was observed with a percent change of 36 per cent in case of respondents of Dimapur district from 2018 to 2022. While, average production of 0.95 q during 2018 was almost doubled to 1.36 q during 2022 with a percent change of 43.00 per cent. Finally, average productivity of Naga king chilli witnessed a marginal increased from 1.37 q/acre to 1.42 q/acre with a percent change of 4.00 per cent.

The findings also explained the growth trend in area, production and productivity of Naga king chilli from 2018 to 2022 in Peren district of Nagaland. A slight increase in average area from 1.20 acre during 2018 to 1.27 acre in 2022 was reported with a percent change of 6.00 per cent. While, in case of average production, a minimal increase of 2.26 q to 2.48 q was observed with a percent change of 10.00 per cent. Similarly, a growth from 1.87 q/acre during 2018 to 1.95 q/acre in 2022 was recorded with a percent change of 4.00 per cent. Interestingly, it was learned that the year 2018 to 2022 exhibited the highest average area, production and productivity for the respondents of peren district of Nagaland.

Table 4.1.14.1: Average Area, Production, Productivity of Naga king chilli for Mon, Dimapur and Peren districts of Nagaland (2018-2022)

Sl. No.	District	Indicators	2018	2019	2020	2021	2022	Pooled	Percent change (%)
1.	Mon	Avg. Area (acre)	1.15	1.17	1.17	1.24	1.26	1.198	10.00
		Avg. prod. (q)	2.03	2.20	2.22	2.35	2.36	2.232	16.00
		Avg. Product. (q/acre)	1.73	1.79	1.83	1.85	1.87	1.814	8.00
2.	Dimapur	Avg. Area (acre)	0.69	0.91	0.93	0.93	0.94	0.88	36.00
		Avg. prod. (q)	0.95	1.25	1.27	1.30	1.36	1.226	43.00
		Avg. Product. (q/acre)	1.37	1.38	1.37	1.39	1.42	1.386	4.00
3.	Peren	Avg. Area (acre)	1.20	1.22	1.24	1.25	1.27	1.236	6.00
		Avg. prod. (q)	2.26	2.33	2.42	2.46	2.48	2.39	10.00
		Avg. Product. (q/acre)	1.87	1.89	1.94	1.95	1.95	1.92	4.00

Table 4.1.14.2 and Fig 4.1.14.2 exhibited the area, production and productivity of Naga king chilli among farmers having different land sizes under cultivation from 2018 to 2022. During these five years it was reported that the highest (2.10 acre) average area was recorded during the year 2022 from farmers having land more than 2 acres. While, in case of farmers having 1-2 acres of land under Naga king chilli cultivation, an average area of 1.17 acre was recorded the highest. An average area of 0.50 acre was found among the farmers with less than 1 acre of land. In case of average production of Naga king chilli during 2018 to 2022, it was revealed that the highest (4.17 q) average production was recorded for the year 2022 from farmers having more than 2 acres of land under Naga king chilli cultivation. Similarly, the year 2022 exhibited the highest average production of 2.01 q and 0.89 q from farmers with land holding of 1 to 2 acres and less that 1 acre respectively. Furthermore, the highest average

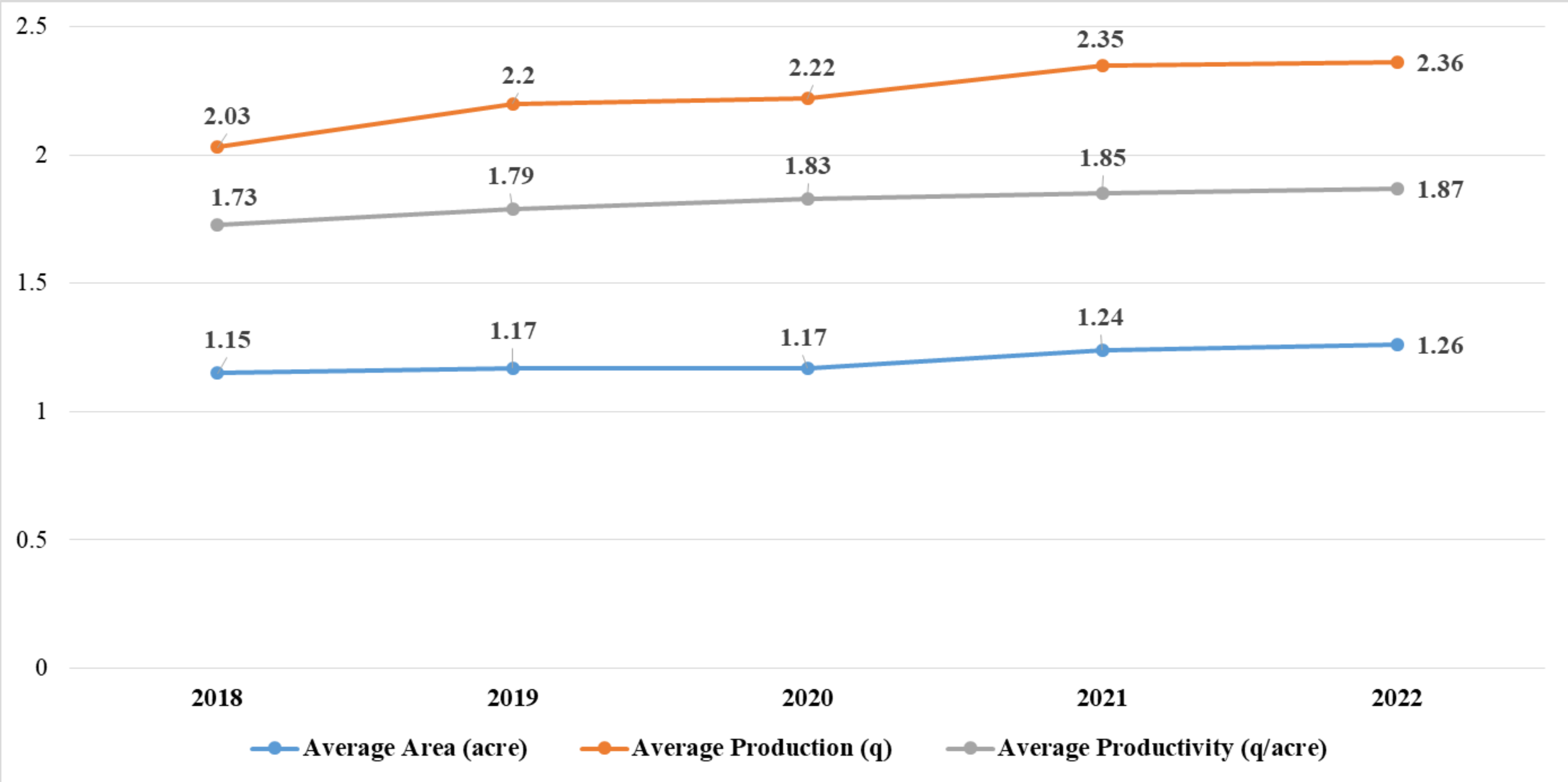

Fig 4.1.14.1.1: Area, Production, Productivity of Naga king chilli for Mon districts of Nagaland (2018-2022)

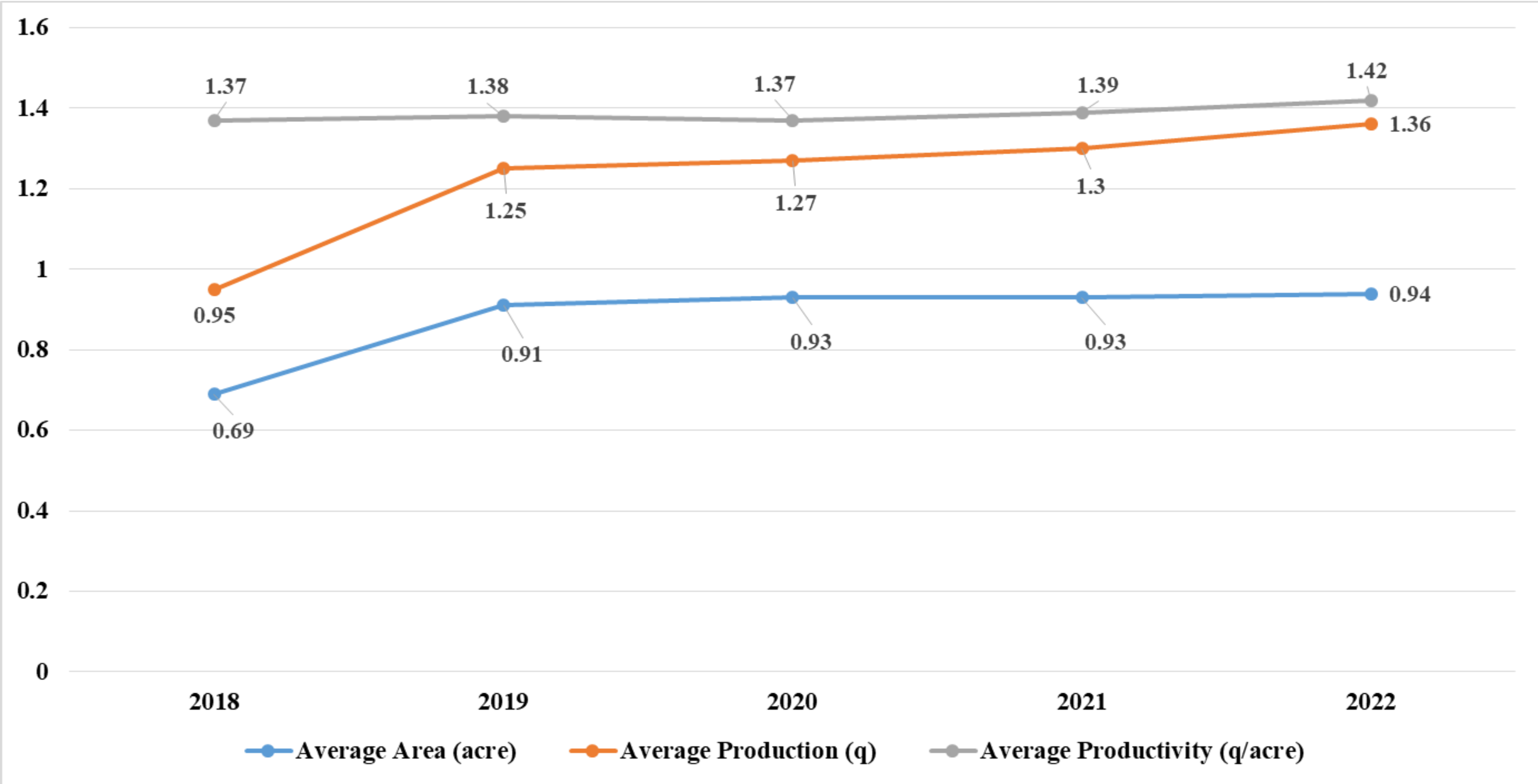

Fig 4.1.14.1.2: Area, Production, Productivity of Naga king chilli for Dimapur districts of Nagaland (2018-2022)

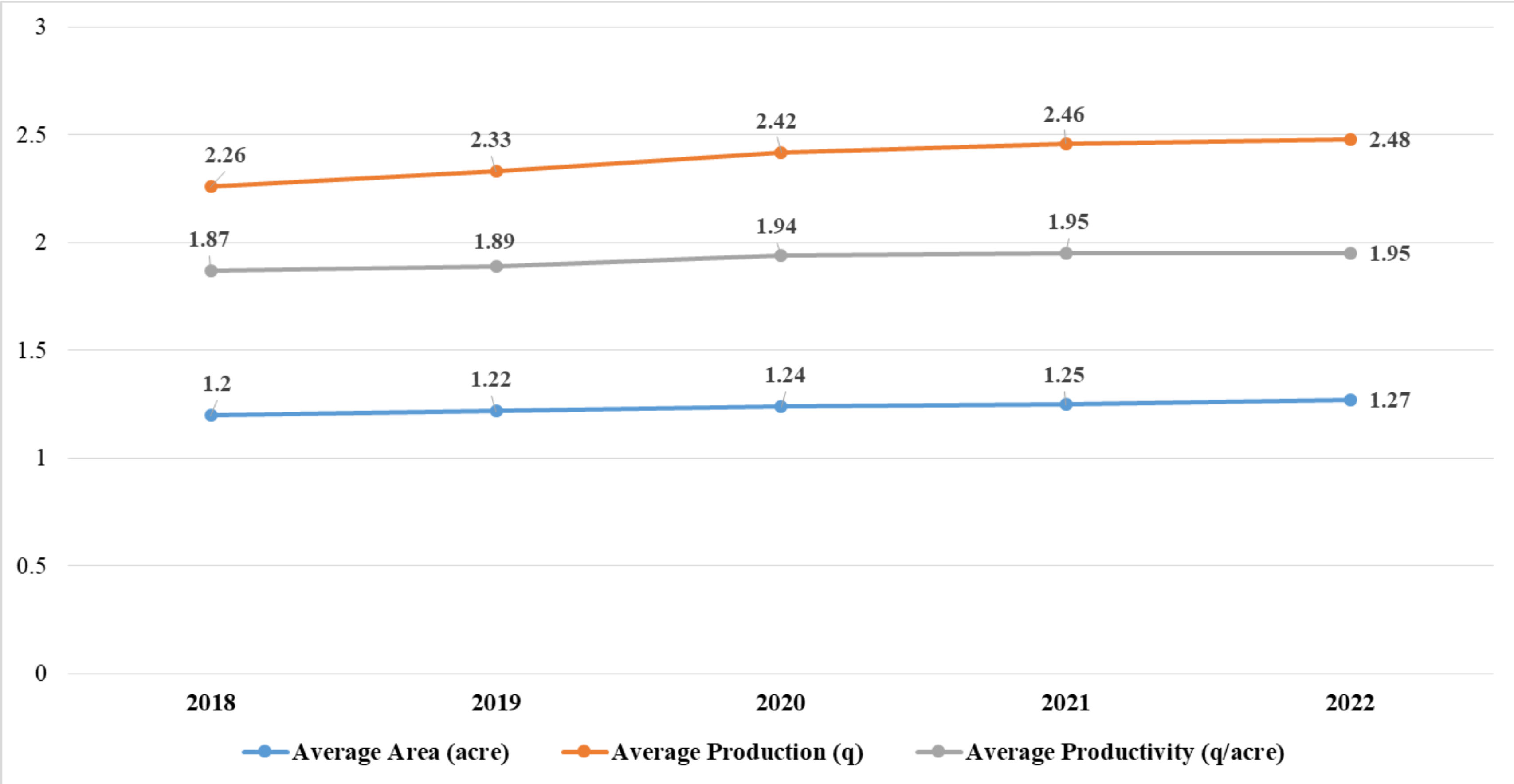

Fig 4.1.14.1.3: Area, Production, Productivity of Naga king chilli for Peren districts of Nagaland (2018-2022)

Table 4.1.14.2: Average Area, production and productivity of Naga king chilli among different group of farmers (2018-2022)

Year	Size of Land	Avg. area (acre)	Average prod. (q)	Average product. (q/acre)
2018	<1.00 acre	0.50	0.66	1.31
	1.00-2.00 acres	1.03	1.34	1.19
	>2.00 acres	2.00	2.85	1.40
	Overall mean	1.04	1.75	1.67
2019	<1.00 acre	0.50	0.76	1.52
	1.00-2.00 acres	1.13	1.70	1.49
	>2.00 acres	2.00	3.40	1.63
	Overall mean	1.11	1.89	1.68
2020	<1.00 acre	0.50	0.78	1.51
	1.00-2.00 acres	1.11	1.81	1.50
	>2.00 acres	2.03	3.72	1.85
	Overall mean	1.11	1.96	1.72
2021	<1.00 acre	0.50	0.75	1.56
	1.00-2.00 acres	1.12	1.80	1.58
	>2.00 acres	2.08	3.90	1.86
	Overall mean	1.14	2.00	1.75
2022	<1.00 acre	0.50	0.89	1.78
	1.00-2.00 acres	1.17	2.01	1.94
	>2.00 acres	2.10	4.17	2.09
	Overall mean	1.17	2.06	1.79
	Pooled	1.11	1.94	1.72
	Percent change from 2018-2022	13.00%	18.00%	7.00%

productivity of 2.09 q/acre was obtained from farmers having 2 acres of land under Naga king chilli cultivation. Likewise, the highest average productivity of 1.94 q/acre and 1.78 q/acre was recorded from farmers with land holding of 1 to 2 acres and less that 1 acre respectively. The average area, average production and average productivity from 2018 to 2022 was pooled to get 1.11 acres, 1.94q

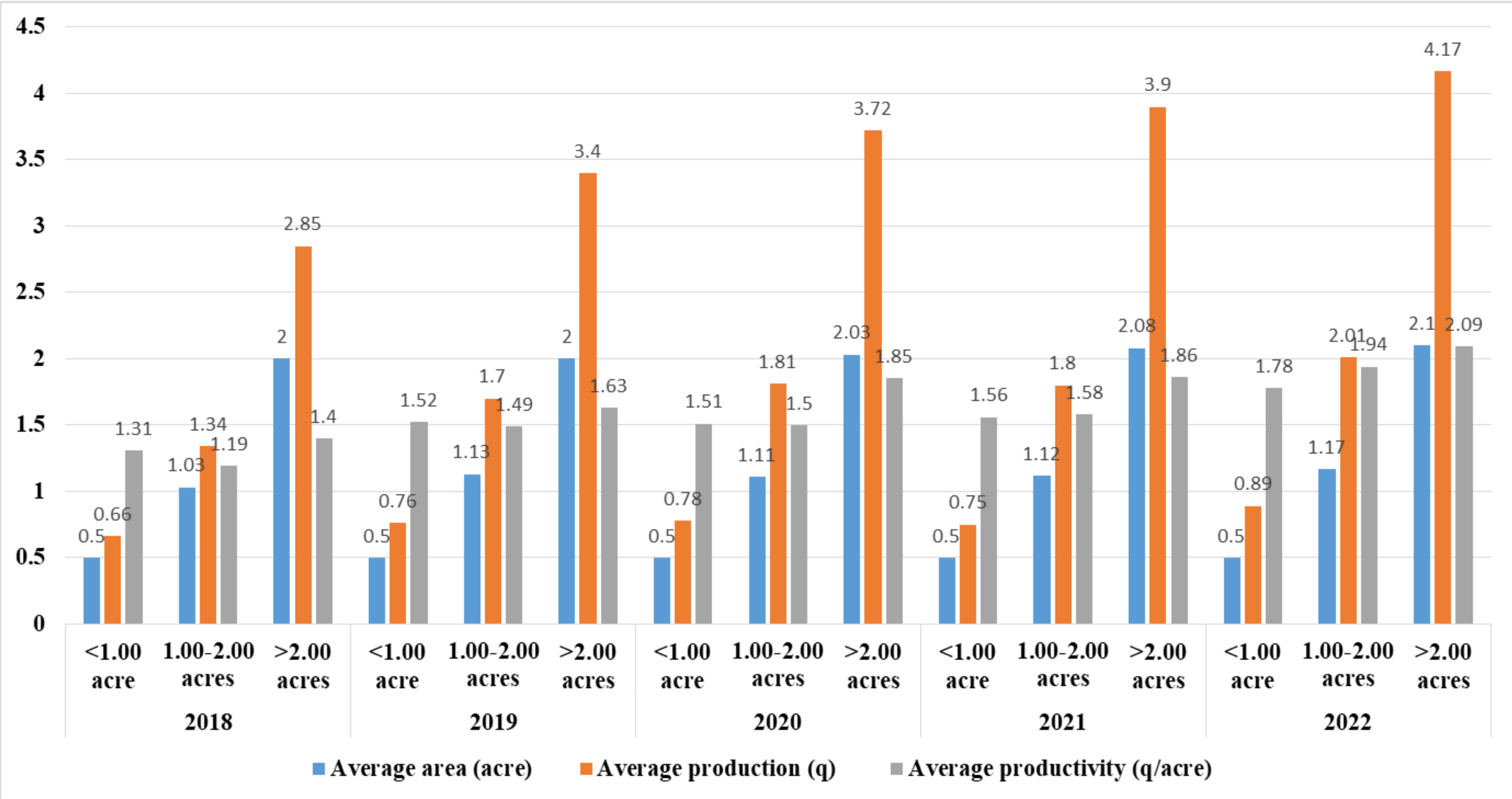

Fig 4.1.14.2: Area, production and productivity of Naga king chilli among different group of farmers (2018-2022)

and 1.72 q/acre respectively. The findings also revealed that the percent change of average area, average production and average productivity from 2018 to 2022 was at 13.00 per cent, 18.00 per cent and 7.00 per cent respectively. A nominal percent change in regard to productivity of Naga king chilli might be due to small and fragmented land-holdings along with farmers' inability to procure and manage the available resources efficiently.

4.2 Knowledge and attitude of Naga king chilli growers towards sustainable cultivation practices of Naga king chilli

4.2.1 Knowledge of sustainable cultivation practices among Naga king chilli growers

Table 4.2.1.1: Knowledge level on different dimensions of sustainable cultivation practices among Naga king chilli growers

N=250

Sl. No.	Dimension of sustainable Naga king chilli cultivation practices	Very High Knowledge (76%-100%)	High Knowledge (51%-75%)	Medium Knowledge (26%-50%)	Low Knowledge (1%-25%)	No Knowledge (0%)
		f (%)	f (%)	f (%)	f (%)	f(%)
1.	Climate	222(88.80)	28(11.20)	0(00)	0(00)	0(00)
2.	Soil	1(0.40)	249(99.60)	0(00)	0(00)	0(00)
3.	Nursery Management	0(00)	1(0.40)	107(42.80)	1(0.40)	141(56.40)
4.	Main Field Preparation	0(00)	0(00)	0(00)	0(00)	250(100.0)
5.	Manures and Fertilizers	0(00)	0(00)	0(00)	0(00)	250(100.0)
6.	Transplanting	0(00)	108(43.20)	0(00)	0(00)	142(56.80)
7.	Intercultural Operations	250(100.0)	0(00)	0(00)	0(00)	0(00)
8.	Plant Protection Measures	0(00)	0(00)	250(100.00)	0(00)	0(00)
9.	Harvesting & Yield	250(100.0)	0(00)	0(00)	0(00)	0(00)
10.	Grading	250(100.0)	0(00)	0(00)	0(00)	0(00)
11.	Curing	0(00)	184(73.60)	66(26.40)	0(00)	0(00)
12.	Storage	0(00)	0(00)	250(100.00)	0(00)	0(00)

Table 4.2.1.1 unveiled that the whole (100.00%) of the respondents displayed very high knowledge of intercultural operations, harvesting and yield and grading followed by 88.80 per cent with very high knowledge on climate requirement for sustainable cultivation of Naga king chilli in the region. While, the bulk (99.60%) of the chilli growers were reported with high knowledge of soil requirement for Naga king chilli cultivation followed by curing (73.60%) and transplanting (43.20). Furthermore, the entire (100.00%) respondents exhibited moderate extent of knowledge for plant protection actions and storage of Naga king chilli followed by nursery management (42.80%) and curing (26.40%). An astounding cent percent of the chilli growers were reported with no knowledge on main field preparation, manures and fertilizers followed by transplanting (56.80%) and nursery management (56.40%).

Table 4.2.1.2: Knowledge Index on recommended practices for sustainable Naga king chilli cultivation

N=250

Sl. No.	Recommended Practices	Knowledge Index	Rank
1.	Intercultural Operations	100.00	I
2.	Grading	100.00	I
3.	Climate	96.13	II
4.	Harvesting & Yield	83.33	III
5.	Curing	75.00	IV
6.	Soil	66.80	V
7.	Plant Protection Measures	45.00	VI
8.	Storage	33.33	VII
9.	Transplanting	28.80	VIII
10.	Nursery Management	19.20	IX
11.	Main Field Preparation	0.00	X
12	Manures and Fertilizers	0.00	X

From Table 4.2.1.2 it can be inferred that Knowledge Index was highest for intercultural operations and grading towards sustainable Naga king chilli cultivation, and thereafter knowledge on climate, harvesting and yield, curing, soil, plant protection measures, storage, transplanting, nursery management, main field preparation and manures and fertilizers.

While, it is clear from Table 4.2.1.3 and Fig 4.2.1.3 that greater percentage (71.05%) of the farmers of Mon district displayed medium range of knowledge on sustainable Naga king chilli cultivation practices, and thereafter high (17.11%) and low(11.84%) knowledge level. In the case of Dimapur district it was reported that more than half (54.76%) of the farmers had medium knowledge, followed by high (42.86%) and low (2.38%) knowledge level. Further, maximum (56.67%) chilli growers of Peren district were found to have moderate knowledge range, and thereafter less than half (43.33%) with high knowledge range and none for low category. The above outcomes reflects the limited training exposure on sustainable Naga king chilli cultivation practices among the farmers. The total knowledge status exhibited that a larger part (60.40%) of the responders had medium range of knowledge, while a small segment (35.20%) showed high range of knowledge and a scant (4.40%) amount with low range. Singh *et al.* (2020), Lakshmi *et al.* (2023) and Lalhlimpuii and Bose (2023) delivered comparable results from their study.

Table 4.2.1.3: Distribution of respondents based on their overall knowledge level of sustainable Naga king chilli cultivation practices

N=250

Sl. No.	**Knowledge level**	**Mon**	**Dimapur**	**Peren**	**Total**
		Frequency (%)	**Frequency (%)**	**Frequency (%)**	**Frequency (%)**
1.	Low (< 33.53)	9(11.84)	2(2.38)	0(00)	11(4.40)
2.	Medium (33.53-39.42)	**54(71.05)**	**46(54.76)**	**51(56.67)**	**151(60.40)**
3.	High (> 39.42)	13((17.11)	36(42.86)	39(43.33)	88(35.20)
4.	Total	76(100.00)	84(100.00)	90(100.00)	250(100.00)
5.	Mean	35.13	37.56	36.61	36.48
6.	SD	2.49	2.82	2.98	2.94
7.	Knowledge Index	66.28	70.86	69.07	68.83

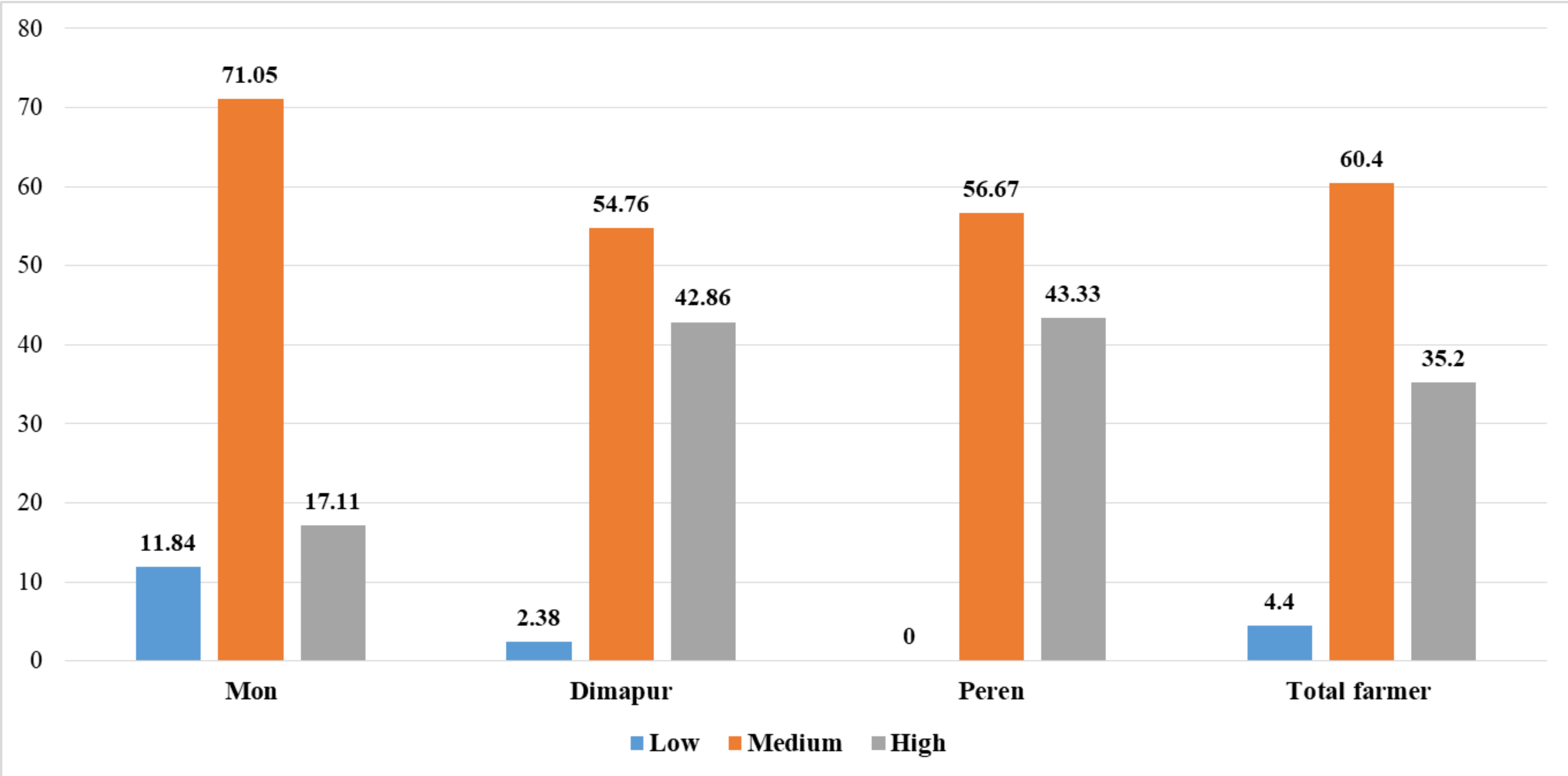

Fig 4.2.1.3: Distribution of respondents based on their overall knowledge level of sustainable Naga king chilli cultivation practices

Table 4.2.1.4: Comparative account of knowledge of farmers on sustainable Naga king chilli cultivation practices

Sl. No.	Name of the District	Mean Knowledge (μ)	z value	Prob.
1.	Mon	35.13	-1.716*	<0.05
	Dimapur	37.56		
2.	Mon	35.13	-0.993	>0.05
	Peren	36.61		
3.	Dimapur	37.56	0.724	>0.05
	Peren	36.61		

* significant at 5% level of probability

From Table 4.2.1.4, it may be inferred that knowledge of the respondents in terms of sustainable cultivation practices was significantly different among the farmers of Mon and Dimapur district.

4.2.2: Attitude of respondents towards sustainable cultivation practices Naga king chilli

Table 4.2.2.1 and Fig 4.2.2.1 explains that greater number (71.11%) of the farmers of Peren district showed favourable attitude towards sustainable Naga king chilli cultivation practices followed by highly favourable (20.00%) and less favourable (8.89%) attitude. While, more than half (68.43%) of the farmers of Mon district were reported to have favourable attitude with regard to sustainable Naga king chilli cultivation practices followed by less favourable (23.68 %) and highly favourable (7.89%) attitude. Meanwhile, Dimapur district exhibited that major part (52.38%) of chilli growers displayed favourable attitude for sustainable Naga king chilli cultivation practices following that by less favourable (36.90%) and highly favourable (10.72%) attitude. While, the overall distribution of respondents revealed that majority (64.00%) of the chilli growers had favourable attitude for sustainable Naga king chilli cultivation practices followed by less favourable (22.80%) and highly favourable (13.20%)

level of attitude. These findings are in conformity with the findings of Bora *et al*. (2018), Pawar and Channaveer (2021) and Pongener and Jha (2023).

Table 4.2.2.1: Distribution of respondents based on their Attitude towards adoption of sustainable Naga king chilli cultivation practices

N=250

Sl. No.	Level of Attitude	Mon	Dimapur	Peren	Total
		Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
1.	Less favourable (< 61.78)	18(23.68)	31(36.90)	8(8.89)	57(22.80)
2.	Favourable (61.78-78.65)	**52(68.43)**	**44(52.38)**	**64(71.11)**	**160(64.00)**
3.	Highly favourable (> 78.65)	6(7.89)	9(10.72)	18(20.00)	33(13.20)
4.	Total	76(100.00)	84(100.00)	90(100.00)	250(100.00)
5.	Mean	69.69	67.51	73.20	70.22
6.	SD	8.18	8.96	7.17	8.43
7.	Attitude Index	87.12	84.38	91.50	87.78

Table 4.2.2.2: Comparative account of attitude towards adoption of sustainable Naga king chilli cultivation

Sl. No.	Name of the District	Mean attitude (μ)	z value	Prob.
1.	Mon	69.69	1.40	>0.05
	Dimapur	67.51		
2.	Mon	69.69	2.50**	<0.01
	Peren	73.20		
3.	Dimapur	67.51	3.90**	<0.01
	Peren	73.20		

** significant at 1% level of probability

Table 4.2.2.2 revealed that attitude of chilli growers in terms of sustainable cultivation practices was significantly different among the farmers of Mon vs. Peren and Dimapur vs. Peren district.

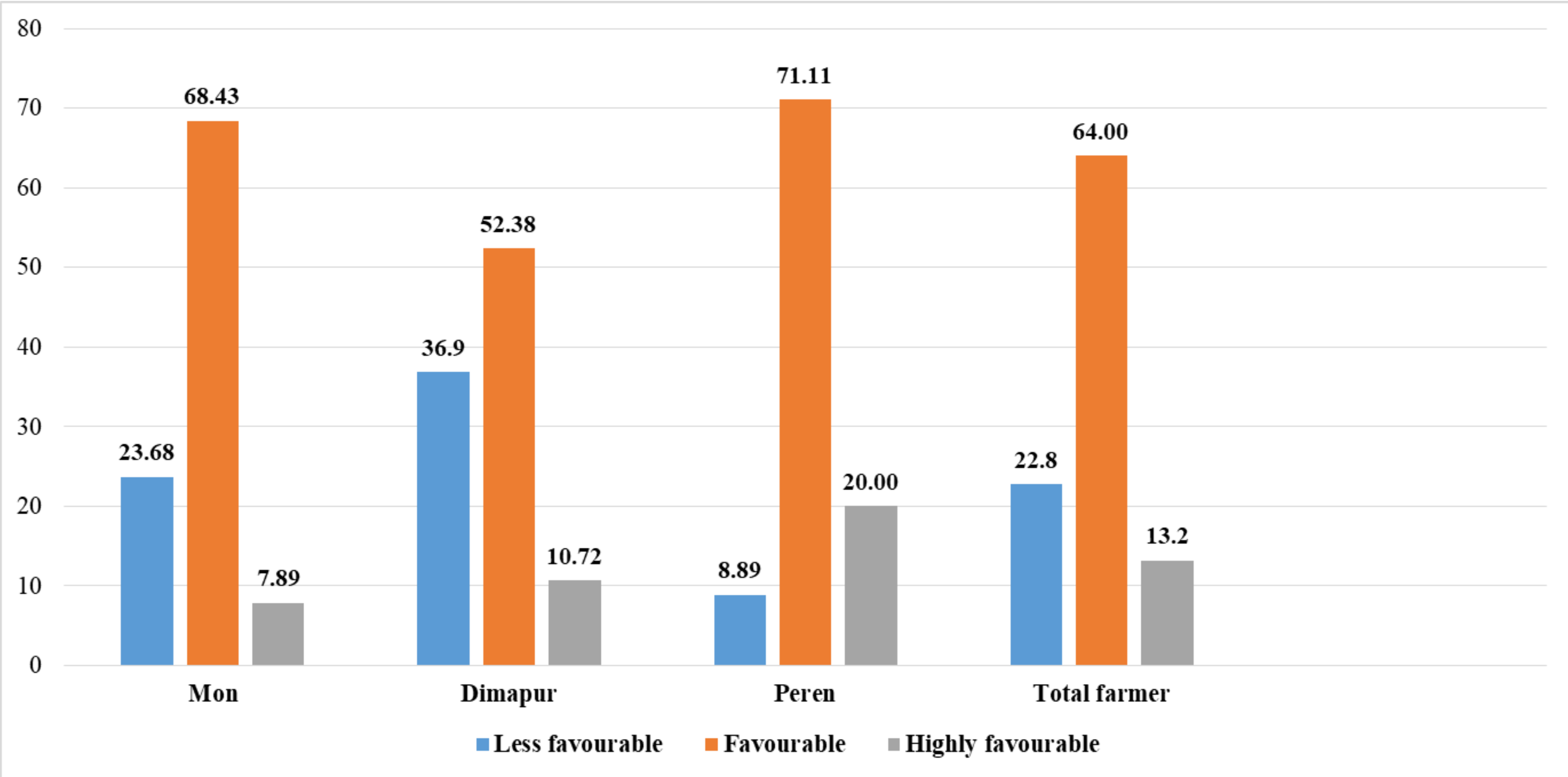

Fig 4.2.2.1: Distribution of respondents based on their attitude towards sustainable Naga king chilli cultivation practice

4.3 Extent of adoption of sustainable cultivation practices among Naga king chilli growers

Table 4.3.1: Distribution of respondents based on their level of adoption of sustainable Naga king chilli cultivation practices

N=250

Sl. No.	Recommended practices	Level of Adoption		
		Full Adoption f(%)	**Partial Adoption f (%)**	**No Adoption f (%)**
1.	**Nursery Management**			
	• Raised seed bed:15 cm hight, 1 m length, ½ m width	00(00)	82(32.80)	168(67.20)
	• Soil treatment with garden soil, vermicompost, sand (1:1:1)	00(00)	00(00)	00(00)
2.	**Seed Treatment** • Mix with Bio-fertilizers like azotobecter and phosphotika 200g each in 300ml water, mix with vermicompost/organic manures and dry in shade for 30 minutes and sow immediately	00(00)	00(00)	250(100.0)
3.	**Sowing** • Line sowing with 5cm apart to avoid overcrowding of the seedlings	00(00)	57(22.80)	193(77.20)
4.	**Mulching** • Mulching the seed bed with paddy straw and twigs to conserve soil moisture and protect from birds and animals	00(00)	39(15.60)	21(84.40)
5.	**Main field preparation** • Pit digging during February to March Pit size: 1ftx1ftx1ft is dug and keep for over a month Pit-pit distance: 4ftx4ft	00(00)	00(00)	250(100.00)
6.	**Soil mixture** • Treat the soil with azotobacter/azospirillum @1-1.25 kg mixed with 50 kg of FYM @4-6 ton/acre, vermicompost @ 1-2 ton/acre	00(00)	00(00)	250(100.0)
7.	**Transplanting** • At 10-12 leaves stage, irrigating the nurseries before transplanting	28(11.2)	58(23.20)	164(65.60)
8.	**Inter cultural operations**	**163(65.20)**	87(34.80)	00(00)

	• Weeding should be done after 30-40 days of planting and repeated at regular intervals as and when required followed by mulching and earthing up			
9.	**Irrigation** • Everyday watering of nursery bed is required • Under open field condition watering should be done at transplanting, vegetative and fruiting stage	00(00) 00(00)	43(17.20) 00(00)	207(82.80) 250(100.00)
10.	**Insect Pest Management** • Early spray of neem oil @5ml/L of water to control disease vector white fly • Release of *T. Chilonis*@50,000/ha per week to coincide with flowering season to control fruit (pod) borer • Hand picking and killing of insect pest in the field	00(00) 00(00) 00(00)	00(00) 00(00) **148(59.20)**	250(100.00) 250(100.00) 102(40.80)
11.	**Disease Management** • Leaf Curl virus: spray Neem oil @5ml/L of water or Dipole (Bio pesticide) @1-4 teaspoon/4L of water • Bacterial wilt and Bacterial leaf spot of chilli: spray 10g of *Trichoderma*/L of water • Early removal of affected plants will control the spread of diseases	00(00) 00(00) 00(00)	00(00) 00(00) 92(36.80)	250(100.00) 250(100.00) 158(63.20)
12.	**Harvesting time, interval and stage** • Harvest fruit during cooler parts of the day(morning/evening) • Do not harvest the fruits during days season as it will lead to rotting of the fruits/pods • Fruit should be harvested with the stalk intact • Dark green fruit stage for long and distant market and red stage for nearby markets, drying and seed purpose	00(00) 4(1.60) **234(93.60)** 120(48.00)	63(25.20) **153(61.20)** 16(6.40) 130(52.00)	187(74.80) 93(37.20) 00(00) 00(00)
13.	**Grading** • The produce should be separated according to size before sending them to market	00(00)	16(6.40)	234(93.60)
14.	**Curing**	00(00)	**250(100.00)**	00(00)

	• Curing of Naga king chilli should be done through sun drying or dehydrator and pickling • Reduced Moisture content (65-80%) to 10% • Store in heap indoor for 2-3 days at a temperature of 22º-25º C to obtain uniform red colour	00(00) 00(00)	00(00) 00(00)	250(100.00) 250(100.00)
15.	**Packaging** • Avoid the exposure of dried chilies to light and air • Maintain moisture content below 15% • For tropical condition, 200 gauge low and high density polyethylene films are appropriate	00(00) 00(00) 00(00)	00(00) 00(00) 00(00)	250(100.00) 250(100.00) 250(100.00)
16.	**Storage Practice** • Store at cool, dark and dry places Cold storage temperature 5º-8º C, RH 55-60%	00(00)	00(00)	250(100.00)

Table 4.3.1 represents the distribution of respondents based on their level of adoption of recommended sustainable Naga king chilli cultivation practices. It was revealed that the highest (93.60 %) percentage of adoption was recorded for the recommended practice of harvesting the fruit with the stalk intact under harvesting time, interval and stage followed by inter cultural operations (65.20%) which explains that weeding should be done after 30-40 days of planting and repeated at regular intervals as and when required followed by mulching and earthing up. It was also reported that, less than half (48.00%) of the farmers had full adoption of the recommended practice of harvesting Naga king chilli at dark green fruit stage for long and distant market and red stage for nearby markets, drying and seed purpose. Highest (100.00%) partial adoption for the recommended practice was recorded for curing of Naga king chilli followed by harvesting time, interval and stage, where it was recommended not to harvest the fruits during rainy days as it will lead to rotting of the fruits/pods. While, over half (59.20%) of the chilli growers were reported of partial adoption of the recommended practice of insect pest management of hand picking and killing of insect pest in the field. Complete no adoption of the recommended

cultivation practices of sustainable Naga king chilli was recorded for seed treatment, main field preparation, soil mixture, irrigation in open field condition, spraying of neem oil, release of *T. Chilonis and* spray of *Trichoderma* for insect pest and disease management. This might be because the farmers are generally depended on the traditional practice of shifting cultivation. Where the crops are fully rain fed and for nutrient management and plant protection measures, bamboo burned areas, banana growing areas and rocky areas are considered ideal for Naga king chilli cultivation under jhum condition. An astounding number (100.00%) of chilli growers were reported with no adoption of the recommended practice of packaging, storage, maintaining moisture content of 10% and temperature of 22º-25º C to obtain uniform red colour for curing Naga king chilli fruits/pods. This might be due to farmers' economic reasons and their inaccessible location which deprive them from accessing to the diverse arrays of new technological advancements, infrastructures and financial opportunities for performing sustainable cultivation practices. Furthermore, it was disclosed that a sizeable portion (93.60%) of the farmers had not adopted the recommended practice of grading the harvest according to size before sending it to market. This might be due to farmers' preference to sell their produce in bulk right after the harvest considering the perishable nature of the fruit. While it was also reported that a larger segment (84.40%) of chilli growers had not adopted the recommended practice of mulching the seed bed with paddy straws and twigs followed by everyday watering of nursery bed (82.80%), raised seed bed (67.20 %) and transplanting (65.60%). This might be because the farmers usually practice direct sowing of seeds in the main field. Further, it was exhibited that larger part (77.20%) of the respondents had not adopted the recommended practice of line sowing of Naga king chilli as the farmers generally practice sporadic mixed cropping of Naga king chilli with summer crops in jhum fields.

Table 4.3.2: Adoption Index on recommended practices for sustainable Naga king chilli cultivation

N=250

Sl. No.	Recommended Practices	Adoption Index	Rank
1.	Intercultural operations	82.60	I
2.	Harvest time interval and stage	53.90	II
3.	Transplanting	22.80	III
4.	Curing	16.67	IV
5.	Sowing	12.60	V
6.	Integrated pest management	9.86	VI
7.	Nursery management	8.20	VII
8.	Mulching	7.80	VIII
9.	Integrated disease management	6.13	IX
10.	Irrigation	4.30	X
11.	Grading	3.20	XI
12.	Seed treatment	0.00	XII
13.	Main field preparation	0.00	XII
14.	Soil mixture	0.00	XII
15.	Packaging	0.00	XII
16.	Storage practices	0.00	XII

Table 4.3.2 revealed that the highest adoption index was recorded for intercultural operations followed by harvest time interval and stage, transplanting, curing, sowing, integrated pest management, nursery management, mulching, integrated disease management, irrigation, grading, seed treatment, main field preparation, soil mixture, packaging and storage.

Table 4.3.3 and Fig 4.3.3 represents the distribution of respondents based on their overall adoption level of sustainable Naga king chilli cultivation practices. A huge part (83.33%) of the respondents of Dimapur district were reported for medium adoption level, and thereafter low (9.52%) and high (7.15%) adoption level. In the case of Mon district it was reported that a larger (61.84%) number of the farmers had medium adoption, and thereafter low (22.37%) and high (15.79%) level of adoption. Peren district reported 54.44 per cent of the respondents had medium level of adoption followed by high (26.67%) and

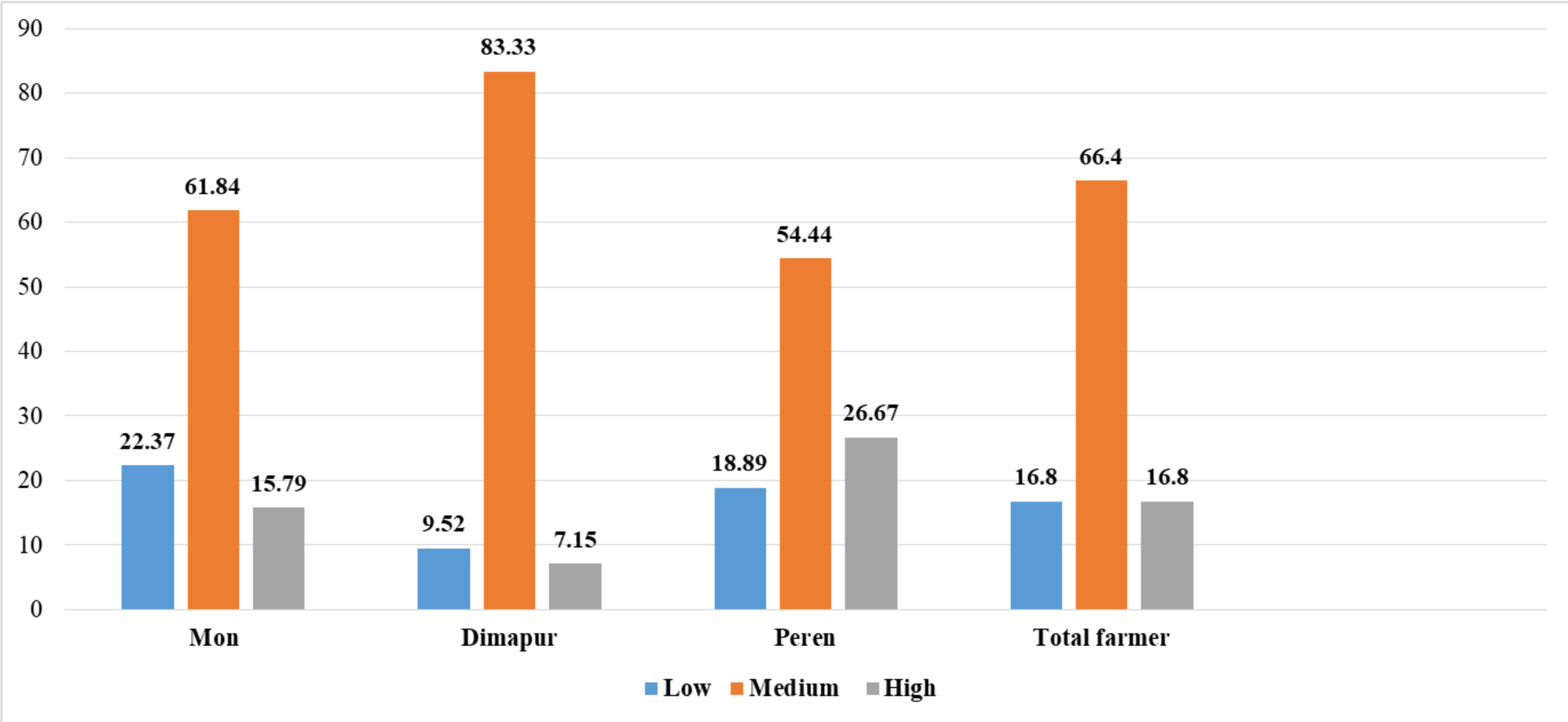

Fig 4.3.3: Distribution of respondents based on their overall adoption of sustainable Naga king chilli cultivation practices

Plate 1: Data collection on sustainable Naga king chilli cultivation practices

Plate 2: Cultivable land for Naga king chilli

Plate 3: Naga king chilli cultivation under Mon district, Nagaland

Plate 4: Cropping pattern of Naga king chilli under Peren and Dimapur district, Nagaland

Plate 5: Traditional tools and implements used for cultivation and postharvest management of Naga king chilli

Table 4.3.3: Distribution of respondents based on their overall adoption level of sustainable Naga king chilli cultivation practices

N=250

Sl. No.	Name of District / Level of Adoption	Mon Frequency (%)	Dimapur Frequency (%)	Peren Frequency (%)	Total Frequency (%)
1.	Low (<6.32)	17(22.37)	8(9.52)	17(18.89)	42(16.80)
2.	Medium (6.32-12.08)	**47(61.84)**	**70(83.33)**	**49(54.44)**	**166(66.40)**
3.	High (>12.08)	12(15.79)	6(7.15)	24(26.67)	42(16.80)
4.	Total	76(100.00)	84(100.00)	90(100.00)	250(100.00)
5.	Mean	8.77	8.61	10.11	9.20
6.	SD	3.05	2.07	3.16	2.88
7.	Adoption Index	27.42	26.93	31.59	28.76

low (18.89%) level of adoption. Further, the overall distribution of respondents revealed that more than half (66.40%) had medium range of adoption, followed by low (16.80%) and high (16.80%) adoption level. These findings are in conformity to that of Boora *et al.* (2023), (Patra *et al.* (2023) and Sinha and Parganiha (2023).

4.4 Entrepreneurial behaviour of Naga king chilli growers

Table 4.4.1: Distribution of Naga king chilli farmers based on entrepreneurial attributes

N=250

Sl. No.	Entrepreneurial attributes	Mon Frequency (%)	Dimapur Frequency (%)	Peren Frequency (%)
A	**Economic Motivation**			
1.	Low (<11.00)	3(3.94)	2(2.38)	4.(4.44)
2.	Medium (11.00-14.00)	62(81.57)	79(94.05)	71(78.89)
3.	High (>14.00)	11(14.47)	3(3.57)	15(16.67)
	Total	76(100.00)	84(100.00)	90(100.00)
B	**Innovativeness**			
1.	Low ((<5.00)	00(00.00)	00(00.00)	00(00.00)
2.	Medium (5.00-10.00)	70(92.11)	78(92.86)	65(72.22)
3.	High (>10.00)	6(7.89)	6(7.14)	25(27.78)
	Total	76(100.00)	84(100.00)	90(100.00)

C	**Achievement motivation**			
1.	Low ((<8.00)	00(00.00)	00(00.00)	00(00.00)
2.	Medium (8.00-13.00)	64(84.21)	73(86.90)	57(63.33)
3.	High (>13.00)	12(15.79)	11(13.10)	33(36.67)
	Total	76(100.00)	84(100.00)	90(100.00)
D	**Decision making ability**			
1.	Low ((<5.00)	00(00.00)	00(00.00)	00(00.00)
2.	Medium (5.00-9.00)	63(82.89)	78(92.86)	59(65.56)
3.	High (>9.00)	13(17.11)	6(7.14)	31(34.44)
	Total	76(100.00)	84(100.00)	90(100.00)
E	**Risk taking ability**			
1.	Low ((<11.00)	00(00.00)	00(00.00)	00(00.00)
2.	Medium (11.00-15.00)	69(90.79)	77(91.67)	73(81.11)
3.	High (>15.00)	7(9.21)	7(8.33)	17(18.89)
	Total	76(100.00)	84(100.00)	90(100.00)
F	**Leadership ability**			
1.	Low ((<5.00)	5(6.58)	5(5.95)	00(00.00)
2.	Medium (5.00-8.00)	66(86.84)	75(89.29)	77(85.56)
3.	High (>8.00)	5(6.58)	4(4.76)	13(14.44)
	Total	76(100.00)	84(100.00)	90(100.00)
G	**Management orientation**			
1.	Low ((<18.00)	2(2.63)	15(17.86)	13(14.45)
2.	Medium (18.00-21.00)	59(77.63)	65(77.38)	66(73.33)
3.	High (>21.00)	15(19.74)	4(4.76)	11(12.22)
	Total	76(100.00)	84(100.00)	90(100.00)
H	**Production orientation**			
1.	Low ((<16.00)	15(19.74)	2(2.38)	4(4.45)
2.	Medium (16.00-20.00)	51(67.10)	76(90.48)	74(82.22)
3.	High (>20.00)	10(13.16)	6(7.14)	12(13.33)
	Total	76(100.00)	84(100.00)	90(100.00)
I	**Marketing orientation**			
1.	Low ((<21.00)	00(00.00)	00(00.00)	00(00.00)
2.	Medium (21.00-23.00)	57(75.00)	78(92.86)	65(72.22)
3.	High (>23.00)	19(25.00)	6(7.14)	25(27.78)
	Total	76(100.00)	84(100.00)	90(100.00)
J	**Entrepreneurial Competencies**			
1.	Low ((<20.00)	6(7.89)	5(5.95)	4(4.44)
2.	Medium (20.00-25.00)	54(71.05)	71(84.53)	61(67.78)
3.	High (>25.00)	16(21.06)	8(9.52)	25(27.78)
	Total	76(100.00)	84(100.00)	90(100.00)

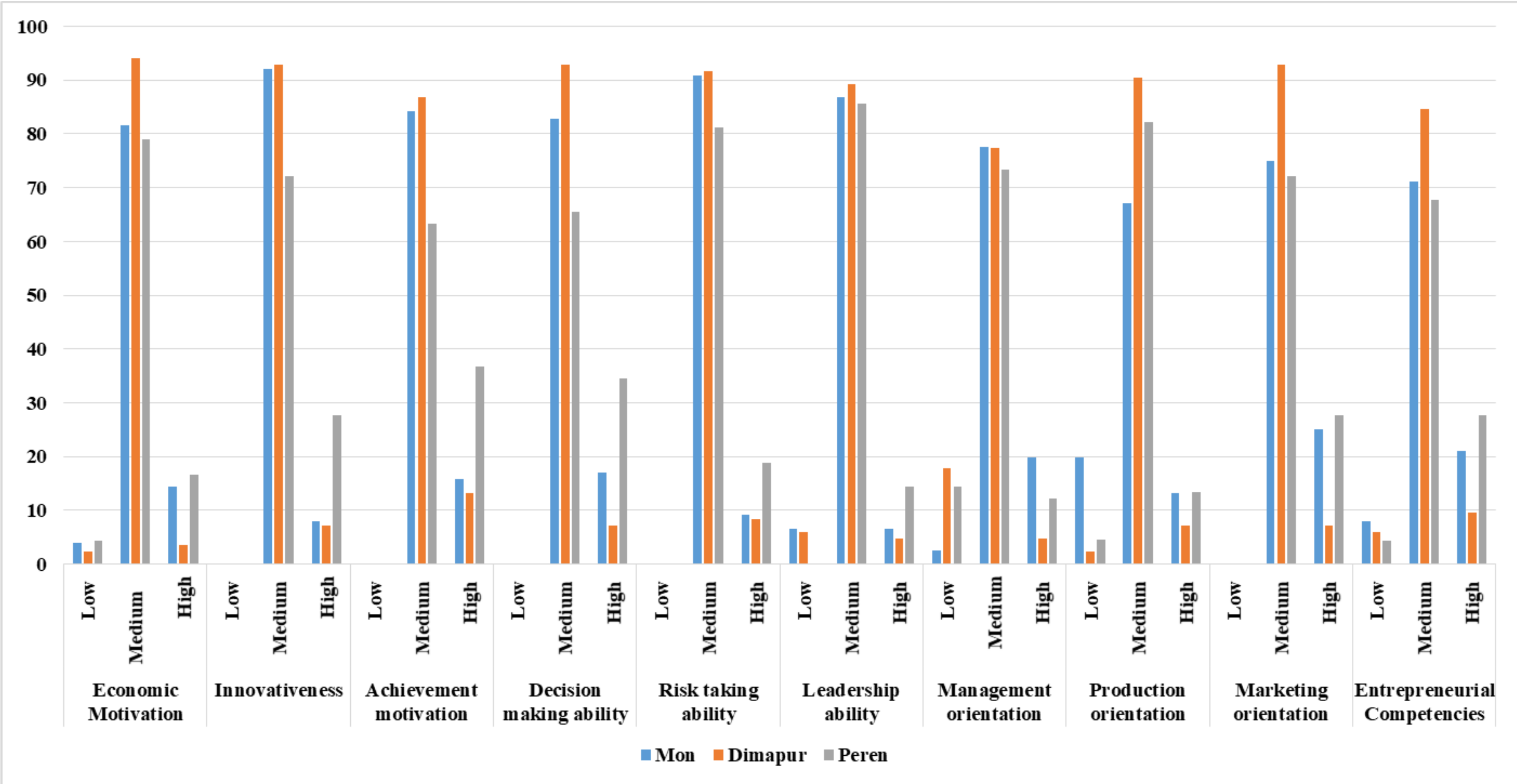

Fig 4.4.1: Distribution of Naga king chilli farmers based on entrepreneurial attributes

Table 4.4.1 and Fig 4.4.1 exhibits the distribution of Naga king chilli farmers based on entrepreneurial attributes. Entrepreneurial attributes *viz*. economic motivation, innovativeness, achievement motivation, decision making ability, risk taking ability, leadership ability, management orientation, production orientation, marketing orientation and entrepreneurial competencies were considered to analyze the entrepreneurial behaviour of Naga king chilli growers.

In the case of Mon district, a sizeable margin (81.57%) of chilli growers belonged to medium category of economic motivation and thereafter high (14.47%) and low (3.94%) level. While, an appreciable amount (92.11%) of farmers were recorded for medium range of innovativeness, and thereafter high (7.89%) level of innovativeness and none (0.00%) under low level. It was also uncovered that major part (84.21%) of the farmers had medium range of achievement motivation, while a small fraction (15.79%) had high level of achievement motivation and none (0.00%) under low range. In case of decision making ability, medium level was recorded for an ample size (82.89%) of chilli growers followed by 17.11 per cent under high level of decision making ability. Risk taking ability of the farmers revealed that majority (90.79%) had medium range and a negligible segment (9.21%) was reported for high range. Furthermore, a considerable part (86.84%) of the respondents were reported for moderate range of leadership ability, and thereafter high (6.58%) and low (6.58%) level. A larger part (77.63%) of the growers had medium range of management orientation, while 19.74 per cent and a negligible segment (2.63%) of the respondents had high and low range of management orientation respectively. Further, it was also revealed that more than half (67.10%) of the growers had medium range of production orientation, and thereafter low (19.74%) and high (13.16%) range. Besides, moderate range of marketing orientation was recorded for three quarters (75.00%) of the respondents, following that a quarter (25.00%) with high range. Finally, greater section

(71.05%) of the respondents were found to have moderate range of entrepreneurial competencies, following that high (21.06%) and low (7.89%) range.

Distribution of Naga king chilli farmers of Dimapur district based on entrepreneurial attributes depicts that, majority (94.05%) had medium range of economic motivation, and thereafter high (3.57%) and low (2.38%) level. While, a staggering fraction (92.86%) of the farmers had medium range of innovativeness, following that 7.14 per cent with high range of innovativeness. In case of achievement motivation, medium and high position was reported for 86.90 per cent and 13.10 per cent of the farmers respectively. Besides, a fraction (82.89%) of the chilli farmers exhibited moderate range of decision making ability and an insignificant number (7.14%) had high range of decision making ability. Further, majority (91.67%) of the growers showed medium extent of risk taking ability, while a minimal (8.33%) section had high range of risk taking ability. In case of leadership ability, medium level was reported for majority (89.29%) of the chilli farmers, following that a meager portion under low (5.95%) and high (4.76%) range. In addition, more than half (77.38%) displayed medium extent of management orientation followed by low (17.86%) and high (4.76%) level. It was also revealed that larger part (90.48%) of the growers had medium range of production orientation followed by high (7.14%) and low (2.38%) range respectively. Vast majority (92.86%) of the farmers displayed moderate range of marketing orientation, however only a small fraction (7.14%) showed high range of market orientation. While, majority (84.53%) of the farmers acheived medium extent of entrepreneurial competencies, only 9.52 per cent and 5.95 per cent delivered high and low range of entrepreneurial competencies respectively.

With regard to entrepreneurial attributes of Naga king chilli farmers of Peren district it was revealed that more than half (78.89%) of the farmers displayed medium range of economic motivation, while 16.67 per cent and 4.44

per cent showed high and low range respectively. Almost a quarter (72.22%) and over a quarter (27.78%) of chilli growers had medium and high range of innovativeness. In regard to achievement motivation, a fair portion (63.33%) were recorded for medium range accompanied by high (36.67%) level. Moreover, a major part (65.56%) and one-third (34.44%) of the growers exhibited moderate and high extent of decision making ability. Further, it was also revealed that the bulk (81.11%) and a small portion (18.89%) of the growers delivered moderate and high range of risk taking ability respectively. A larger part (85.56%) of the chilli growers had moderate range of leadership ability, however a scant percentage (14.44%) exhibited with high range of leadership ability. In the case of management orientation, medium range was obtained by a large section (73.33%) of the farmers, while a marginal section (14.45%) and (12.22%) reported for low and high range respectively. The study also disclosed that a greater part (82.22%) of the growers had medium production orientation, while an insignificant portion (13.33%) and (4.45%) had high and low range respectively. While, over seven tenth (72.22%) of the growers had moderate range of marketing orientation, and thereafter one-fourth (27.78%) belonged to high range. Lastly, more than half (67.78%) of the growers exhibited medium extent of entrepreneurial competencies, and thereafter high (27.78%) and low (4.44%) level of entrepreneurial competencies.

Table 4.4.2: Distribution of overall Naga king chilli farmers based on entrepreneurial attributes

N=250

Sl. No.	Entrepreneurial attributes	Frequency	Percentage (%)	Mean Score	Rank
A	**Entrepreneurial Competencies**				
1.	Low ((<20.00)	15	6.00		
2.	Medium (20.00-25.00)	186	**74.40**	22.99	I
3.	High (>25.00)	49	19.60		
	Total	250	100.00		
B	**Marketing orientation**				
1.	Low ((<21.00)	00	00.00		
2.	Medium (21.00-23.00)	200	**80.00**	22.50	II
3.	High (>23.00)	50	20.00		

	Total	250	100.00		
C	**Management orientation**			19.63	III
1.	Low ((<18.00)	30	12.00		
2.	Medium (18.00-21.00)	190	**76.00**		
3.	High (>21.00)	30	12.00		
	Total	250	100.00		
D	**Production orientation**			17.69	IV
1.	Low ((<16.00)	21	8.40		
2.	Medium (16.00-20.00)	201	**80.40**		
3.	High (>20.00)	28	11.20		
	Total	250	100.00		
E	**Risk taking ability**			13.28	V
1.	Low ((<11.00)	00	00.00		
2.	Medium (11.00-15.00)	219	**87.60**		
3.	High (>15.00)	31	12.40		
	Total	250	100.00		
F	**Economic Motivation**			12.60	VI
1.	Low (<11.00)	9	3.60		
2.	Medium (11.00-14.00)	212	**84.80**		
3.	High (>14.00)	29	11.60		
	Total	250	100.00		
G	**Achievement motivation**			11.48	VII
1.	Low ((<8.00)	00	00.00		
2.	Medium (8.00-13.00)	194	**77.60**		
3.	High (>13.00)	56	22.40		
	Total	250	100.00		
H	**Innovativeness**			7.81	VIII
1.	Low ((<5.00)	00	00.00		
2.	Medium (5.00-10.00)	213	**85.20**		
3.	High (>10.00)	37	14.80		
	Total	250	100.00		
I	**Decision making ability**			7.42	IX
1.	Low ((<5.00)	00	00.00		
2.	Medium (5.00-9.00)	200	**80.00**		
3.	High (>9.00)	50	20.00		
	Total	250	100.00		
J	**Leadership ability**			6.48	X
1.	Low ((<5.00)	10	4.00		
2.	Medium (5.00-8.00)	218	**87.20**		
3.	High (>8.00)	22	8.80		
	Total	250	100.00		

Table 4.4.2 and Fig 4.4.2 represented the distribution of overall Naga king chilli farmers based on entrepreneurial attributes. It was unveiled that almost

three quarters (74.40%) of the farmers had moderate extent of entrepreneurial competencies, following that nearly one-fifth (19.60%) had high range and a negligible portion (6.00%) under low range of entrepreneurial competencies. In the case of marketing orientation, it was revealed that medium level was recorded for a fairly large segment (80.00%) of the respondents and one-fifth (20.00%) for high level. The findings are in accordance with that of Khose *et al.* (2022). Furthermore, over three quarters (76.00%) of the growers were reported for moderate extent of management orientation, and thereafter low (12.00%) and high (12.00%) level. Sundresha *et al*. (2020) and Khawale *et al.* (2021) delivered similar results. It was found that, majority (80.40%) of the growers had medium extent of production orientation, however only 11.20 per cent and 8.40 per cent were reported for high and low range of production orientation. The findings are in relevance to that of Jha (2023). Risk taking ability of the respondents showed that majority (87.60%) had medium level followed by a small fraction (12.40%) with high extent of risk taking ability. It was exposed that a sizeable part (84.80%) of the growers had moderate range of economic motivation, and thereafter minimal percentage was reported for high and low range of economic motivation. Bushetti, *et al.* (2022) presented identical observations from their study. In case of achievement motivation, it was unveiled that medium level was secured by a great number (77.60%) of the respondents while 22.40 per cent had high range of achievement motivation. These outcomes are conforming to that of Sundresha *et al*. (2020) and Khose *et al.* (2022). The data also explains that a larger number (85.20%) of the chilli growers expressed moderate range of innovativeness, however only 14.80 per cent reported for high range of innovativeness. The findings are in supportive to that of Yewatkar *et al.* (2019) and Jha (2023). In case of decision making ability, moderate level was obtained by a stunning number (80.00%), and therafter one-fifth (20.00%) of the respondents for high level. The findings are corresponding to that of Bushetti and Krishnamurthy (2022). Leadership ability of the farmers revealed that substantial number (87.20%) had moderate level, following that a minimal nunber (8.80%) and (4.00%) had high and low range respectively. The findings are conforming to that of Khawale *et al.* (2021) and Khose *et al.* (2022). In compliance to the mean score status of entrepreneurial attributes of Naga king chilli growers, it was also observed that entrepreneurial competencies top the ranking followed by marketing orientation, management orientation, production orientation, risk taking ability, economic motivation, achievement motivation, innovativeness, decision making ability and leadership ability.

Table 4.4.3: Distribution of respondents based on their overall entrepreneurial behaviour

N=250

Sl. No.	Name of the Districts	Mon	Dimapur	Peren	Total
	Level	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
1.	Low (<127.58)	11(14.47)	12(14.29)	8(8.89)	31(12.40)
2.	Medium (127.58-156.28)	**59(77.63)**	**66(78.57)**	**61(67.78)**	**155(62.00)**
3.	High (>156.28)	6(7.90)	6(7.14)	21(23.33)	64(25.60)
4.	Total	76(100.00)	84(100.00)	90(100.00)	250(100.00)
5.	Mean	141.47	137.35	146.58	141.93
6.	SD	13.35	11.27	16.29	14.35
7.	Entrepreneurial Behavioural Index	73.30	71.17	75.95	73.53

Table 4.4.3 and Fig: 4.4.3 exhibited the classification of chilli growers based on their overall entrepreneurial behaviour and the data explained that majority (78.57%) of the farmers of Dimapur district were under medium category, following that a marginal segment (14.29%) and (7.14%) belonged to low and high category respectively. In the case of Mon district 77.63 per cent

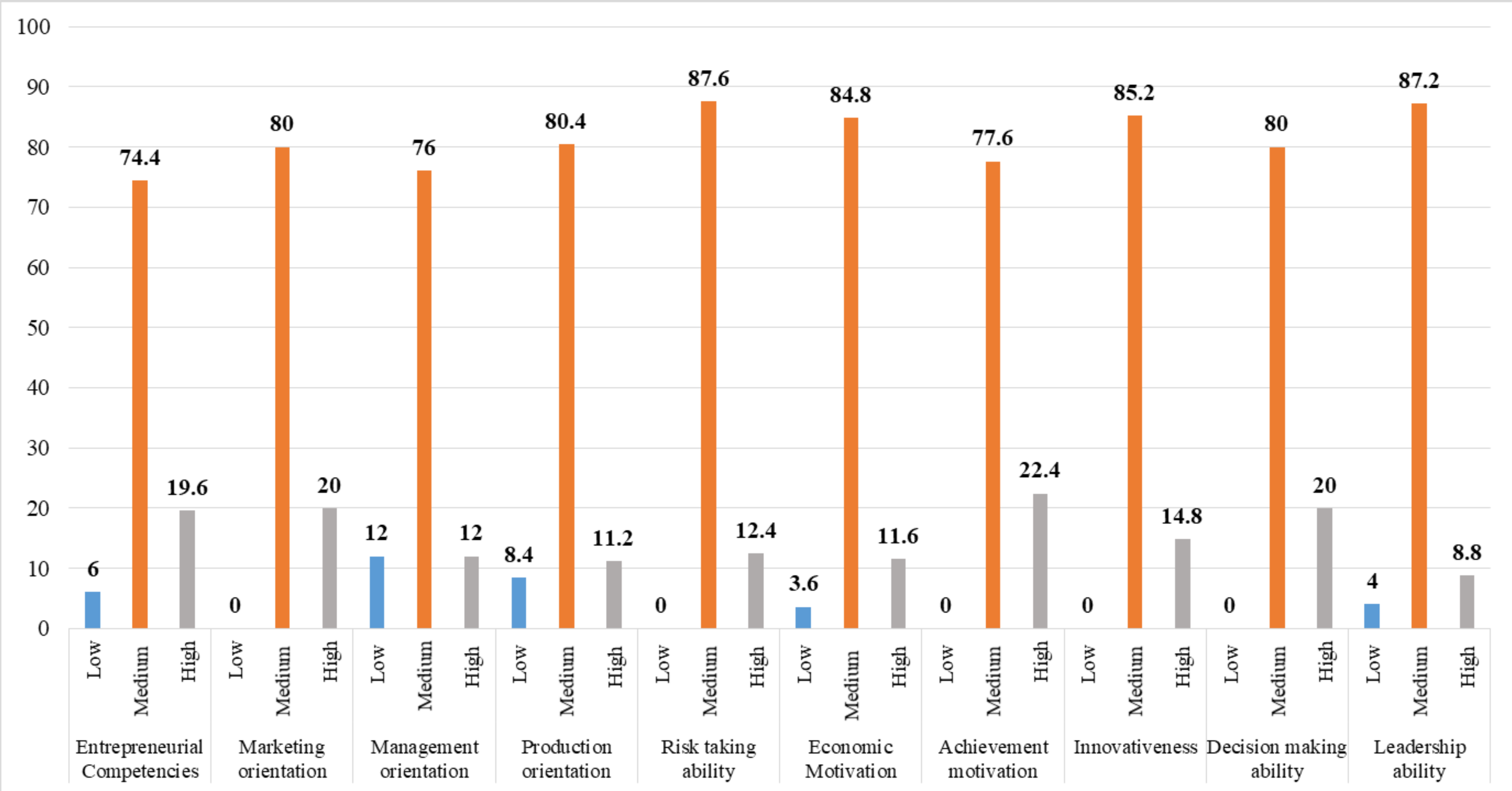

Fig 4.4.2: Distribution of overall Naga king chilli farmers based on entrepreneurial attributes

displayed for medium category of entrepreneurial behaviour, while a marginal portion (14.47%) and (7.90%) were under low and high category. Meanwhile, it was disclosed that a major segment (67.78%) of the chilli growers of Peren district belonged to moderate category, while below one-fourth (23.33%) were under high category and a modest number (8.89%) of the farmers belonged to low category of entrepreneurial behaviour. This could be because the villages covered for the study were in close proximity with the commercial hub of Nagaland, Dimapur and this encourages entrepreneurial exposure among Naga king chilli farmers of the region. Finally, the overall distribution of respondents exhibited that larger part (62.00%) of the chilli growers were included under medium category of entrepreneurial behaviour, while a quarter (25.60%) and a negligible part (12.40%) of the farmers were under high and low category of entrepreneurial behaviour. These findings are in relevance with that of Khawale*et al.* (2021) and Bushetti and Krishnamurthy (2022).

Table 4.4.4: Comparative account of entrepreneurial behaviour of the respondents

Sl. No.	Name of the District	Mean entrepreneurial behaviour (μ)	z value	Prob.
1.	Mon	141.47	2.74**	<0.01
	Dimapur	137.35		
2.	Mon	141.47	3.66**	<0.01
	Peren	146.58		
3.	Dimapur	137.35	6.40**	<0.01
	Peren	146.58		

** significant at 1% level of probability

From Table 4.4.4, it is revealed that entrepreneurial behaviour of the respondents of Mon vs. Dimapur district, Mon vs. Peren district and Dimapur vs. Peren district were significantly different.

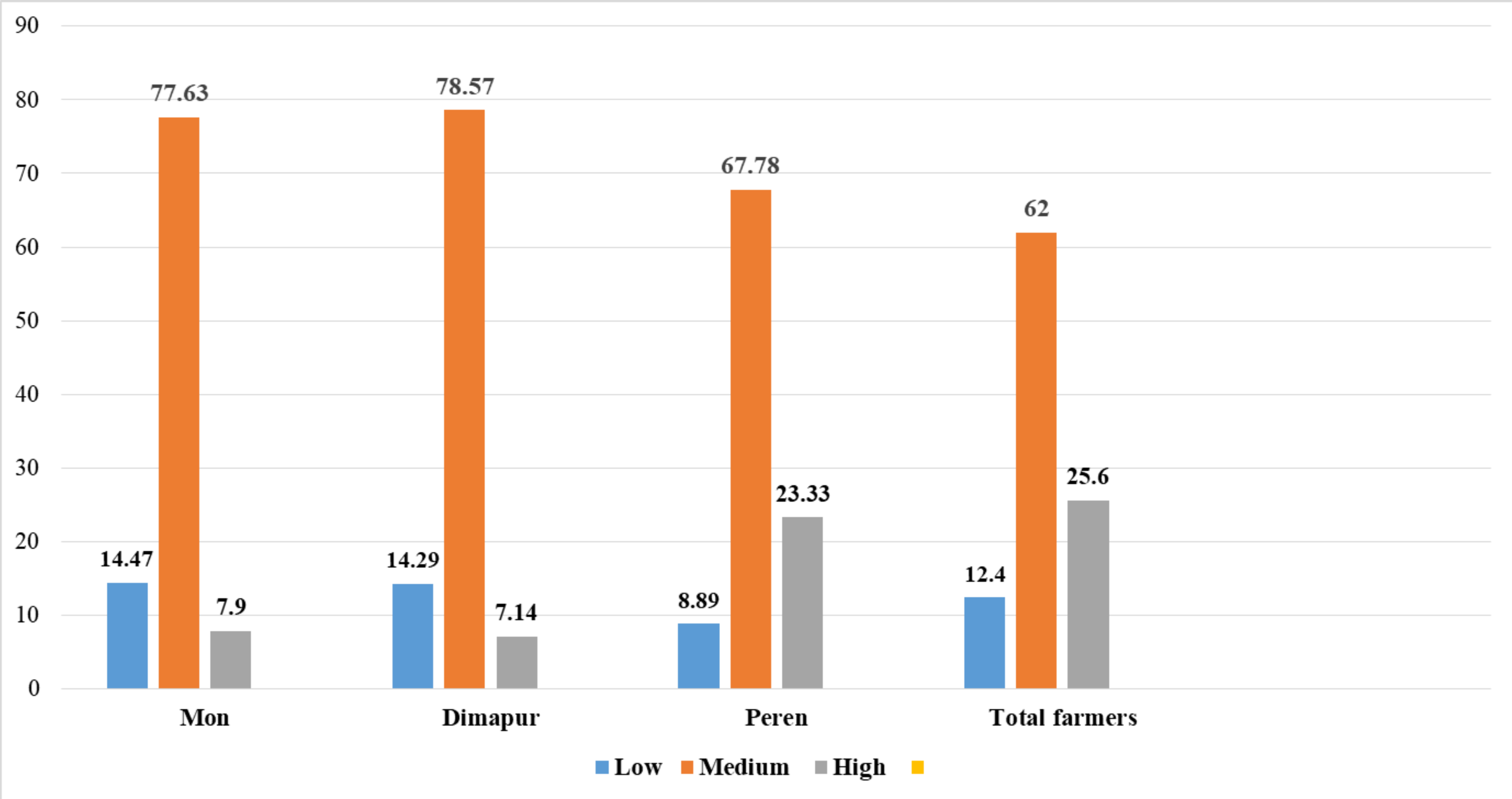

Fig: 4.4.3 Distribution of respondents based on their overall entrepreneurial behaviour

4.5 Status of sustainable performance of Naga king chilli cultivation practiced by the farmers of Nagaland

Table 4.5.1: Distribution of respondents based on dimensions of sustainable cultivation

N=250

Sl. No.	Dimensions of sustainability	Mon	Dimapur	Peren
		Frequency (%)	Frequency (%)	Frequency (%)
1.	**Economic sustainability**			
	Low (<14)	16(21.05)	10(11.90)	10(11.11)
	Medium (14-16)	46(60.53)	56(66.67)	59(65.56)
	High (>16)	14(18.42)	18(21.43)	21(23.33)
	Total	76(100.00)	84(100.00)	90(100.00)
2.	**Social sustainability**			
	Low ((<56)	7(9.21)	9(10.71)	13(14.44)
	Medium (56-76)	62(81.58)	66(78.57)	63(70.00)
	High (>76)	7(9.21)	9(10.71)	14(15.56)
	Total	76(100.00)	84(100.00)	90(100.00)
3.	**Environmental sustainability**			
	Low ((<23)	10(13.15)	00(00.00)	27(30.00)
	Medium (23-25)	51(67.11)	56(66.67)	48(53.33)
	High (>25)	15(19.74)	28(33.33)	15(16.67)
	Total	76(100.00)	84(100.00)	90(100.00)
4.	**Institutional sustainability**			
	Low ((<3)	24(31.58)	7(8.33)	16(17.78)
	Medium (3-6)	34(44.74)	64(76.19)	65(72.22)
	High (>6)	18(23.68)	13(15.48)	9(10.00)
	Total	76(100.00)	84(100.00)	90(100.00)

Table 4.5.1 and Fig 4.5.1 represents the distribution of respondents based on dimensions of sustainable Naga king chilli cultivation. Four dimensions of sustainability *viz.* economic sustainability, social sustainability, environmental sustainability and institutional sustainability were considered for analyzing the sustainability of Naga king cultivation among Naga king chilli growers of the region.

It was reported that a larger part (60.53%) of the respondents of Mon district showed medium range of economic sustainability, while over one-fifth (21.05%) and below one-fifth (18.42%) displayed low and high range. In the case of social sustainability, medium level was secured by a greated section (81.58%) of the growers, and thereafter low (9.21%) and high (9.21%) level. In addition, it was uncovered that a fair number (67.11%) of the growers expressed medium range of environmental sustainability, while a marginal of (19.74%) and (13.15%) displayed high and low range respectively. Institutional sustainability of the farmers revealed that below half (44.74%) of the farmers expressed medium level, while over one-third (31.58%) of the farmers were included under low level of institutional sustainability and lower than one-fourth (23.68%) of displayed high level of institutional sustainability.

Furthermore, major part (66.67%) of the chilli growers of Dimapur district exhibited medium range of economic sustainability, while more than one-fifth (21.43%) and a marginal section (11.90%) reported for high and low range respectively. A larger number (78.57%) of the respondents showed medium range of social sustainability. However, negligible (10.71%) number displayed low and high range of social sustainability. It was also revealed that a little over half (66.67%) of the farmers were recorded for medium extent of environmental sustainability, while over one-third (33.33%) possessed high range of environmental sustainability. In case of institutional sustainability, medium level was reported for majority (76.19%) of the respondents followed by high (15.48%) and low (8.33%) level.

Peren district also reported a medium level (65.56%) of economic sustainability among the Naga king chilli growers, and thereafter lower than a quarter (23.33%) for high category and scant number (11.11%) for low category. Meanwhile, close to three quarter of the respondents (70.00%) displayed medium range of social sustainability, however a marginal of (15.56%) and (14.44%) expressed high and low range of social sustainability. The data revealed that just about half (53.33%) of the farmers showed medium range of environmental sustainability along with one-third (30.00%) and a modest number (16.67%) with low and high level of environmental sustainability respectively. In addition it was unfolded that a major part (72.22%) of the chilli growers had medium range of institutional sustainability following that with a low (17.78) and high (10.00) level of institutional sustainability.

Table 4.5.2: Distribution of Naga king chilli farmers based on overall dimensions of sustainable cultivation

N=250

Sl. No.	Dimensions of sustainability	Frequency	Percentage (%)	Mean Score	Rank
1.	**Social sustainability**			65.88	I
	Low (<56)	38	15.20		
	Medium (56-76)	179	**71.60**		
	High (>76)	33	13.20		
	Total	250	100.00		
2.	**Environmental sustainability**			24.40	II
	Low (<23)	0	0		
	Medium (23-25)	192	**76.80**		
	High (>25)	58	23.20		
	Total	250	100.00		
3.	**Economic sustainability**			15.48	III
	Low (<14)	13	5.20		
	Medium (14-17)	237	**94.80**		
	High (>17)	0	0.00		
	Total	250	100.00		
4.	**Institutional sustainability**			4.13	IV
	Low (<3)	47	18.80		
	Medium (3-6)	179	**71.60**		
	High (>6)	24	9.60		
	Total	250	100.00		

Table 4.5.2 and Fig 4.5.2 depicts the distribution of Naga king chilli farmers based on overall dimensions of sustainable cultivation. It was observed that a good number (71.60%) of the growers had medium range of social sustainability, while a marginal of 15.20 per cent and 13.20 per cent delivered

for low and high range of social sustainability. In case of environmental sustainability, it was revealed that, medium level was possessed by over three-quarters (76.80%) of the respondents, while close to a quarter (23.20%) had high level of environmental sustainability. A vast majority (94.80%) of the respondents displayed medium level of economic sustainability, however only 5.20 per cent represented high level of economic sustainability. Finally, it was revealed that 71.60 per cent of the growers had medium range of institutional sustainability, while a small portion of (18.80%) and (9.60%) were reported for low and high range of institutional sustainability. In addition, according to the mean score of the dimensions of sustainability it was reported that, social sustainability top the ranking followed by environmental sustainability, economic sustainability and institutional sustainability.

Table 4.5.3: Sustainability Index of different dimensions of sustainable Naga king chilli farming

Sl. No.	Dimensions of sustainability	Sustainability Index
1.	Social sustainability	78.43
2.	Environmental sustainability	70.38
3.	Economic sustainability	48.80
4.	Institutional sustainability	29.51

Table 4.5.3 and Fig 4.5.3 depicts the Sustainability Index of Naga king chilli farming in the region. It was observed that social sustainability contributed the highest in the sustainable performance of Naga king chilli farming among the respondents with Sustainability Index of 78.43. Environmental sustainability obtained the second highest position with Sustainability Index of 70.38 followed by economic sustainability (48.80) and institutional sustainability (29.51). It may be explained that the sustainable Naga king chilli cultivation practices had

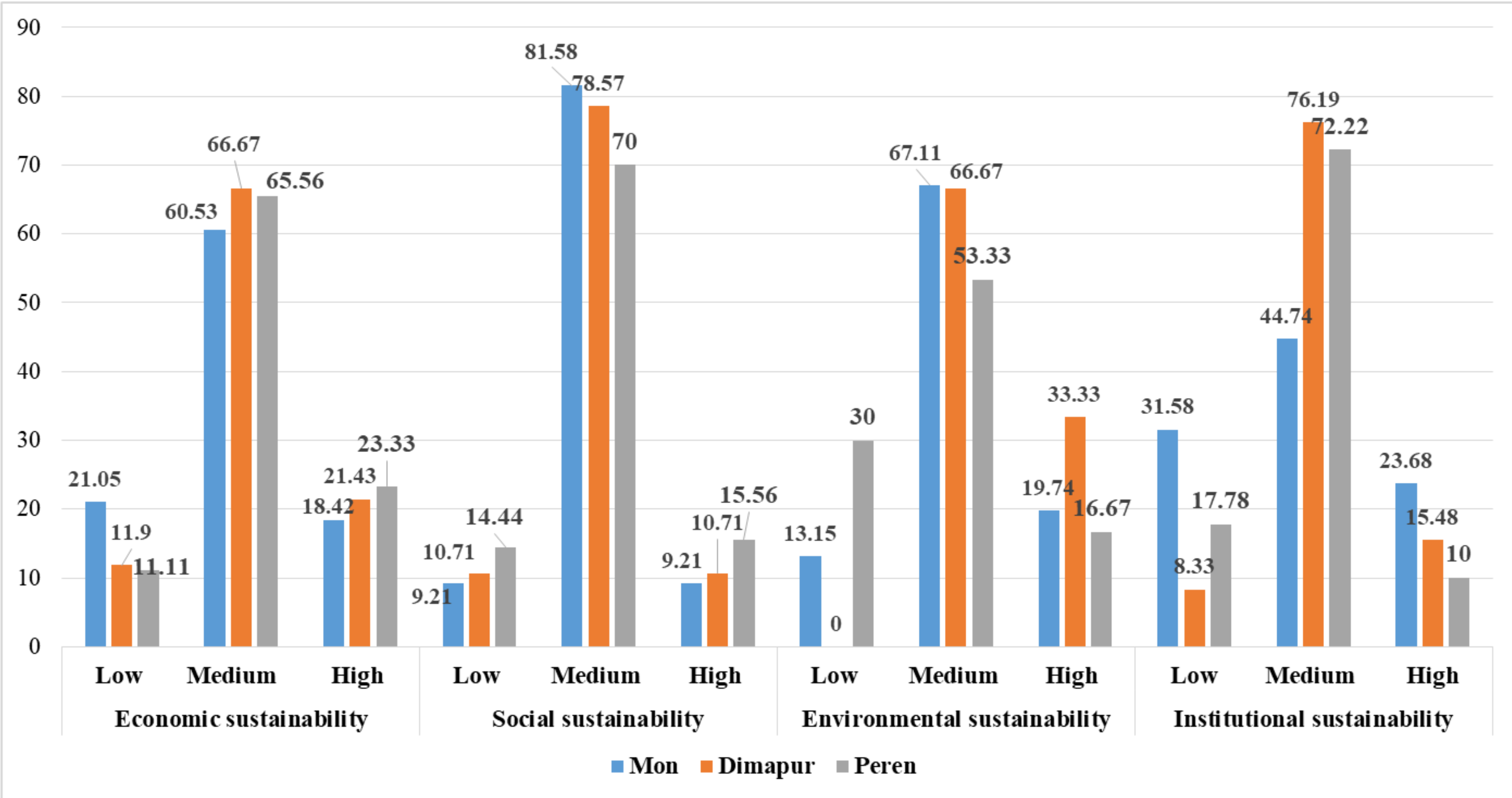

Fig 4.5.1: Distribution of respondents based on dimensions of sustainable cultivation

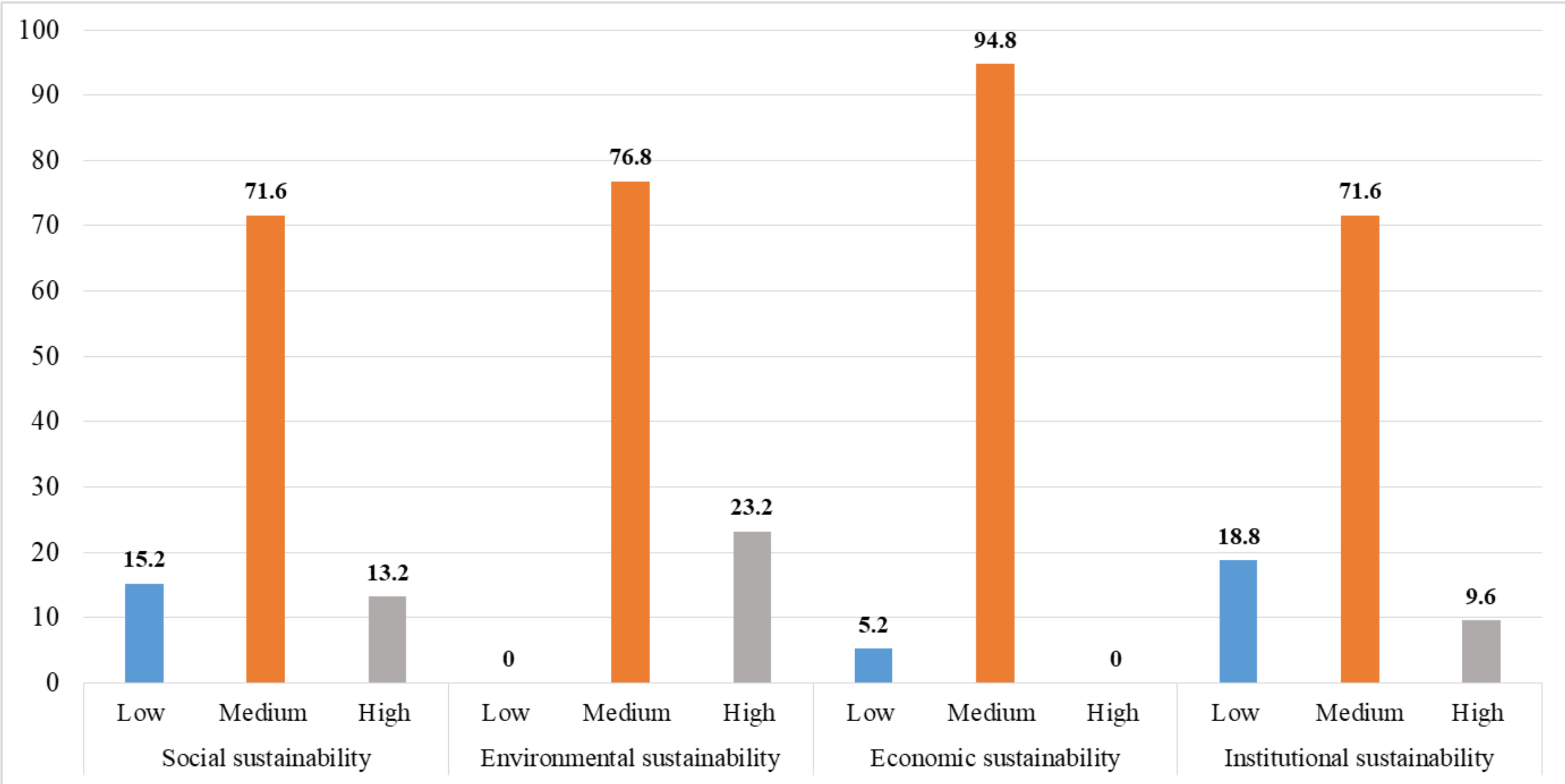

Fig 4.5.2: Distribution of respondents based on overall dimensions of sustainable cultivation

significantly impacted on the quality of life of farmers, the whole communities and their social well-being. While, it may be inferred that the sustainable cultivation practices among Naga king chilli growers had established methods that are environment-friendly, preserve resources and integrate natural biological cycles reducing environmental degradation. Further, it may also be implied that an increased in the farmers' level of exposure towards improved Naga king chilli cultivation practices may significantly improve crop productivity, net farm income, per capita food grain production and the benefit-cost ratio of production to ensure business viability and efficiency of a farming system for a long-term investment and economic stability. Finally, a cohesive linkage between the village institutions and the concern department is vital for the Naga king growers to coordinate the information related to sustainable improved practices and facilitate farmers' decision making and sustainable production of Naga king chilli in the region. Similar findings were reported by Das (2021) and Miranda and Dries (2022).Table 4.5.4 and Fig 4.5.4 represents distribution of respondents based on overall sustainability status of Naga king chilli farming in the study areas. The data displayed that larger part (73.81%) of chilli growers of Dimapur district reported medium level sustainability, and thereafter high (19.05%) and low (7.14%) level of sustainability. In the case of Peren district it was perceived that nearly three-quarters (71.11%) of the growers had medium degree, following that high (15.56%) and low (13.33%) degree of sustainability. Similarly, Mon district also disclosed that a little over two-thirds (68.42%) of the growers had medium degree of sustainability, while a quarter (25.00%) and an insignificant number (6.58%) were reported to have low and high extent of sustainability. Overall, moderate range of sustainability was recorded for a considerable size of the respondents (71.20%) and subsequently low (14.80%) and high (14.00%) range of sustainability.

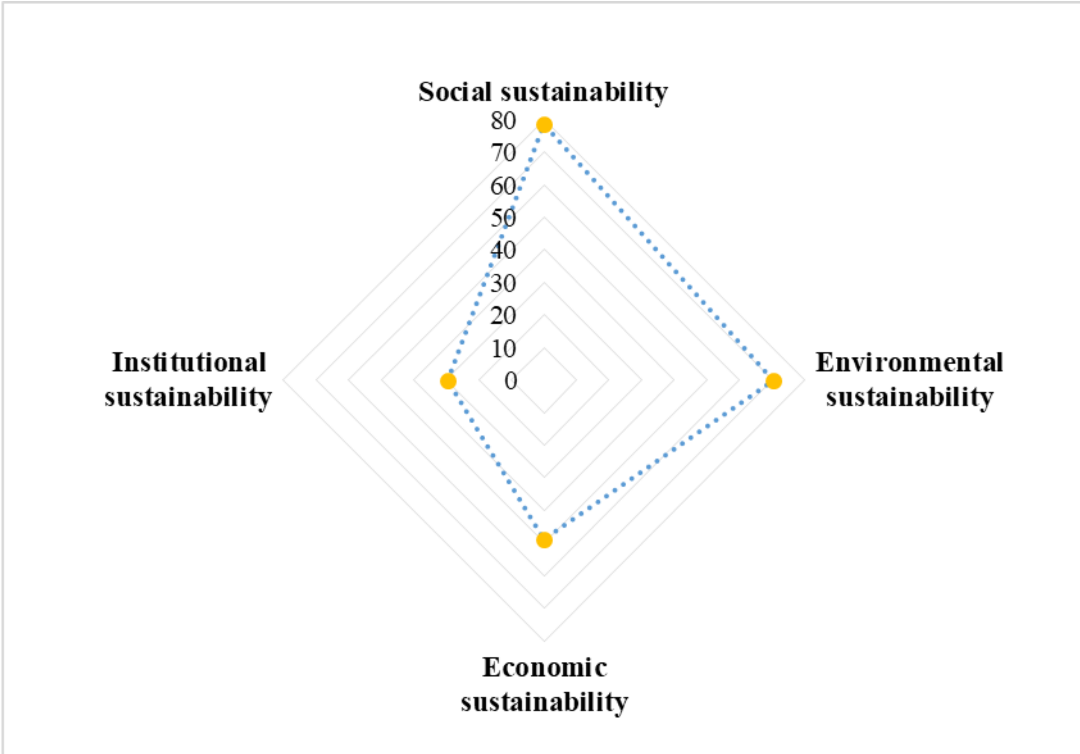

Fig 4.5.3 Contribution of different dimensions of sustainability towards sustainable Naga king chilli farming

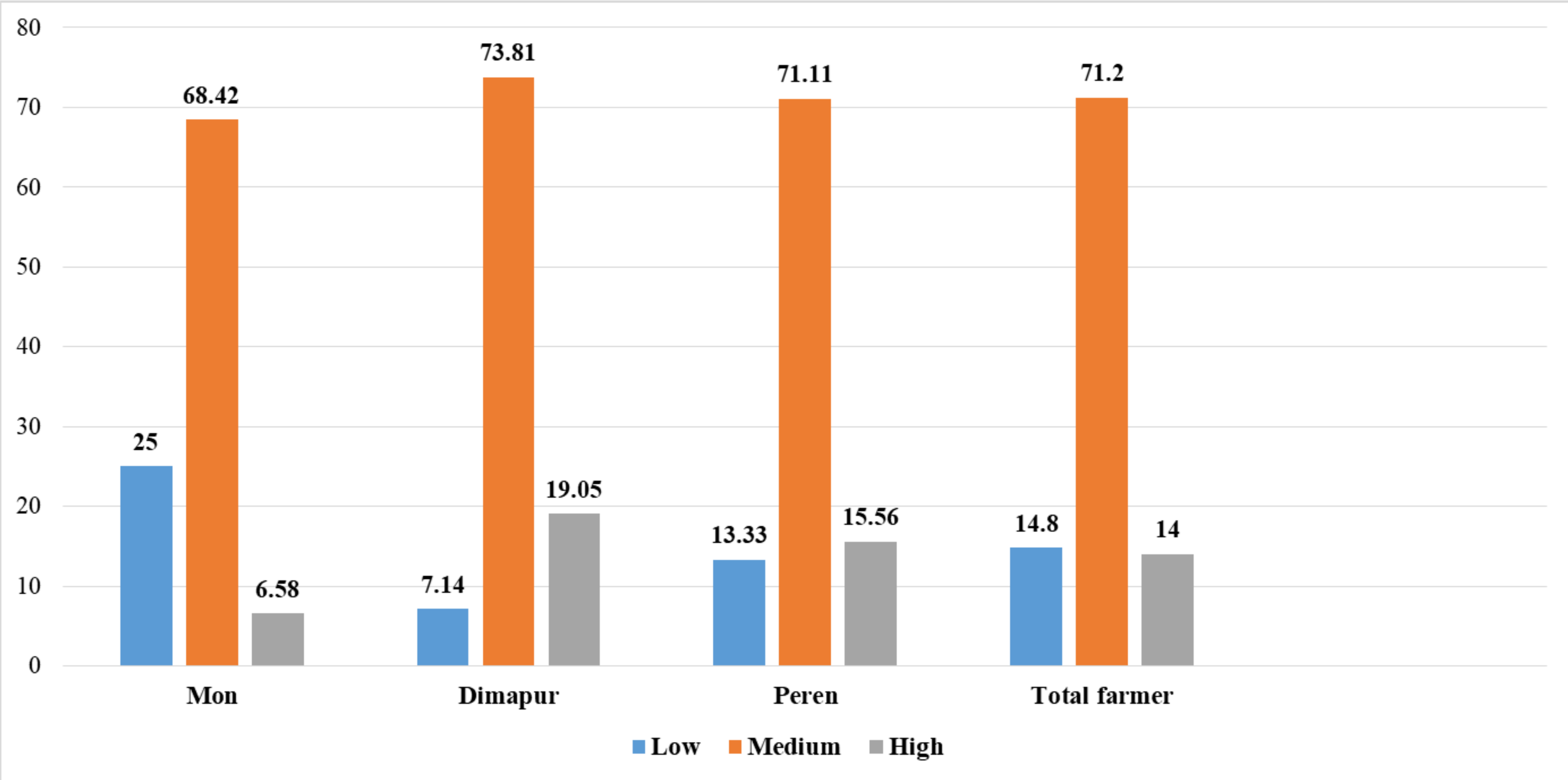

Fig 4.5.4: Distribution of respondents based on overall sustainability status of Naga king chilli farming

Table 4.5.4: Distribution of respondents based on overall sustainable performance of Naga king chilli farming

N=250

Sl. No.	Name of the Districts	Mon	Dimapur	Peren	Total
	Level	**Frequency (%)**	**Frequency (%)**	**Frequency (%)**	**Frequency (%)**
1.	Low (<99)	19(25.00)	6(7.14)	12(13.33)	37(14.80)
2.	Medium (99-120)	**52(68.42)**	**62(73.81)**	**64(71.11)**	**178(71.20)**
3.	High (>120)	5(6.58)	16(19.05)	14(15.56)	35(14.00)
4.	Total	76(100.00)	84(100.00)	90(100.00)	250(100.00)
5.	Mean	106.21	112.73	110.36	109.9
6.	SD	11.14	9.08	10.26	10.46

4.6 Correlation of personal, socio-economic and psychological characteristics of the respondents with knowledge and attitude

4.6.1 Correlation of personal, socio-economic and psychological characteristics of the respondents with knowledge

From Table 4.6.1.1 it was revealed that size of land under Naga king chilli cultivation and extent of adoption of sustainable cultivation practices of Naga king chilli had significant association with the dependent variable knowledge level at 1 per cent level of probability and family size, training exposure and information sources utilization had significant association with the dependent variable knowledge level at 5 per cent level of probability. Thus it may inferred that larger size of land under Naga king chilli cultivation, higher extent of adoption, larger family size, high training exposure and more information sources utilization may contribute positively towards increasing knowledge level on sustainable cultivation practices of Naga king chilli. These findings were similar to the findings of Lalhlimpuii and Bose (2023) and Walenpong and Mazhar (2023).

Based upon the findings, the null hypothesis ($H_0$1a) was rejected:

$H_0$1a: There is no association between the variables family size, size of land under Naga king chilli cultivation, training exposure, information sources utilization and extent of adoption of sustainable cultivation practices of Naga king chilli with the knowledge of Naga king chilli growers was rejected.

Nevertheless, it was found out that the variable age, education, size of total land holding, annual income, annual income from Naga king chilli cultivation, experience in Naga king chilli cultivation, marketing orientation, economic motivation, social participation, productivity of Naga king chilli and entrepreneurial behaviour of Naga king chilli growers had non-significant association with the dependent variable knowledge level on sustainable cultivation practices of Naga king chilli growers.

Therefore, the following null hypothesis ($H_0$1b) was accepted.

$H_0$1b: There is no association between the variables age, education, size of total land holding, annual income, annual income from Naga king chilli cultivation, experience in Naga king chilli cultivation, marketing orientation, economic motivation, social participation, productivity of Naga king chilli and entrepreneurial behaviour of Naga king chilli growers with the knowledge of Naga king chilli growers. These findings are in supportive to that of Ghosh *et al.* (2020), Walenpong and Mazhar (2023) and Lalhlimpuii and Bose (2023).

Table 4.6.1.1: Correlation of personal, socio-economic and psychological characteristics of the respondents with knowledge

Sl. No.	Independent variables	*Pearson's coefficient Correlation*	*p value*
1.	Age	-0.060	0.342
2.	Family size	0.146*	0.041
3.	Education	-0.011	0.864
4.	Size of total land holding	0.005	0.939
5.	Size of total land under Naga king chilli	0.167**	0.008
6.	Annual income	-0.086	0.177
7.	Annual income from Naga king chilli cultivation	0.070	0.271
8.	Training exposure	0.159*	0.032
9.	Experience in Naga king chilli cultivation	-0.055	0.390
10.	Information sources utilization	0.140*	0.046
11.	Marketing orientation	0.046	0.473
12.	Economic motivation	-0.115	0.170
13.	Social participation	0.086	0.177
14.	Productivity of Naga king chilli	0.019	0.758
15.	Entrepreneurial behaviour of Naga king chilli growers	0.034	0.596
16.	Extent of adoption of sustainable cultivation practices of Naga king chilli	0.382**	0.002

Note: df = (250-2) = 248 r0.05 = 0.124 r0.01 = 0.163
* = Significant at 5% α ** = Significant at 1% α

4.6.2 Correlation of personal, socio-economic and psychological characteristics of the respondents with their attitude towards sustainable Naga king chilli cultivation practices

Table 4.6.2.1 exhibited that annual income from Naga king chilli cultivation, economic motivation, productivity and entrepreneurial behaviour of Naga king chilli growers had significant association with the dependent variable attitude at 1 per cent level of probability and size of total land holding under Naga king chilli had significant association with the dependent variable attitude at 5 per cent level of probability. Thus, it may be explained that higher annual income from Naga king chilli cultivation, higher economic motivation, with increasing productivity and higher entrepreneurial behavior may contribute positively towards respondents' attitude on sustainable cultivation practices of Naga king chilli.

Based upon the findings, the null hypothesis ($H_0$2a) was rejected:

$H_0$2a: There is no association between the variables size of total land under Naga king chilli, annual income from Naga king chilli cultivation, economic motivation, productivity and entrepreneurial behaviour of Naga king chilli growers with the dependent variable attitude of Naga king chilli growers was rejected.

The independent variables age, family size, education, size of total land holding, annual income, training exposure, experience in Naga king chilli cultivation, information sources utilization, marketing orientation, social participation and extent of adoption were found non-significant.

Therefore, the following null hypothesis ($H_0$2b) was accepted.

$H_0$2b: There is no association between the variables age, family size, education, size of total land holding, annual income, training exposure, experience in Naga king chilli cultivation, information sources utilization, marketing orientation, social participation and extent of adoption with the dependent variable attitude of Naga king chilli growers. Similar findings were reported by Kiranmayi and Vijayabhinandana (2018), Raj and Thomas (2022), Patra *et al.* (2023) and Saha *et al*. (2023).

Table 4.6.2.1: Correlation of personal, socio-economic and psychological characteristics of the respondents with attitude towards sustainable cultivation practices of Naga king chilli

Sl. No.	Independent variables	Pearson's coefficient Correlation	P value
1.	Age	0.046	0.466
2.	Family size	-0.005	0.943
3.	Education	-0.013	0.835
4.	Size of total land holding	0.039	0.544
5.	Size of total land under Naga king chilli	0.141*	0.046
6.	Annual income	0.078	0.221
7.	Annual income from Naga king chilli cultivation	0.180**	0.004
8.	Training exposure	0.052	0.414
9.	Experience in Naga King chilli cultivation	0.045	0.483
10.	Information sources utilization	0.161	0.011
11.	Marketing orientation	-0.090	0.157
12.	Economic motivation	0.313**	0.002
13.	Social participation	-0.050	0.433
14.	Productivity of Naga king chilli	0.211**	0.002
15.	Entrepreneurial behaviour of Naga king chilli growers	0.608**	0.0001
16.	Extent of adoption of sustainable cultivation practices of Naga king chilli	0.053	0.401

Note: df = (250-2) = 248   r0.05 = 0.124   r0.01 = 0.163
* = Significant at 5% α ** = Significant at 1% α

4.6.3 Regression analysis of personal, socio-economic and psychological characteristics of the respondents with attitude towards sustainable cultivation practices among Naga king chilli growers

Regression analysis was applied to quantify the combined effect of independent variables on the dependent variable. Table 4.2.2.4 revealed that economic motivation and entrepreneurial behaviour of Naga king chilli growers showed significant association with the attitude of the respondents at 1 per cent level of probability. Thus, the findings indicated that independent variables economic motivation and entrepreneurial behaviour of Naga king chilli growers had significant contribution in respondents' attitude towards sustainable cultivation practices of Naga king chilli. The variables explained 64.60 per cent of variance embedded with the dependent variable attitude. It may be inferred that respondents economic motivation and their entrepreneurial behaviour had significant impact on the attitude of the farmers towards sustainable Naga king chilli cultivation practices.

Table 4.6.3.1: Multiple linear regression of predictor variables with the respondents' attitude towards sustainable cultivation practices of Naga king chilli

Sl. No.	Variables	b	SE(b)	t value	Pr > |t
1.	Intercept	19.426	4.476	4.340	0.000
2.	Size of total land under Naga king chilli	-1.034	1.236	-0.837	0.404
3.	Annual income from Naga king chilli cultivation	0.000	0.000	0.541	0.589
4.	Productivity of Naga king chilli	1.924	2.178	0.883	0.378
5.	Economic motivation	2.598	0.434	5.987**	0.000
6.	Entrepreneurial behaviour of Naga king chilli growers	0.570	0.047	12.186**	0.000

Note: R2 = 0.657, Adjusted R^2 = 0.646, F value= 3.80
**= significant level at 1% α

4.6.4 Path analysis

4.6.4.1 Direct and indirect effect of independent variables on knowledge of respondents towards sustainable cultivation practices of Naga king chilli

Data presented in Table 4.6.4.1indicated that the highest positive direct influence on the knowledge of sustainable cultivation practices of Naga king chilli among Naga king chilli growers of the region was exerted by the size of

Table 4.6.4.1: Direct and indirect effect of independent variables on knowledge of respondents towards sustainable cultivation practices of Naga king chilli

Variable no.	Independent variables	Effect over knowledge				
		Direct	Rank	Total Indirect	Rank	Largest indirect through single variable
X_1	Age	-0.021	VIII	0.039	III	0.974(X_9)
X_2	Family size	- 0.147	XIV	-0.001	VII	0.785(X_1)
X_3	Education	-0.049	X	-0.038	X	0.236(X_1)
X_4	Size of total land holding under agriculture	-0.114	XIII	-0.119	XIII	0.732(X_5)
X_5	Size of total land under Naga king chilli	0.402	I	0.235	I	0.739(X_7)
X_6	Annual income	-0.051	XI	0.035	IV	0.447(X_1)
X_7	Annual income from Naga king chilli cultivation	-0.207	XV	-0.277	XV	0.627(X_5)
X_8	Training exposure	0.012	VII	-0.147	XIV	0.547(X_1)
X_9	Experience in Naga king chilli cultivation	-0.041	IX	0.014	V	0.965(X_1)
X_{10}	Information source utilization	0.148	IV	0.008	VI	0.206(X_7)
X_{11}	Market orientation	0.013	VI	-0.033	IX	0.360(X_1)
X_{12}	Economic motivation	-0.262	XVI	-0.147	XIV	0.806(X_7)
X_{13}	Social participation	0.041	V	-0.045	XI	0.215(X8)
X_{14}	Productivity	-0.079	XII	-0.098	XII	0.902(X_7)
X_{15}	Extent of adoption	0.360	II	- 0.022	VIII	0.282(X_{14})
X_{16}	Entrepreneurial behaviour	0.227	III	0.193	II	0.790 (X_{14})

total land under Naga king chilli (0.402), followed by extent of adoption (0.360), entrepreneurial behaviour (0.227) and information source utilization (0.148). While, remaining variables have relatively lower direct effects (less that 0.1).

In respect to the total indirect effect, the highest positive indirect effect was mostly channelled through size of total land under Naga king chilli (0.235) and entrepreneurial behaviour (0.193).While, remaining variables have relatively lower indirect effects (less that 0.1).

Further, the findings also revealed that the largest indirect effect through single variable was channelled through age(X_1) for six variable followed by annual income from Naga king chilli (X_7) for four variables, size of total land under Naga king chilli (X_5) for two variables, training exposure (X_8), experience in Naga king chilli cultivation (X_9) and productivity (X_{14}) for two variable each. These findings are in line with that of Khode *et al*. (2021).

4.6.4.2 Direct and indirect effect of independent variables on attitude of respondents towards sustainable cultivation practices of Naga king chilli

Data furnished in Table 4.6.4.2 revealed that the variable entrepreneurial behaviour (0.968) showed the highest positive direct influence on the attitude of Naga king chilli growers towards sustainable Naga king chilli cultivation followed by age (0.330).While, remaining variables have relatively lower direct effects (less that 0.1).

With regards to the total indirect effect, the highest positive indirect effect was mostly channelled through entrepreneurial behaviour (0.360) and age (0.284). While, remaining variables have relatively lower indirect effects (less that 0.1).

Further, the findings also revealed that the largest indirect effect through single variable was channelled through age(X1) for eight variable followed by size of total land under Naga king chilli (X5) and annual income from Naga king chilli cultivation (X7) for two variables each, training exposure (X8), experience in Naga king chilli cultivation (X9) and productivity (X14) for two variable each. The results are in agreement with that of Reddy *et al.* (2021) and Vihari *et al.* (2022).

Table 4.6.4.2: Direct and indirect effect of independent variables on attitude of respondents towards sustainable cultivation practices of Naga king chilli

Variable no.	Independent variables	Effect over attitude				
		Direct	Rank	Total Indirect	Rank	Largest indirect through single variable
X_1	Age	0.330	II	0.284	II	0.974(X_9)
X_2	Family size	-0.022	X	-0.017	V	0.811(X_1)
X_3	Education	-0.032	XII	-0.019	VI	0.237(X_1)
X_4	Size of total land holding	-0.030	XI	-0.069	X	0.708(X_5)
X_5	Size of total land under Naga king chilli	-0.051	XIII	-0.192	XIII	0.751(X_7)
X_6	Total annual income	0.012	VIII	-0.066	IX	0.449(X_1)
X_7	Annual income from Naga king chilli cultivation	0.042	V	-0.138	XII	0.612(X_5)
X_8	Training exposure	0.016	VI	-0.036	VII	0.547(X_1)
X_9	Experience in Naga king chilli cultivation	-0.316	XIV	-0.361	XIV	0.965(X_1)
X_{10}	Information source utilization	0.043	IV	-0.118	XI	0.208(X_1)
X_{11}	Market orientation	-0.051	XIII	0.039	IV	0.360(X_1)
X_{12}	Economic motivation	-0.475	XV	-0.788	XV	0.804(X_1)
X_{13}	Social participation	0.015	VII	0.065	III	0.216(X_8)
X_{14}	Productivity	0.073	III	-0.138	XII	0.914(X_7)
X_{15}	Extent of adoption	-0.003	IX	-0.056	VIII	0.291(X_{14})
X_{16}	Entrepreneurial behaviour	0.968	I	0.360	I	0.968(X_{14})

4.6.5 Factors influencing the sustainable performance of Naga king chilli farming

Table 4.6.5.1 represents the factors that influenced the sustainable performance of Naga king chilli cultivation among Naga king chilli growers of the region. 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 0.613. A total of 18 independent variables were assorted and these, eight factors were obtained and renamed. The six factors accounted for 65.32 per cent variation in the study.

Factor-I accounted for 19.53 per cent of total variation embedded with the sustainable performance of Naga king chilli cultivation among the respondents. This factor was an aggregation of variables namely, size of total land under Naga king chilli (X_5), annual income from Naga king chilli cultivation (X_7), productivity of Naga king chilli (X_{14}), size of total landholding (X_4), annual income (X_6) and experience in Naga king chilli cultivation (X_9). This factor was renamed as 'land use and income'. These findings inferred that the sustainable performance of Naga king chilli cultivation among Naga king chilli growers were found influenced by a combination of land holding size, economic component and their years of experience.

Factor-II was an aggregation of variables namely, education (X_3), entrepreneurial behaviour (X_{17}), economic motivation (X_{12}) and attitude (X_{15}) which contributed 13.31 per cent of the total variance. This factor was renamed as 'Entrepreneurial attributes'. This factor inspire in shaping an entrepreneurial mindset among Naga king chilli farmers of the region and which eventually lead towards sustainable performance of Naga king chilli cultivation.

Factor-III was renamed as 'Resource management' which exhibited 11.01 per cent of total variation. The variables included are size of total land under Naga king chilli (X_5), annual income from Naga king chilli cultivation (X_7), knowledge (X_{16}) and extent of adoption of sustainable cultivation practices (X_{18}). These findings illustrates that efficient management of available resources like knowledge, cultivable land and economic generation from Naga king chilli influences the sustainable performance of Naga king chilli farming among the farmers of the region.

Factor-IV accounted for 9.50 per cent of total variation and was renamed as ‘Extension accesses’. This factor was a combination of variables namely, extent of adoption of sustainable cultivation practices (X_{18}), training exposure (X_8) and social participation (X_{13}). The findings revealed that Naga king chilli farmers with access to extension services have more affinity towards the sustainable agricultural practices and thus contributes towards sustainable performance of Naga king chilli farming.

Factor-V was an assortment of variables namely, information sources utilization (X_{10}), social participation (X_{13}) and marketing orientation (X_{11}) which was renamed as ‘Marketing strategy’. This factor contributed a total variation of 6.11 per cent. These findings inferred that Naga king chilli farmers with active participation in different groups and organizations guide towards an arrays of sources of information on market orientation and thus, encourages towards sustainable performance of Naga king chilli in the region.

Factor-VI exhibited 5.8 per cent of total variance and was renamed as ‘Socio economic’ factor. The variables included are age (X_1) and family size (X_2). With age and family size comes the wide range of knowledge and skills accumulated from each individual members of the family which drives informed decision making and influences sustainable performance of Naga king chilli cultivation among Naga king chilli growers of the region.

Table 4.6.5.1: Factors influencing sustainable performance of Naga king chilli farming

Factors	Variables	Factor loading	% of variance explained	Cumulative % explained	Factors renamed
Factor-1	Size of total land under Naga king chilli (X_5)	0.781	19.535	19.535	Land use and income
	Annual income from Naga king chilli cultivation (X_7)	0.778			
	Productivity of Naga king chilli (X_{14})	0.662			
	Size of total landholding (X_4)	0.651			
	Annual income (X_6)	0.561			
	Experience in Naga king chilli cultivation (X_9)	0.418			
Factor-2	Education (X_3)	0.648	13.318	32.852	Entrepreneur-ial attributes
	Economic motivation (X_{12})	0.346			
	Entrepreneurial behaviour (X_{17})	0.425			
	Attitude (X_{15})	0.314			
Factor-3	Size of total land under Naga king chilli (X_5)	0.359	11.014	43.866	Resource management
	Annual income from Naga king chilli cultivation (X_7)	0.365			
	Knowledge (X_{16})	0.333			
	Extent of adoption of sustainable cultivation practices (X_{18})	0.373			
Factor-4	Knowledge (X_{16})	0.599	9.509	53.375	Extension accesses
	Extent of adoption of sustainable cultivation practices(X_{18})	0.590			
	Training exposure (X_8)	0.516			
	Social participation (X_{13})	0.339			
Factor-5	Information sources utilization (X_{10})	0.489	6.113	59.488	Marketing strategy
	Social participation (X_{13})	0.464			
	Marketing orientation (X_{11})	0.473			
Factor-6	Age (X_1)	0.416	5.84	65.327	Socio-economic
	Family size (X_2)	0.537			

4.7 Constraints perceived by Naga king chilli growers in adopting sustainable Naga king chilli cultivation practices

Table 4.7.1 Overall ranking of different aspects of constraints

N=250

Sl. No.	Constraints	Mean score	Rank
1.	Biotic and abiotic constraints	63.54	I
2.	Technical constraints	60.32	II
3.	Extension constraints	59.83	III
4.	Post-harvest constraints	58.80	IV
5.	Input supply constraints	57.15	V
6.	Marketing constraints	56.58	VI
7.	Land/soil related constraints	55.61	VII
8.	Economic constraints	54.86	VIII
9.	Social constraints	54.23	IX
10.	Labor constraints	53.87	X

Constraints perceived by the Naga king chilli farmers were grouped under nine components, such as biotic & abiotic constraints, technical constraints, extension constraints, post-harvest constraints, input supply constraints, marketing constraints, land/soil related constraints, economic constraints, social constraints and labor constraints. Garrett ranking technique was used to analyze the constraints faced by Naga king chilli growers in adopting sustainable Naga king chilli cultivation practices in the region. Table 4.7.1 and Fig 4.7.1 exhibited the overall ranking of different aspects of constraints based on overall mean score. It was learned that biotic and abiotic constraints top the ranking with a mean score of 63.54 followed by technical constraints (60.32), extension constraints (59.83), post-harvest constraints (58.80), input supply constraints (57.15), marketing constraints (56.58), land/soil related constraints (55.61), economic constraints (54.86), social constraints (54.23) and labor constraints

(53.87).The findings are in accordance with that of Begna (2020) and Ali *et al*. (2023).

Table 4.7.2 Biotic and abiotic constraints in adoption of sustainable cultivation practices of Naga king chilli

N=250

Sl. No.	Constraints	Mean score	Rank
1.	Epidemics of pests and diseases	70.34	I
2.	Fluctuation of temperature	65.20	II
3.	Drought during crop period	60.76	III
4.	Occurrence of showers during harvest	60.76	III
5.	Weed infestations	60.64	IV

Table 4.7.2 revealed the biotic and abiotic constraints perceived by the respondents in adoption of sustainable cultivation practices of Naga king chilli in the region. The highest constraint was epidemics of pests and diseases (70.34%) followed by fluctuation of temperature (65.20). While, the third constrain was drought during crop period (60.76) and occurrence of showers during harvest (60.76). Finally, the fourth constraint faced by Naga king chilli growers was weed infestations (60.64%).The ramifications of climate change on insect pest biology and ecology are profound and has pose a significant threat to the traditional cultivation practices of Naga king chilli in Nagaland. Moreover, the rural areas are more exposed to climate change as the people are fully dependent on natural resources for livelihood. Integrated pest and diseases management strategies, combining cultural, biological, and chemical methods, may be employed to minimize the risk of crop damage, improve food security and livelihood of the farmers. Shaker *et al*. (2019), Noopur *et al.* (2022) and Sahoo *et al.* (2023) reported similar findings.

Table 4.7.3 Technical constraints in adoption of sustainable cultivation practices of Naga king chilli

N=250

Sl. No.	Constraints	Mean score	Rank
1.	Lack of knowledge about insect-pest and diseases management	66.85	I
2.	Lack of mechanization of farm	60.91	II
3.	Lack of knowledge about seeds/seedling treatment	57.28	III
4.	Lack of knowledge about value addition of Naga king chilli	56.24	IV

Table 4.7.3 explained the technical constraints discerned by the respondents in adoption of sustainable cultivation practices of Naga king chilli. It was found that lack of knowledge about insect-pest and diseases management (66.85%) was the most severe constraint. While, the second constraint was lack of mechanization of farm (60.91) followed by lack of knowledge about seeds/seedling treatment (57.28) and value addition of Naga king chilli (56.24). Naga king chilli is generally cultivated in *jhum* hills under rain-fed condition using traditional cultivation practices. These traditional practices become inefficient during high incidence of insect pest and diseases. Therefore, technical assistance in core areas of Naga king chilli cultivation, location specific production and management strategies might be effective in reducing the constraints perceived by the farmers in regard to technical knowledge. The results were in supportive to that of *Naik et al.* (2019), Rais *et al.* (2021) and Logesh *et al.* (2023).

Table 4.7.4 showed the extension constraints perceived by the respondents in adoption of sustainable cultivation practices of Naga king chilli in the region. The highest constraint recorded was the lack of technical guidance from extension staffs with a mean score of 63.30 followed by extension agents not available for consultation (63.26), untimely visit of extension agents (58.87) and insufficient extension activities like training, demonstrations, kisan mela etc. by extension agencies (53.91).These constraints may be intervened by maintaining face-to-face relationship between the farmers and extension agents for rapport building through timely and regular meetings, field visits and capacity building programmes. Encouraging farmers to avail the benefits of online networks for an efficient exchange of farm information and research knowledge between the farmers and the extension agents, while keeping farmers abreast with cutting-edge methods of sustainable farming. The results obtained were in compliance with that Sharma *et al.* (2015) and Sahoo *et al.* (2023).

Table 4.7.4 Extension constraints in adoption of sustainable cultivation practices of Naga king chilli

N=250

Sl. No.	**Constraints**	**Mean score**	**Rank**
1.	Lack of technical guidance from extension staffs	63.30	I
2.	Extension agents not available for consultation	63.26	II
3.	Untimely visit of extension agents	58.87	III
4.	Insufficient extension activities like training, demonstrations, kisan mela etc. by extension agencies	53.91	IV

Table 4.7.5 classified the post-harvest constraints among the respondents in adoption of sustainable cultivation practices of Naga king chilli. It revealed that the top constraints was lack of proper storage facilities with a mean score of 61.46. While, the second constraint was lack of processing facilities at local level (60.89) followed by increasing processing cost (59.08) and lack of knowledge about storage pests and diseases (53.78). Naga king chilli have intrinsic value and holds a distinct place in global trade due to its unique characteristics of high pungency, flavour and bio active components. There is a vast scope for value addition of Naga king chilli. But unfortunately irrespective of much biological and commercial strength of the crop, the post-harvest handling and processing

is still at infancy stage (NEDFi, 2021). Therefore, training on post-harvest management activities like grading, processing, packaging and storage of Naga king chilli is essential. This will protect the farmers from postharvest losses and ultimately add value to their produce and improve economic stability among the farmers. Similar constraints were also identified by Kumar *et al*. (2019), Sahoo *et al*. (2023) Shivaji and Madhuprasad (2023).

Table 4.7.5 Post-Harvest constraints in adoption of sustainable cultivation practices of Naga king chilli

N=250

Sl. No.	Constraints	Mean score	Rank
1.	Lack of proper storage facilities	61.46	I
2.	Lack of processing facilities at local level	60.89	II
3.	Increasing processing cost	59.08	III
4.	Lack of knowledge about storage pests and diseases	53.78	IV

Table 4.7.6 represented the input supply constraints in adoption of sustainable cultivation practices of Naga king chilli among the respondents. It was classified that high requirement of manure and fertilizer for recommended varieties was the most severe constraint with a mean score of 62.26 followed by non-availability of fertilizers and bio-pesticides in time (60.61), lack of irrigation facilities (53.10) and non-availability of seeds and planting materials in time (52.64). These constraints may be surmounted by introducing the farmers on the use and production of organic manures like Farm Yard Manure (FYM), compost prepared from crop residues and kitchen wastes, vermicompost, oil cakes and slaughter house refuse. While, the farmers may also be encouraged on incorporating the use of cover crops and trap crops in the jhum fields and use of neem extracts and canola oil which act as an insect irritant. In addition farmers need to be encouraged on constructing water harvesting structures in the jhum

Table 4.7.6 Input supply constraints in adoption of sustainable cultivation practices of Naga king chilli

N=250

Sl. No.	**Constraints**	**Mean score**	**Rank**
1.	High requirement of manure and fertilizer for sustainable cultivation	62.26	I
2.	Non-availability of fertilizers and bio-pesticides in time	60.61	II
3.	Lack of irrigation facilities	53.10	III
4.	Non-availability of seeds and planting materials in time	52.64	IV

fields. Rais *et al.* (2021), Ali *et al.* (2023) and Logesh *et al.* (2023) delivered similar results from their study.

Table 4.7.7 exhibited the marketing constraints recognized by the respondents in adoption of sustainable cultivation practices of Naga king chilli in the region. The top constraint was poor access of market information with a mean score of 66.15 followed by lack of proper market (64.73), distressed sale (59.62), high charges on transporting (52.40), exploitation by middle men (48.94) and fluctuation in market price (47.61).Modern technology up skilling on managing online platforms may be incorporated for accessing market information and stay connected with the buyers around the world. The farmers may also be encouraged on forming Farmer Producer Organizations (FPOs) among Naga king chilli growers within the village and among the neighbouring villages to enhance economic strength and marketing linkages while eliminating exploitation by middlemen and acquiring better price realization for their produces. The above findings were in line with that of Shaker *et al.* (2019), Noopur *et al*. (2023) and Ali *et al.* (2023).

Table 4.7.7 Marketing constraints in adoption of sustainable cultivation practices of Naga king chilli

N=250

Sl. No.	Constraints	Mean score	Rank
1.	Poor access of market information	66.15	I
2.	Lack of proper market	64.73	II
3.	Distressed sale	59.62	III
4.	High charges on transporting	52.40	IV
5.	Exploitation by middle men	48.94	V
6.	Fluctuation in market price	47.61	VI

Table 4.7.8 Land/soil related constraints in adoption of sustainable cultivation practices of Naga king chilli

N=250

Sl. No.	Constraints	Mean score	Rank
1.	Steep and undulated land	62.18	I
2.	Soil erosion	61.39	II
3.	Poor land preparation	52.45	III
4.	Soil fertility	46.43	IV

Table 4.7.8 represented land/soil related constraints in adoption of sustainable cultivation practices of Naga king chilli. It was uncovered that steep and undulated land was the most critical constraint among Naga king chilli farmers of the region with a mean score of 62.18. While, the second highest constraint was soil erosion (61.39) followed by poor land preparation (52.45) and soil fertility (46.43).Introduction of soil conservation oriented farming system like, Sloping Agricultural Land Technology (SALT) and Soil and Water Conservation (SWC) approaches among Naga king chilli farmers may defer the

problems in regard to land/soil related constraints . Furthermore, longer follow period (up to 15 years) to naturally build-up soil fertility and integrated farming system with fast growing and nitrogen fixing trees and shrubs like *Alnus nepalensis, Leucaena leucocephala, Flemingia macrophyla, Cajanus cajan, Desmodium sp.,* etc. on contours boundaries and hill top may help in reducing soil erosion, enrich soil, provide fodder, fuel-wood and biomass (FAO, 2018). The outcome recorded were in conformity with the outcome of Rani *et al*. (2012) and Rais *et al.* (2021).

Table 4.7.9 Economic constraints in adoption of sustainable cultivation practices of Naga king chilli

N=250

Sl. No.	**Constraints**	**Mean score**	**Rank**
1.	High cost of inputs	60.56	I
2.	High cost of planting material	56.22	II
3.	Lack of credit facilities	52.00	III
4.	Labor intensive crop	50.66	IV

Table 4.7.9 displayed the economic constraints in adoption of sustainable cultivation practices of Naga king chilli among the respondents. It was reported that high cost of inputs top the ranking with a mean score of 60.56 followed by high cost of planting material (56.22), lack of credit facilities (52.00) and labour intensive crop (50.66). Poor financial position of the farmers contributed towards farmers' inability to avail the necessary tools, implements, planting materials and other farm inputs. These constraints may be mediated by providing financial assistance through government schemes and loans to economically weaker section of the community and enabling access of planting materials at subsidized rate for the farmers in the region. Further, quality inputs may be made available timely to the farmers at reasonable prices. These government initiatives may come as an essential tool in developing confidence

among the farmers to take up sustainable cultivation of Naga king chilli on commercial scale whilst increasing productivity and livelihood status of the farmers. Naik *et al.* (2019), Ali *et al.* (2023) and Kumar *et al.* (2023) also reported similar findings.

Table 4.7.10 Social constraints in adoption of sustainable cultivation practices of Naga king chilli

N=250

Sl. No.	Constraints	Mean score	Rank
1.	No institutional support for commercial Naga king chilli cultivation from the grass root organization	60.86	I
2.	Farmers has poor resource base	53.32	II
3.	Younger generation not interested in farming	52.96	III
4.	Poor educational status	52.36	IV
5.	Lack of motivation for Naga king chilli cultivation	51.68	V

Table 4.7.10 revealed the social constraints perceived by the respondents and it was found that, no institutional support for commercial Naga king chilli cultivation from the grass root organization was the highest constraint with a mean score of 60.86. While, farmers has poor resource base was the second highest constraint (53.32) followed by younger generation not interested in farming (52.96), poor educational status (52.36) and lack of motivation for Naga king chilli cultivation (51.68).With no insurance or security against financial losses during crop failures the farmers usually settle for sporadic intercrop of Naga king chilli with other summer crops in the jhum fields. These constraints may be averted through a comprehensive approach and community involvement by educating and engaging farmers, youths and village leaders on available institutional credit and crop insurance schemes to safeguard framers from financial losses occurring due to non-preventable natural risks and promoting

farming as a rewarding business among younger generations. Realization among the farmers on emerging agribusiness opportunities, such as microenterprises, value-addition, processing, packaging and the opportunities of e-marketing among the rural youths might perhaps benefit the farmers to take up sustainable Naga king chilli cultivation practices in the region. The findings are similar to that of Sahoo *et al.* (2023) and Kumar *et al.* (2023).

Table 4.7.11 Labor constraints in adoption of sustainable cultivation practices of Naga king chilli

N=250

Sl. No.	Constraints	Mean score	Rank
1.	High cost of labor	56.90	I
2.	Scarcity of labor	54.24	II
3.	unskilled labor	52.92	III
4.	Low labor productivity	51.42	IV

Table 4.7.11 revealed the labor constraints discerned by the respondents in adoption of sustainable cultivation practices of Naga king chilli in the region. It was reported that high cost of labor was one of the major constraint with a mean score of 56.90 followed by scarcity of labor (54.24), unskilled labor (52.92) and low labor productivity (51.42). Considering the economic condition of the rural population, it may be inferred that, the farmers often faced the problem of hiring labor for the cultivation of Naga king chilli. Moreover, the rural labors usually do not consider performing farm activities and go for work with high wages which leads to scarcity of labor forces during peak season. The findings are in support with that of Rais *et al.* (2021), Kumar and Avale (2022) and Kumar *et al.* (2023).

Sensitization of farmers on the importance of sustainable production and need based training on technical know-how of sustainable Naga king chilli cultivation practices should be imparted to the respondents along with assistance from the government to promote and upgrade Naga king chilli cultivation towards sustainability and entrepreneurship development for market led production. Farmers may also be motivated on production practices which are environment friendly, economically viable as well as socially acceptable so that productivity level is sustained with optimum utilization of inputs and resources without compromising the availability of products for future generation.

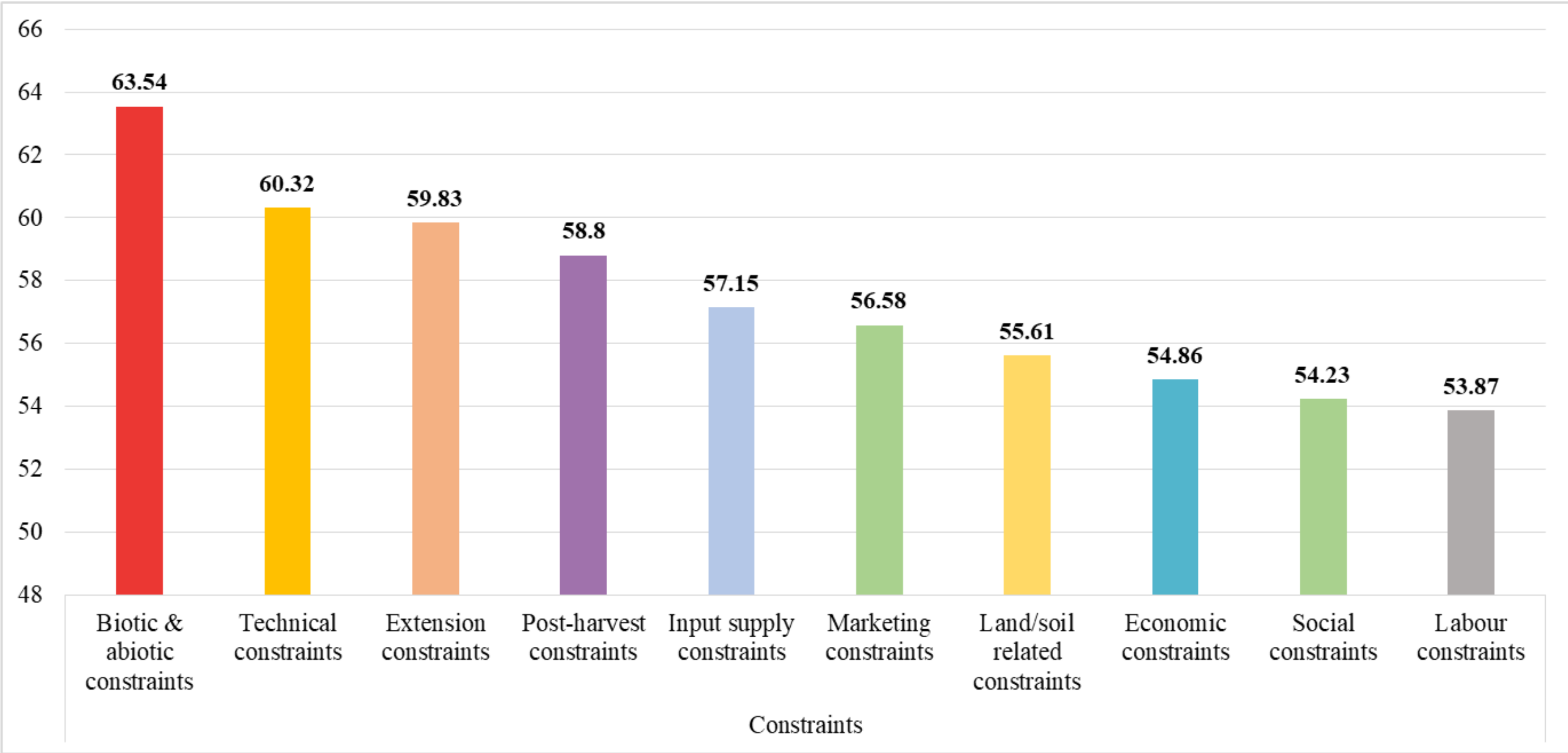

Fig 4.7.1 Constraints perceived by Naga king chilli growers in adopting sustainable Naga king chilli cultivation practices

CHAPTER-V

SUMMARY AND CONCLUSIONS

SUMMARY AND CONCLUSIONS

5.1 Introduction

India is popularly known as the “Spice Bowl of the World” and “The Land of Spices” since prehistoric times. During 2021-22, the single and the biggest spice export consignment from India was chilli. India produce about 109 varieties of spices registered by the International Organization for Standardization (ISO), India produces 75 varieties of spices and accounts for around half of the global trading in spices. Northeastern region produces more than 7 lakh tonnes of spices annually which accounts for 9 per cent of the total production of spices in the country. The area and production of spices in Nagaland during 2021-22 was 124378 ha and 593818 MT respectively (NEDFi, 2021). Naga king chilli with GI tag is one of the high value spice crop grown in almost all the district of the state covering an area of 1385 ha with a total production of 7739 MT (Statistical Handbook of Nagaland, 2017). Sustainable Naga king chilli farming has immense potential for economic grow and development of the farmers. Hence, taking into account the above conditions, the present study was undertaken with the following objectives:

5.2 Objectives

5.2.1 To study the socio-economic, personal and psychological characteristics of Naga king chilli growers,

5.2.2. To assess the knowledge and attitude of farmers towards sustainable cultivation practices of Naga king chilli,

5.2.3 To examine the extent of adoption of sustainable cultivation practices by Naga king chilli growers,

5.2.4 To analyze the entrepreneurial behavior of Naga king chilli growers

5.2.5 To know the constraints faced by Naga king chilli growers in following sustainable cultivation practices and suggest strategies to overcome them.

5.3 Research Methodology

The study was executed in Nagaland. Naga king chilli is cultivated practically in the whole of the districts of Nagaland. However, Peren district has a considerable area (230 ha) and production (1,564 MT) of Naga king chilli followed by Dimapur (200 ha, 1,010 MT) and Mon (150 ha, 930 MT) district (Statistical Handbook, 2017). Henceforth, the above districts were purposively chosen for the present study. Two Rural Development (RD) block from these districts viz., Tening block and Jalukie block from Peren district, Niuland block and Medziphema block from Dimapur district and Mon block and Wakching block from Mon district were picked randomly. Further, two villages from each RD blocks *viz.*, Old Tesen and Upper Sinjol from Tening block, Dungki and Lamhai villages from Jalukie block, S Hetoyi and Ghokuto villages from Niuland block, Pongkong and Wangla villages from Mon block, Wanching and Tanhai villages from Wakching block, Tsiepama and Tsiepama Model villages from Medziphem block were selected. The variables for study included age, family size, education, size of total land holding under agriculture, size of total land holding under Naga king chilli cultivation, total annual income, income from Naga king chilli cultivation, training exposure, experience in Naga king chilli cultivation, information sources utilization, marketing orientation, economic motivation, social participation, productivity, attitude, knowledge level of sustainable Naga king chilli cultivation practices, entrepreneurial behaviour of Naga king chilli growers and their extent of adoption of sustainable cultivation practices of Naga king chilli.

The primary data were obtained by conducting personal interview with the assistance of a pre-tested structured schedule. The secondary data were obtained from various publications, journals, magazines relevant text books, internet sources etc. the collected were scored, tabulated and analysed to calculate frequency, percentage, mean, standard deviation, correlation, multiple regression, Z test, path analysis and factor analysis were used to deduce relevant inferences.

5.4 Salient findings

5.4.1 Socio-economic, personal and psychological characteristics of the Naga king chilli growers

The study unveiled that greater number (69.20%) of the Naga king chilli growers were included under the age category of 35 to 55 years, and thereafter 19.20 per cent with age less than 35 years and 11.60 per cent with age more than 55 years. While, 66.40 per cent of the farmers had family size between 5 to 8 members, following that 28.80 per cent with less than 5 members and 4.80 per cent with more than 8 members. 44.40 per cent has education up to primary school level, and therafter middle school (25.20%), high school (14.40%), Pre-University Course (PUC) (8.00%) and graduate (2.40%). Literacy rate was high with just 5.60 per cent of the respondents with no formal education. The overall distribution of respondents based on total land holding under agriculture revealed that 69.20 per cent were found to be small farmers with total land holding of 2.50 to 5.0 acre followed by 30.80 per cent with marginal (<2.50 acres) land. The overall distribution of respondents based on the size of land holding under Naga king chilli showed that majority (82.00%) had 1 to 2 acres of land holding under Naga king chilli cultivation followed by 12.80 per cent with less than 1 acre and 5.20 per cent with more than 2 acres. The overall distribution of respondents based on annual income also revealed that 44.44 per cent had annual income between Rs.50, 000 to Rs.1, 00,000, following that 25.60 per cent with annual income less that Rs.50, 000. While, 18.00 per cent had annual income between Rs.1, 00,000 to Rs.1, 50,000 and 12.00 per cent with more than Rs.1, 50,000 per annum. While, majority (72.40%) had annual income between Rs.19, 294 to Rs.59, 145 from Naga king chilli followed by15.20 per cent and 12.40 per cent with more than Rs.59, 145 and less than Rs.19, 294 respectively.

The training exposure of the respondents revealed that 52.40 per cent had not received any training related to sustainable Naga king chilli cultivation, while 47.60 per cent had received training related to sustainable Naga king chilli cultivation. While, 66.80 per cent had medium level of training needs for sustainable Naga king chilli cultivation followed by high level of training needs (16.80%) and 16.40 per cent with low training needs. It was revealed that 49.60 per cent of the farmers had high experience in Naga king chilli cultivation with more than 19 years of experience followed by 43.20 per cent with 10-19 years of experience and 7.20 per cent with less than 10 years of experience in Naga king chilli cultivation. Majority (73.60%) of the growers were under medium scale of information source utilization, and thereafter high (17.60%) and low (8.80%) level of information source utilization, 46.00 per cent had medium range of marketing orientation, and thereafter low (28.00%) and high (26.00%). 58.80 per cent had medium level of economic motivation followed by high (29.60%) and low (11.60%), 63.20 per cent were under high scale of social participation, and thereafter low (20.00%) and medium (16.80%) scale of social participation.

The average productivity of Naga king chilli during 2018 to 2022 showed that, the highest (2.09 q/acre) average productivity was recorded during 2022 from farmers having more than 2 acres of land under Naga king chilli cultivation. Similarly, the highest average productivity of 1.94 q/acre and 1.78 q/acre was recorded for the year 2022 from farmer with 1 to 2 acres and less than 1 acre of land under Naga king chilli cultivation respectively. The findings also revealed that the per cent change of average area, average production and average productivity from 2018 to 2022 was at 13.00 per cent, 18.00 per cent and 7.00 per cent respectively.

5.4.1 Knowledge and attitude of Naga king chilli growers towards sustainable cultivation practices of Naga king chilli

100.00 per cent had very high knowledge of intercultural operations, harvesting and yield and grading followed by 88.80 per cent with very high knowledge on climate requirements for sustainable cultivation of Naga king chilli. While, 99.60 per cent were reported with high knowledge of soil requirement for Naga king chilli cultivation

followed by curing (73.60%) and transplanting (43.20). It was also exposed that 100.00 per cent of the farmers had medium level of knowledge of plant protection measures and storage of Naga king chilli followed by nursery management (42.80%) and curing (26.40%). It was noteworthy that none of the respondents had knowledge on main field preparation, manures and fertilizers followed by transplanting (56.80%) and nursery management (56.40%). Further majority (60.40 %) of the growers had medium range of knowledge, following that 35.20 per cent of them under high knowledge and 4.40 per cent under low knowledge range.

Size of land holding under Naga king chilli cultivation and extent of adoption of sustainable cultivation practices of Naga king chilli had significant association with the dependent variable knowledge level at 1per cent level of probability and family size, training exposure and information sources utilization had significant association with the dependent variable knowledge level at 5 per cent level of probability.

Majority (71.11%) of the respondents of Peren district had favourable attitude towards sustainable Naga king chilli cultivation practices followed by Mon district (68.43%) and Dimapur district (52.38%). The overall distribution of respondents revealed that majority (64.00%) had favourable attitude towards sustainable Naga king chilli cultivation practices followed by less favourable (22.80%) and highly favourable (13.20%) attitude.

It was also revealed that annual income from Naga king chilli, economic motivation, productivity and entrepreneurial behavior of Naga king chilli growers had significant association with the dependent variable attitude at 1 per cent level of probability and size of total land holding under Naga king chilli had significant association with the dependent variable attitude at 5 per cent level of probability.

Economic motivation and entrepreneurial behaviour of Naga king chilli growers showed significant association with the attitude of the respondents at 1 per cent level of probability. Thus, the findings indicated that independent variables economic motivation and entrepreneurial behaviour of Naga king chilli growers had significant contribution in respondents' attitude towards sustainable cultivation practices of Naga king chilli. The selected variables explained 64.60 per cent of variance embedded with the dependent variable attitude.

5.4.3 Extent of adoption of sustainable cultivation practices among Naga king chilli growers

It was revealed that the highest percentage (93.60 %) of adoption was recorded for the recommended practice of harvesting the fruit with the stalk intact under harvesting time, interval and stage followed by inter cultural operations (65.20%). 48.00 per cent had full adoption of the recommended practice of harvesting Naga king chilli at dark green fruit stage for long and distant market and red stage for nearby markets, drying and seed purpose. Highest (100.00%) partial adoption of the recommended practice was recorded for curing of Naga king chilli followed by harvesting time, interval and stage, While, 59.20 per cent had partial adoption of the recommended practice of insect pest management of hand picking and killing of insect pest in the field. None of the farmers adopted the recommended practices of seed treatment, main field preparation, soil mixture, irrigation in open field condition, spraying of neem oil, release of *T. Chilonis and* spray of *Trichoderma* for insect pest and disease

management, packaging, storage, maintaining moisture content of 10% and temperature of 22º-25º C to obtain uniform red colour for curing Naga king chilli fruits/pods. 93.60 per cent didn't adopt the recommended practice of grading the harvest according to size before sending it to market. 84.40 per cent had not adopted the recommended practice of mulching the seed bed with paddy straws and twigs followed by everyday watering of nursery bed (82.80%), raised seed bed (67.20 %) and transplanting (65.60%). Further, the overall distribution of respondents revealed that 66.40 per cent of the respondents had medium range of adoption, and thereafter low (16.80%) and high (16.80%) range of adoption of the recommended practices.

5.4.4 Entrepreneurial behaviour of Naga king chilli growers

Majority (74.40%) were under medium range of entrepreneurial competencies, and thereafter high (19.60%) and low (6.00%). Marketing orientation revealed that medium level was recorded for 80.00 per cent and 20.00 per cent for high level. While, 76.00 per cent were under medium scale of management orientation, following that low (12.00%) and high (12.00%) level. A larger part (80.40%) of the respondents were reported for medium scale of production orientation, and thereafter high (11.20%) and low (8.40%). Risk taking ability of the respondents showed that majority (87.60%) had medium range followed by high (12.40%) level. 84.80 per cent of the farmers had

medium range of economic motivation, following that (11.60%) and (3.60%) under high and low range of economic motivation. In case of achievement motivation, medium level was obtained by 77.60 per cent, while 22.40 per cent for high level of achievement motivation. Majority (85.20%) of the farmers had medium range of innovativeness, 14.80 per cent had high range of innovativeness. In case of decision making ability, medium level was obtained by 80.00 per cent and 20.00 per cent for high level. Leadership ability revealed that 87.20 per cent had medium level followed by high (8.80%) and low (4.00%). The overall distribution of entrepreneurial behaviour displayed that 62.00 per cent had medium range of entrepreneurial behaviour, while 25.60 per cent and 12.40 per cent had high and low range of entrepreneurial behaviour.

5.4.5 Status of sustainable performance of Naga king chilli cultivation practiced by the farmers of Nagaland

It was recorded that a major part (71.60%) of the farmers displayed medium range of social sustainability, and therafter low (15.20%) and high (13.20%) range of social sustainability. 76.80 per cent had medium level of environmental sustainability while 23.20 per cent were reported with high level of environmental sustainability. 94.80 per cent and 5.20 per cent of the growers had medium and high range of economic sustainabilityrespectively. Finally, it was revealed that 71.60 per cent had medium range of institutional sustainability followed by 18.80 per cent and 9.60 per cent with low and high range of institutional sustainability. Distribution of respondents based on overall sustainable performance of Naga king chilli farming revealed that medium level of sustainability was recorded for 71.20 per cent followed by 14.80 with low level and 14.00 per cent with high level of sustainability. Social sustainability contributed the highest in the sustainable performance of Naga king chilli farming among the respondents with Sustainability Index of 78.43 followed by environmental sustainability (70.38), economic sustainability (48.80) and institutional sustainability (29.51).

Factors influencing the sustainable performance of Naga king chilli cultivation

A total of 18 independent variables were assorted and six factors were obtained and renamed. Six factors accounted for 65.32 per cent variation in the study. Factor-I accounted for 19.53 per cent of total variation embedded with the sustainable performance of Naga king chilli cultivation among the respondents. This factor was an aggregation of variables namely, size of total land under Naga king chilli annual income from Naga king chilli~~,~~ productivity of Naga king chilli, size of total landholding, total annual income and experience in Naga king chilli cultivation. This factor was renamed as ‘land use and income’. Factor-II was a conglomeration of variables namely, education, entrepreneurial behaviour, economic motivation and attitude which contributed 13.31 per cent of the total variance. This factor was renamed as ‘Entrepreneurial attributes’. Factor-III was renamed as ‘Resource management’ which exhibited 11.01 per cent of total variation. The variables included are size of total land holding under Naga king chilli, annual income from Naga king chilli, knowledge and extent of adoption of sustainable cultivation practices. Factor-IV accounted for 9.50 per cent of total variation and was renamed as ‘Extension accesses’. This factor was a combination of variables namely, extent of adoption of sustainable cultivation practices, training exposure and social participation. Factor-V consisted of variables information sources utilization, social participation and marketing orientation which was renamed as ‘Marketing strategy’. This factor contributed a total variation of 6.11 per cent. Factor-VI exhibited 5.8 per cent of total variance and was renamed as ‘Socio economic’ factor. The variables included are age and family size.

5.4.6 Direct and indirect effect of independent variables on knowledge of respondents towards sustainable cultivation practices of Naga king chilli

The highest positive direct influence on the knowledge of sustainable cultivation practices of Naga king chilli among Naga king chilli growers of the region was exerted by the size of total land holding under Naga king chilli, followed by extent of adoption, entrepreneurial behavior and information source utilization. The highest positive indirect effect was mostly channeled through size of total land holding under Naga king chilli and entrepreneurial behaviour.

5.4.7 Direct and indirect effect of independent variables on attitude of respondents towards sustainable cultivation practices of Naga king chilli

The variable entrepreneurial behaviour and age showed the highest positive direct influence on the attitude of Naga king chilli growers towards sustainable Naga king chilli cultivation. While, remaining variables have relatively lower direct effects. While,

the highest positive indirect effect was also mostly channeled through entrepreneurial behaviour and age. While, remaining variables have relatively lower indirect effects.

5.4.8 Constraints perceived by Naga king chilli growers in adopting sustainable Naga king chilli cultivation practices

Respondents perceived the biotic & abiotic constraints as most severe followed by technical constraints, extension constraints, post-harvest constraints, input supply constraints, marketing constraints, land/soil related constraints, economic constraints, social constraints and labor constraints.

The biotic & abiotic constraints faced by the respondents in adoption of sustainable cultivation practices of Naga king chilli in the region revealed that the highest constraint was epidemics of pests and diseases followed by fluctuation of temperature. While, the third constraint was drought during crop period and occurrence of showers during harvest. Finally, the fourth constraint faced by Naga king chilli growers of the region was weed infestations.

The technical constraints of the respondents revealed that lack of knowledge about insect-pest and diseases management was a major constraint among the respondents followed by lack of mechanization of farm, lack of knowledge about seeds/seedling treatment and lack of knowledge about value addition of Naga king chilli.

The extension constraints faced by the respondents was expressed in terms of lack of technical guidance from extension staffs followed by non-availability of extension agents for consultation, untimely visit of extension agents and insufficient extension activities like training, demonstrations, kisan mela etc.

The post-harvest constraints included lack of proper storage facilities followed by lack of processing facilities at local level high processing cost and lack of knowledge on storage pests and diseases. The input supply constraints of the respondents revealed high requirement of manure and fertilizer for recommended varieties followed by non-availability of fertilizers and bio-pesticides in time, lack of irrigation facilities and non-availability of seeds and planting materials in time. The marketing constraints faced by the respondents included poor access of market information followed by lack of proper

market, distressed sale, high charges on transportation, exploitation by middle men) and fluctuation in market price.

Steep and undulated land posing difficulty in farming operations was perceived as the highest constraint related to and/soil among the Naga king chilli farmers followed by soil erosion, poor land preparation and soil fertility. The economic constraints included high cost of inputs followed by high cost of planting materials, lack of credit facilities.

The social constraints faced by the respondents included no institutional support for commercial Naga king chilli cultivation from the grass root organizations followed by poor resource base, non interest of younger generation in farming, poor educational status and lack of motivation. Finally, the labor constraints perceived by the respondents included high cost of labor as one of the major constraints followed by scarcity of labor, pre dominance of unskilled labor and low labor productivity.

5.5 Conclusions

1. Majority of the Naga king chilli growers were middle aged, had medium family size, had education from primary school till graduate level, had 2.50 to 5.0 acres of land under agriculture, had 1acre to 2 acres of land under Naga king chilli cultivation.

2. Majority had annual income between Rs.50, 000 to Rs.1, 00,000, had annual income from king chilli between Rs 19,294 to Rs 59,145, 47.60 per cent of the respondents had received training on sustainable Naga king chilli cultivation practices, had medium level of training need, had high experience in Naga king chilli cultivation, had medium level of information sources utilization**,** had medium level of marketing orientation and economic motivation. While majority of the respondents had high level of social participation.
3. The average productivity of Naga king chilli during 2018 to 2022 showed that, the highest (2.09 q/acre) average productivity was recorded for the year 2022 from farmers with more than 2 acres of landholding under Naga king chilli cultivation . Similarly, the highest average productivity of 1.94 q/acre and 1.78 q/acre was recorded for the year 2022 from farmer with 1 to 2 acres and less than 1 acre of land under Naga king chilli cultivation respectively. The findings also revealed that the percent change of average area, average production and average productivity
4. from 2018 to 2022 was at 13.00 per cent, 18.00 per cent and 7.00 per cent respectively.
5. Majority of the respondents had medium level of risk taking ability followed by leadership ability, innovativeness, economic motivation, production orientation, marketing orientation, decision making ability, achievement motivation, management orientation and entrepreneurial competencies.
6. Majority of the respondents had medium knowledge level towards sustainable Naga king chilli cultivation practices. Independent variables *viz.*, size of total land holding under Naga king chilli and extent of adoption of sustainable cultivation practices of Naga king chilli were positively significant at 1 per cent level with knowledge level of Naga king chilli growers. While family

size, training exposure and information sources utilization were positively significant at 5 per cent level of probability.

7. Majority of the respondents had medium level of attitude towards sustainable Naga king chili cultivation practices. Annual income from Naga king chilli, economic motivation, productivity of Naga king chilli and entrepreneurial behaviour of Naga king chilli growers showed positive significant association with attitude at 1 per cent level of probability. While, size of total land holding under Naga king chilli was positively significant at 5 per cent level of probability.
8. It was revealed that economic motivation and entrepreneurial behaviour of Naga king chilli growers showed significant association with the attitude of the respondents at 1 per cent level of probability. The variables explained 64.60 per cent of variance embedded with the consequent variable with the dependent variable attitude.
9. Majority of the respondents had medium level of economic sustainability followed by environment sustainability, social sustainability and institutional sustainability. Factor analysis revealed that 'Land used and income' accounted for 19.53 per cent of total variation with the sustainability of Naga king chilli cultivation practiced by the farmers followed by 'Entrepreneurial attributes' (13.31%), 'Resource management' (11.01%), 'Extension accesses' (9.50%), 'Marketing strategy' (6.11%) and 'Socio economic' (5.8%). The six factors accounted for 65.32 per cent variation in the study.

10. Major constraints faced by the respondents included biotic & abiotic constraints with mean score of 63.54. Followed by technical constraints (60.32), extension constraints (59.83), post-harvest constraints (58.80), input supply constraints (57.15), marketing constraints (56.58), land/soil related constraints (55.61), economic constraints (54.86), social constraints (54.23) and labour constraints (53.87).

5.6 Policy implications and recommendations

1. Majority of the respondents were educated and middle aged between 35 to 55 years. It is recommended to provide timely and need based training to this age group of people for stepping up the productivity of Naga king chilli by adopting sustainable innovative farming practices.
2. Majority of the farmers' possessed small (1 to 2 acres) land under Naga king chilli cultivation; therefore, farmers should be encouraged to go for aggregation of products and form cooperative farming. Naga king chilli based Farmer Producer Organizations (FPOs) may also be encouraged for social and economic sustainability.
3. Majority of the respondents had medium level of information sources utilization. Therefore it is necessary to educate the farmers on the importance of keeping contact with the extension functionaries so as to assist them on various problems. They should be also trained and motivated to use ICT for receiving the updated technological information.
4. Majority of the respondents lacked trainings related to sustainable Naga king chilli cultivation practices. Therefore, need based training, field visit and demonstrations should be organized seasonally.
5. The farmers were found successful in production of large quantities of Naga king chilli without the use of additional manures and fertilizers and they possess substantial entrepreneurial potentials. Therefore, it is recommended that the farmers should be motivated, encouraged and trained to develop Naga king chilli based enterprises for maximising income and profitability.
6. Most of the farmers often faced difficulty in selling their produce during peak season due to poor road connectivity, which leads to post harvest loss and distressed sale

   among the farmers. Therefore, it is necessary to empower the farmers on sustainable post-harvest handling by providing training on value addition, facilitate storage facilities and marketing linkages for availing the best price for their produce in the market.

7. Economic and institutional sustainability contribution in achieving overall sustainability of Naga king chilli cultivation was lower compared to social and environmental sustainability. Therefore, more emphasis should be laid upon improving the production and productivity of Naga king chilli by involving village council, church body, women groups and youth clubs in educating and promoting the necessity for sustainable innovative cultivation practices.
8. Majority of the Naga king chilli farmers' prioritized biotic and abiotic constraints, technical constraints, extension constraints, post-harvest constraints and marketing constraints in adoption of sustainable cultivation practices. Therefore, location specific production and management strategies with regards to plant protection measures and integrated nutrient management while maintaining an efficient research-extension farmer linkages along with provision of storage facilities and introduction of e- marketing platforms might be helpful to overcome the constraints faced by the farmers in adopting sustainable Naga king chilli cultivation practices.

5.7 Suggestions for further studies

1. The present study was conducted within the prominent districts in the state of Nagaland. Similar studies may be conducted in the entire North eastern states to analyze the feasibility for adoption of sustainable Naga king chilli farming in the entire region.
2. A separate study on Naga king chilli based entrepreneurial ventures may be undertaken for promoting the avenues of agripreneurship among Naga king chilli growers.
3. Participatory research on developing location specific sustainable Naga king chilli farming models may also be taken into consideration.

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APPENDICES

APPENDICES

A STUDY ON SUSTAINABLE CULTIVATION PRACTICES FOLLOWED BY NAGA KING CHILLI (*Capsicum chinense* Jacq.) GROWERS IN NAGALAND

INTERVIEW SCHEDULE

Respondent No:…… Date of Interview:…..... House No /ward No: .... (M):....................

Part-A

1. General Information:

1. Name of the respondent :
2. Name of the village:
3. Name of the C&RD Block:
4. Name of the district:
5. Year of establishment of the village:
6. Total geographical area of the village:
7. Total cultivable land of the village:
8. Total number of households:
9. Total population:
10. Total number of household involved in (Naga king chilli) farming:
11. Type of soil:
12. Longitude and Latitude:
13. Elevation (MSL):

2. Socio -economic, personal and psychological characteristics:

I. Personal characteristics

i. Age : .... (Years)
ii. Gender : Male/Female
iii. Marital status : Married/Unmarried
iv. Family type : Joint / Nuclear
v. Family size : Male......... Female......... Total.........
vi. Education : Illiterate / Primary school / Middle (5-7) / High school / PU / Graduate /Above graduate
vii. Formal education : .... (No. Of years of schooling)
viii. Experience in Naga king chilli cultivation : Traditional .... Improved .... (in years)

II. Economic characteristics

i. Occupation (Please tick √ where appropriate):
(a) Farmer: ( ) (c) Farmer + Business: ( )
(b) Farmer + Service: ( ) (d) Farmer + Business + Service: ( )

ii. Size of the total land holding under agriculture:

Own land: ....acre/bigha/hectare

Land on lease: ....acre/bigha/hectare

Total: .... acre/bigha/hectare

iii. Size of land holding under Naga king chilli cultivation: .... acre/bigha/hectare
Naga king chilli is grown by you :

i. On a separate plot …….. if yes, land ……….. acre/bigha/hectare
ii. As mixed crop ……… if yes, land ……….. acre/bigha/hectare
iii. Under jhum ……….. if yes, land ……….. acre/bigha/hectare
iv. Under terrace ……….. if yes land ……….. acre/bigha/hectare
v. Which farm implements do you use for fruit cultivation & management :
i)…………… ii)……………..iii)………………iv..................

vi. Crops grown other than Naga king chilli in a year

a. In the same field along with the Naga king chilli:…….................land ....acre
b. In separate field:……………...land..........acre

vii. Do you also rear livestock? If yes please state their names, breed and number

Sl. No.	Name of livestock	Name of breed	No.	Purpose Meat / Milk or other	Income per year	Do animal waste recycled to make compost/ manure
1						
2						
3						
4						

viii. What is your Primary motive of Naga king chilli cultivation: Give your rank preference

a) For home consumption ……………….
b) Selling and profit making ………………
c) Because other farmers are also producing ………………
d) As government is giving subsidy ………………
e) Want to be the highest producer of Naga king chilli in my area………….
f) For making value added products for profit ……………
g) For selling to other states ....
h) Any other, please specify

ix. Marketing Pattern:

1.	Do you cultivate Naga king chilli for selling in market?	Y/N
2.	Do you sell your produce to nearby markets only?	Y/N
3.	Do you sell your produce in the nearest market whatever price is given to you?	Y/N
4.	Do you sell your produce to distant markets for high profits?	Y/N
5.	Whether traders come to your doorstep to purchase Naga king chilli?	Y/N
6.	Whether you sell Naga king chilli to a commission agent?	Y/N
7.	Whether you sell Naga king chilli to whole sellers directly?	Y/N
8.	Whether you sell Naga king chilli to retailers directly?	Y/N

What market channel you prefer for nearby & distant market?

Nearby market:

1. .... 2..

In which market channel ....you get max. av profit Rs. ....

Distant market:

1. .... 2. ....

In which market channel ....you get max. av profit Rs.......................

x. Annual income:

(a) Income from Naga king chilli : Rs..........
(b) Income from agriculture : Rs……...
(c) Income from business : Rs……...
(d) Income from services : Rs………
(e) Income from other enterprises
Dairy : Rs………
Piggery : Rs………
Poultry : Rs……...
Fishery : Rs………
Duckery : Rs………
(f) Others : Rs..........
Total : Rs..........

xi. Employment generated

Please mention the number of man days generated for every practice during sustainable Naga king chilli cultivation

Labour	Durat-ion	Land prepar-ation	Sowing	Manuring	Irriga-tion	Weeding	IPM	DM	Harvest-ing	PHM	VA
Family labour											
Hired labour											

III. Communication characteristics

i. Training exposure:

Have you undergone trainings related to sustainable Naga king chilli cultivation during the last 5 years? : .... (Yes/No)

If yes, please give the following details:

Sl. No.	Training imparted by	Govt / NGO / Pvt	Year of training	Area/topic of training	No. of days

ii. Extension contact

Please mention from which of the following and frequency of contact you seek for sustainable Naga king chilli cultivation:

Sl. No	Types of Extension Agents	Frequency of contact			Purpose of visit
		Most Often	Sometimes	Never	
		Weekly / fortnightly/ monthly	Once in 3 months /6 months/ 9 months/12 months		
1.	VEW				
2.	AO SDAO HO SDHO				
3.	KVK (SMS)				
4.	ATMA professionals ATM BTM Dy Director				
5.	NGOs a. NGO 1……… b. NGO 2……… c. NGO 3………				
6.	Rural Devp. Deptt. Officers				
7.	Land Resource Deptt. Officers				
	ICAR				
9.	Any other				

iii. Information sources utilization:

a. Formal information sources:

Sl. No.	Sources of information	Most often	Sometimes	Never
1.	VLW			
2.	AO SDAO HO SDHO			
3.	KVK professionals			
4.	ATMA professionals			
5.	ICAR			
6.	NGOs			
7.	Any other			

b. Informal information sources:

Sl. No.	Sources of information	Most often	Sometimes	Never
1.	Friends			
2.	Relatives			
3.	Neighbours			
4.	Progressive farmers			

c. Mass-media sources:

Sl. No.	Sources of information	Most often	Sometimes	Never
1.	Radio programmes…………………………			
2.	Television programmes……………………..			
3.	Newspapers 1………………… 2…………………			
4.	Exhibition held at ……….........Year ……			
5.	Print media Poster………………… Folder………………… Leaflet………………...			
6.	Mobile phones or Smart phones WhatsApp Facebook Instagram SMS based services			

programme & at what time you listen for agriculture
……………………………………………………...
TV: which programme & at what time you view for agriculture…………………………………….............

iv. Social Participation:

Are you a member (s) of any of the following organization? If yes, please mention the details:

Sl. No.	Organizations/Groups	Membership		Frequency of participation		
		Member	Office bearer	Regularly	Occasionally	Never
1.	VD Board					
2.	Village Council					
3.	Church					
4.	SHG					
5.	Farmer's Club					
6.	Others pl specify					

IV. Entrepreneurial behaviour

A set of statements representing economic motivation of farmers are given below. Please state the degree of your agreement (A- Agree, UD- Undecided, DA- Disagree), about each statement.

i. Economic Motivation:

Sl. No.	Statements	A	UD	DA
1.	A Naga king chilli grower should work towards more yield and economic profit.			
2.	The most successful farmer is one who makes more profit.			
3.	A Naga king chilli grower should try any new idea, which may earn more money.			
4.	A Naga king chilli farmer should adopt improved practices of large cardamom cultivation to increase monetary profits.			
5.	It is difficult for the farmer’s children to make good start unless he provides them with economic assistance.			
6.	A Naga king chilli grower must earn his living but the most important thing in life cannot be defined in economic terms.			

ii. Innovativeness

Sl. No.	Statements	A	UD	DA
1.	I am very much interested in adopting improved varieties of Naga king chilli.			
2.	Since I am not sure of success of new varieties of Naga king chilli, I would like to wait till others adopt.			
3.	Since new varieties of Naga king chilli is not profitable, I am not interested in it.			
4.	I try to keep myself well informed about any new variety of Naga king chilli and try to adopt as soon as possible.			
5.	New variety of Naga king chilli are not easily adoptable and hence I do not adopt.			

iii. Achievement Motivation

Sl. No.	Statements	A	UD	DA
1.	Work should come first even if one cannot get proper rest in order to achieve ones goals			
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 now-a-days, discourage one to work hard			
6.	One should succeed in occupation even if one has to neglect his family.			

iv. Decision making ability

Sl. No.	Statements	Not considered	Considered after consultation with others	Considered independently
1.	To try improved Naga king chilli cultivation			
2.	To increase or decrease crop area in Naga king chilli cultivation			
3.	To hire farm labour for Naga king chilli cultivation			
4.	To borrow loan for the inputs and farm work for Naga king chilli cultivation.			
5.	To buy farm equipments			
6.	To try new variety of crop			

v. Risk taking ability

Sl. No.	Statements	A	UD	DA
1.	A farmer should grow large number of crops to avoid greater risks involved in growing one or two crops.			
2.	A farmer should rather take more of a change in making a big profit than to be content with smaller but less risky profits.			
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 risks 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.			

vi. Leadership Ability

Sl. No.	Statements	Always	Sometimes	Never
1.	Did you participate in group discussions on new farm practice?			
2.	Whenever you see/hear a new farm practice did you initiate discussion about it with your colleagues?			
3.	Do people in your village regard you as good source of information on new farm practice?			
4.	Do you assign the farm work to your family members?			
5.	Do you offer new approaches to problems?			

vii. Management Orientation

Sl. No.	Statements	SA	A	DA	SDA
1.	Everyone should think about the income generating activity available to the local areas				
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 steps to be followed in taking up economic activity.				
4.	It is not necessary to think ahead the total cost involved in starting income generating activity.				
5.	One should not consult experts and experience persons for planning the economic activities.				
6.	It is possible to increase the returns through production plans.				

viii. Production Orientation

Sl. No.	Statements	SA	A	DA	SDA
1.	Timely planning of economic activity will yield good results.				
2.	For timely solving of problems, one should use appropriate problem solving techniques.				
3.	One should invest as much as he likes in taking up any economic activity.				
4.	Economic activities should be adopted as recommended by specialists.				
5.	With less input one can produce as much quality goods as possible				
6.	One should go for lower investment with higher returns.				

ix. Marketing Orientation

Sl. No.	Statements	SA	A	DA	SDA
1.	Marketing information is not much necessary to Naga king chilli growers.				
2.	A farmer can get a good price by producing good quality of Naga king chilli.				
3.	Better market facilities can help the Naga king chilli growers to get a better price for his produce.				
4.	One should sell his Naga king chilli to the nearest market irrespective of prices.				
5.	One should cultivate other crops instead of Naga king chilli which has more demand in market.				
6.	A farmer should cultivate more for crops he gets subsidy rather than market demand.				

x. Attitude towards sustainable Naga king chilli farming

Please indicate the choice among five alternatives (SA = Strongly Agree; A = Agree; N = Neutral; D = Disagree; SD = Strongly Disagree)

Sl. No.	Statements	Categories				
		SA	A	N	D	SD
1.	Sustainable Naga king chilli farming is helpful to increase my standard of living.					
2.	Sustainable Naga king chilli farming may prove a boon for the farmers and the earth as well.					
3.	Farmers can use Indigenous Technical Knowledge to improve sustainable Naga king chilli farming.					
4.	Sustainable Naga King Chilli farming has the potential to contribute towards a clean and safe environment.					
5.	I feel that one should go for sustainable king chilli farming rather traditional farming for more profit.					
6.	Advanced technologies are capable to attract younger generation's interest towards sustainable Naga king chilli farming.					
7.	Sustainable Naga king chilli farming can reduce the production cost in comparison to conventional farming.					
8.	I prefer to be a Naga king chilli farmer than going for a white- collar job.					
9.	I would like to gain more knowledge and skills in sustainable Naga king chilli farming.					
10.	There is a great scope for sustainable Naga king chilli farming as people are becoming more concerned about one's health.					
11.	Since my farm is situated in upland conditions and fragmented also, I cannot follow sustainable farming.					
12.	Sustainable Naga king chilli farming is uneconomical in the long run.					
13.	One should not worry about the excessive use of chemicals in Naga King Chilli farming as long as it is profitable.					
14.	Sustainable Naga king chilli farming is very laborious and stressful.					
15.	There is less opportunity for income and livelihood improvement by following sustainable Naga king chilli farming.					
16.	If one chooses sustainable Naga king chilli farming, he has to be ready to face the adverse effects.					
17.	Inability to access the necessary inputs may prove a hindrance for sustainable Naga king chill farming.					

18.	Crop rotations and diversifications are not important for sustainable Naga king chilli farming.					
19.	I don't want to adopt sustainable Naga king chill farming as it is input intensive.					
20.	Farmers should only focus on one farm activity rather than crop diversification.					

xi. Entrepreneurial Competencies

Please indicate the choice among three alternatives (A=Agree, UD=Undecided, DA=Disagree

Sl. No.	Statements	A	UD	DA
1.	One can start his own enterprise no matter the circumstances if he is passionate.			
2.	Interacting with people with more experience and seeking for their advice is a must in any start-up.			
3.	I see myself as a proficient farmer in treating problems as opportunities.			
4.	I see myself as a successful businessman after 10 years.			
5.	I've the ability to generate new and innovative ideas.			
6.	One should take up less risky business which is already in practice.			
7.	It is not necessary to keep up-to-date agriculture information in relation to setting up new entrepreneurial ventures.			
8.	Maintaining a good marketing network is not necessary as long as one have good relation with the farmers.			
9.	Being an effective leader is not important as long as you are effective in your personal work.			
10.	I do not make plans for starting a business because I do not have enough capital.			

Part-B

KNOWLEDGE LEVEL

Please indicate the most appropriate answer from the alternatives given under each of the following statements.

I. CLIMATE

1. Naga king Chilli can grow upto ………. above sea level:
   a) 600-1700 b) 1000-2500 c) 500-1800 d) 800-2100

2. The optimum temperature for Naga king chilli cultivation is:
   a) 20-25 ºC b) 18-26 ºC c) 25-30 ºC d) 22-32 ºC

3. Naga king chilli is a …………. loving plant
   a) Very high shade loving b) Sun c) Moderate shade loving

d) High shade loving

II. SOIL

1. The soil type best suited for Naga king chilli cultivation is:
   a) Sandy soil b) Loamy soil c) Clay soil d) Sandy loam soil

2. Soil condition should be:
   a) Water logged b) Well drained c) Eroded soil d) None

3. Soil PH
   a) 5.5 – 6.0 b) 5.0 – 6.0 c) 4.5 – 5.5 d) 5 – 5.5

III. NURSERY MANAGEMENT

1. For nursery management raised seed bed should be :
   a) 1m width, 15cm height c)1.5m width, 10 cm height
   b) 2m width, 15cm height d)2.5 m width, 10 cm height

2. For nursery management the soil treatment include:
   a) FYM+ sand+ ash+ vermicompost
   b) Ash+Phosphotika+Azotobacter+FYM+ Sand
   c) Phosphotika+Sand+FYM+ash
   d) Vermicompost+Trichoderma+sand+ash

3. The seeds should be treated with :
   a) Biofertilizers b)*Trichoderma sp.* *c)* Vermicompost d) All of the above

4. Sowing should be done in the month of :
   a) Last week of Jan to first week of Feb
   b) Last week of Feb to first week of March
   c) Last week of March to first week of April
   d) Last week of April to first week of May

5. Do you think that line sowing in the seed bed is necessary?
   a) Yes b) No

6. Line sowing is done at :
   a) 5cm apart b) 4cm apart c) 3cm apart d) 2cm apart

7. Do you think that mulching the seed bed is necessary?
   a) Yes b) No

8. Mulching the seed bed is done to :
   a) Conserve soil moisture
   b) Check soil erosion and weed growth
   c) Conserve soil moisture and protect from birds and animals
   d) Check weed growth

9. Please mention how it is done?
   a) Base of the plants should be mulched with dried leaves after few days
   b) Mulch the collar region of the clumps with fallen leaves

c) The bed should be mulched with Paddy straw and twigs soon after plantin

d) Both a & b

IV. MAIN FIELD PREPARATION

1. What field preparation operation should be followed?
   a) Pits of 1x1x1 ft , Pit to pit distance of 4ft x 4ft
   b) Pits of 2x2x2 ft, Pit to pit distance of 2.5 ft x 2.5 ft
   c) Pits of 0.5x0.5x0.5 ft, Pit to pit distance of 1ft x 1ft
   d) Pits of 1.5x1.5x1.5 ft, Pit to pit distance of 2ft x 2ft

2. Pit digging should be done during the month of :
   a) Jan- Feb
   b) Feb- March
   c) March- April
   d) April- May

3. Pit manuring is done with:
   a) FYM/Vermicompost b) Top soil c) Biofertilizer & Trichoderma
   d) All of these

V. MANURES AND FERTILIZERS

1. Integrated application of ....per ha give maximum yield and quality of Naga king chilli
   a) 45:30:30 kg + 10 t FYM + Bio fertilizers (Azotobacter & Phosphotika)
   b) 40:30:30 + 10 t FYM + Bio fertilizers (Azotobacter & Phosphotika)
   c) 50:30:30 + 10 t FYM + Bio fertilizers (Azotobacter & Phosphotika)
   d) 55:30:30 + 10 t FYM + Bio fertilizers (Azotobacter & Phosphotika)

2. .... NPK/ha recommended dosage
   a) 45:30:30 b) 40:30:30 c) 50:30:30
   d) 55:30:30

VI. TRANSPLANTING

1. What is the appropriate time of planting?
   a) April-May b) June-August c) April-June
   d) May-August

2. Seedlings will be dipped for 30 minutes in.....
   a) 2 kg Azotobacter and 2 kg Phosphotika in 20 L of water
   b) 3 kg Azotobacter and 3 kg Phosphotika in 20 L of water
   c) 4 kg Azotobacter and 4 kg Phosphotika in 20 L of water
   d) 5 kg Azotobacter and 5 kg Phosphotika in 20 L of water

3. Transplanting should be done at :
   a) 5-7 leaves stage b)7-10 leaves stage c)10-12 leaves stage
   d) 12-14 leaves stage

VII. INTERCULTURAL OPERATIONS

1. Do you think that weeding is necessary in Naga king chilli?
   a) Yes b) No

2. Weeding should be done after

   a) 20-30 DAP and at regular intervals
   b) 30-40 DAP and at regular intervals
   c) 40-50 DAP and at regular intervals
   d) 50-60 DAP and at regular intervals

3. Which intercultural operations are required for proper growth and development of the plant?
   a) Mulching
   b) Weeding & Earthing up
   c) Staking
   d) All of the above

4. Do you think that irrigating the nurseries is necessary?
   a) Yes b) No

5. What is the optimum interval of irrigation for nurseries?
   a) Alternate days b) 5 DAT c) Every day d) 2 days

6. Do you think that irrigating the main field is necessary?
   a) Yes b) No

7. Irrigation should be done at which stage?
   a) Transplanting stage b) Fruiting stage c) Vegetative stage d) all of the above

VIII. PLANT PROTECTION MEASURES

A. DISEASES:

1. Anthracnose and Fruit rot

Symptoms:

i. Necrosis of twigs from ………… occures
   a) Tip downwards b) Downwards to tip c) Between d) None

ii. Spots on the ......usually sunken with black margins can also be seen
   a) leaves b) Fruits c) Trunk d)Twigs

Management:

i. Seed treatment with.............@ 10g/kg seed is recommended
   a) Azolla b) Trichoderma c) Bacillus gordonae d) a & b

ii. Uproot and ......infested plants to control the spread of the diseases
   a) Dispose b) Burn c) Bury d) None

2. Bacterial wilt and bacterial leaf spot of chilli

Symptoms

i. Wilting of the ....leaves, then of the whole plant
   a) Youngest b) Middle c) Oldest d) a & b

ii. .... of the plant become browinish

a) Leaves and Petioles

b) Margin and the midrib of the leaves

c) Roots and lower parts of the stem

Management:

i. Early removal of ....will control the spread of the diseases

a) Only the affected part

b) Clipping off the affected leaves

c) Affected whole plant

ii. For effective disease control,.....should be used for spraying

a) 10g Trichoderma /1 L water

b) Bordeaux mixture (1%)

c) None

3. Leaf curl of chilli (Tobacco Leaf Curl virus)

Symptoms:

i. Leaves become.......in size

a) Large b) Triangle c) Small

ii. The affected plants become……… with no bearing of fruits

a) Discoloured b) Stunted c) Uncontrolled

Management:

i. The disease vector white fly is controlled by early spray of:

a) Neem oil @ 5ml/L water b) Dipole(Biopesticide)@ 1-4 tsp/4 L water c) Both

ii. Uproot and ......infested plants to control the spread of the diseases

a) Collect b) Burn c) Bury

B. PEST

1. Fruit (Pod) Borer

Symptoms:

i. Young larvae feed on flower buds and pods resulting in

a) Circular hole at the base of the pedicel

b) Premature dropping of flower and pods

c) Fruits turn to white colour/ discoloured

d) All of the above

Management

i. Biological control include :

a) Release of T. Chilonis @50,000/ha per week coinciding with flowering time

b) Growing of marigold in the field

c) None

d) All of the above

ii. Cultural practice include setting up of :

a) Pheromone traps in the field @ 25 Nos. Per Ha to monitor the adult moth
b) Summer deep ploughing
c) None
d) All of the above

ii. Thrips, Aphids and Mites

Symptoms:

i. Adults and Nymphs suck sap from the leaves and growing shoots resulting in

a) Elongation of leaf petiole and clustering of tender leaves
b) Smaller, thickened and brittle leaves
c) None
d) Both

Management:

i. Spray..........after fruit setting to control the aphid population at Economic Threshold Level

a) Neem oil @5ml/L of water
b) Malathion @2ml/L of water
c) a & b
d) None

iii. White Fly

Symptoms:

i. White fly suck sap from the leaves and growing shoots resulting in

a) Stunted growth c) Dried leaves
b) Dead of infested plant d) Wilted leaves

Management:

i. The disease vector white fly is controlled by early spray of:

a) Neem oil @ 5ml/L of water
b) Dipole(Biopesticide)@ 1-4 teaspoon/4 L of water
c) Both

ii. Cultural management of white fly include

a) Use of yellow sticky traps coated with grease and sticky oils
b) Intercropping with leguminous crops for one year
c) Both

IX. HARVESTING AND YIELD

1. What should be the appropriate time of harvesting?
   a) 8 MAT b) 6 MAT c) 7 MAT d) 5 MAT

2. The fruit should be harvested with the ....intact.
   a) Stalk b) Branch c) Leaves d) None

3. The fruit should be harvested during ....part of the day.
   a) Hotter b) Cooler c) Sunny d) Any

4. The fruit should not be harvested during...........as it will lead to rotting of fruits.
   a) Sunny day   b) Cooler day   c) Rainy day   d) None

5. Do you think that harvesting of fruits should depend on the end use?
   a) Yes   b) No

6. Average yield ranges from:
   a) 80-120 qtl/ha   b) 200-300 qtl/ha   c) 54-100 qtl/ha   d)150-200 qtl/ha

X. POST HARVEST MANAGEMENT

1. GRADING

i. Grading of Naga king chilli is done on the basis of:
   a) Colour   b) Size   c) Stage of maturity
d) All of the above

ii. What is the physiological stage of maturity of Naga king chilli for drying and seed purpose?
   a) Green stage   b)Brown stage   c) Yellow stage   d) Red stage

iii. What is the physiological stage of maturity of Naga king chilli for long distant market?
   a) Green stage   b) Brown stage   c) Yellow stage   d) Red stage

iv. Do you think that packing of the produce separately according to grade before sending them to market is necessary?
   a) Yes   b) No

2. CURING

i. Do you think that curing of Naga king chilli is necessary?
   a) Yes   b) No

ii. Moisture content should be reduced to
   a) 10%   b) 9%   c) 8%   d) 7%

iii. Curing of Naga king chilli is done through:
   a) Drying   b) Pickling   c) Cooking   d) All of the above

iv. What temperature should be maintained to obtain uniform colour when the harvest is kept indoor?
   a) 22-25ºC   b) 20-25ºC   c) 21-25ºC   d) 23-25ºC

3. STORAGE

i. Storage Temperature should be
a) 5-8 ºC   b) 4-8ºC   c) 7-8ºC   d) 6-8ºC

ii. Chillies are attacked by.............during storage
   a) Spice beetle and cigarette beetle   c) Cockroaches and ants
   b) Moths   d) All

iii. Relative Humidity

a) 55-60% b) 60-65% c)50-55% d)65-70%

Note: Each correct answer carry 1 mark and wrong answer 0 mark

ADOPTION LEVEL

Recommended Practices		Adoption Status			Actual practices done by farmers & ITK used	Trainings required		
		F	P	N		MN	N	NN
Nursery management	• Raised seed bed: 15 cm height 1m length, ½ m width • Soil Treatment with Garden soil, Vermicompost, Sand (1:1:1)							
Seed treatment	• Mix with Bio-fertilizers like Azotobacter and Phosphotika 200g each in 300 ml water, mix with vermicompost/organic manure and dry in shade for 30 minutes and sow immediately							
Sowing	• Line sowing with 5cm apart to avoid overcrowding of the seedlings							
Mulching	• Mulching the seed bed with paddy straw and twigs to conserve soil moisture and protect from birds and animals							
Main field preparation	• Pit digging during Feb to Mar Pit size: 1ftx1ftx1ft is dug and kept for about one month Pit-pit distance: 4ftx4ft							
Soil Mixture	• Treat the soil with azotobacter/azospirillum @1-1.25 kg mixed with 50kg of FYM FYM @ 4-6 ton/acre, Vermicompost @1-2 ton /acre							
Transplanting	• At 10-12 leaves stage, Irrigating the nurseries before transplanting							
Intercultural Operations	• Weeding should be done after 30-40 days of planting and repeated at regular intervals as and when required followed by Mulching & Earthing up.							
Irrigation	• Everyday watering of nursery bed is required • Under open field condition watering should be done at transplanting, vegetative and fruiting stage							

Insect Pest Management	• Early spray of Neem oil @ 5ml/L of water to control disease vector white fly • Release of T. Chilonis @50,000/ha per week coinciding with flowering time to control fruit (pod) borer • Hand picking and killing of insect pest in the field							
Disease Management	• Leaf Curl Virus- Spray Neem oil @ 5ml/L of water or Dipole(Biopesticide)@ 1-4 teaspoon/4 L of water • Bacterial Wilt and Bacterial leaf spot of chilli - Early removal of affected plants will control the spread of the diseases or spray 10g of *Trichoderma* /l of water • Early removal of affected plants will control the spread of diseases							
Harvesting time, interval and stage	• Harvest fruits during cooler parts of the day (Morning/Evening) • Do not harvest the fruits during rainy season as it will lead to rotting of fruits/pods • Fruit should be harvested with the stalk intact • Dark green fruit stage for long distant market and red stage for nearby markets, drying and seed purpose							
Grading	• The produce should be separated according to size before sending them to market							
Curing	• Curing of Naga king chilli should be done through sun drying or dehydrator and pickling • Moisture content of 65-80% should be reduced to 10% • Store in heap indoor for 2-3 days at a Temp. of 22-25ºC to obtain uniform red colour							
Packaging	• Exposure of dried chillies to light and air should be avoided • Moisture content higher than 15% is critical • Under tropical condition, 200 gauge low and high density polyethylene films are suitable for packing							
Storage Practice	• Store at cool, dark and dry place Cold storage Temp 5-8ºC, RH 55-60%							

SUSTAINABILITY

1. Economic dimension

1.1 Productivity

Can you please recall the total quantity of yield produced on your farm during the last 5 years?

Items	2018	2019	2020	2021	2022
Area under Naga king chilli cultivation in acre					
Yield (q)					
Productivity (q/a)					

1.2 Input-Output Relationship

Inputs	2018		2019		2020		2021		2022	
	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value
Seed Cost										
Organic manures • FYM • Vermicompost • Bio fertilizers										
Inorganic fertilizers • Ff •										
Plant protection measures • Mechanical • Biological • Chemical										
Weed control • Mechanical • Biological • Chemical										
Irrigation										
Labour • Male • Female • Bullock • Tractor • Others										
Tools and Implements										
Transportation										
Others										
TOTAL										

1.3 Man days generated (2018, 2019, 2020, 2021, 2022)

Sl. No.	Category	Charge of labour/day	Total working days/annum	Total cost (Rs.)
1.	Male			
2.	Female			

1.4 Profitability

Items	2018	2019	2020	2021	2022
Area under Naga king chilli cultivation in acre					
Varieties used					
Source of obtaining seed / sapling					
Production (q)					
Productivity (q/a)					
Cost of production (Rs) a. Seed / planting materials b. Labour charges c. Fencing d. Implements e. Manures f. Fertilizer g. Plant protection h. Storage i. Transportation j.Any other charges					
HH consumption (Kg)					
Total Quantity Sold (q)					
Quantity sold in nearest market (q)					
Quantity sold in other market (q)					
Rate of sale (Rs/Kg) in nearest market					
Rate of sale / kg) in other market					

1.5 Risk and Risk management

a) Do you practice crop diversification and inter cropping? Y/N
b) Do you practice sharing of seeds, labour, agricultural equipments, irrigation sources, etc? Y/N
c) Are you availing any loan from any banks for Naga king chilli cultivation? Y/N
d) Did you apply for crop or livestock loan in times of crop failure or death of animal? Y/N
e) Do you face problem selling off your produce? Y/N

2. Social dimension

Sl. No.	Statements	Yes	No
1.	Formation of SHG		
	a. Are you a member of any SHG?		
	b. Are you actively involved in the activities of your SHG?		
2.	Formation of Co- operative societies		
	a. Are you a part of any co-operative societies?		
	b. Are you actively involved in the activities of your society?		
3.	Formation of FPOs		
	a. Are there any FPOs in your locality?		
	b. Are you a member of the FPO?		

2.1 Information Self-Reliance

Mention the extent of dependency for information on the following areas on yourself and others

Sl. No.	**Information areas**	**Source of information**		
		Self	**Partly others**	**Others**
1.	Selection of suitable seeds/ planting material			
2.	Time of sowing			
3.	Soil management practices			
4.	Manures and fertilizers			
5.	Use of bio-fertilizers			
6.	Plant protection			
7.	Weed management			
8.	Water management			
9.	Harvesting			
10.	Storage			
11.	Marketing			
12.	Tools and implements			

2.2 Human Development Index/ Quality of life

Sl. No.	**Statements**	**Yes**	**No**
1.	Are you able to utilize the profit from pineapple cultivation to pay your home expenses?		
2.	Are you able to send your children to school with the profit earned from pineapple cultivation?		
3.	Are you able to afford food for your family whole year round?		
4.	Are you able to provide nutritious food to your family?		
5.	Are you able to provide facilities such as farm machineries, television, radio, mobile phones, etc both in the farm and at home?		

2.3 Gender roles in farming

Participation and decision making pattern of women in sustainable Naga king chilli practices:

Practices	Women Part.	Process of decision making					Does by consulting husband
	Y/N	Her-self	Husband alone	Husband & wife together	With relatives	Based on recommenda-tion of Govt/KVK	Always/ ST/Never
Land preparation							
Seed treatment							

Selection of good seedlings							
Sowing time							
Sowing method							
Seed rate/acre							
Depth of seeding							
Spacing							
Irrigation							
Mulching							
Weeding							
Earthing							
Plant protection measures							
Harvesting							
Grading							
Packaging							
Value addition							
Transportation							
Marketing							
Seed storage							

2.4 Access to latest knowledge of sustainable Naga king chilli cultivation practices

Sl. No.	Are you getting any information/knowledge on sustainable Naga king chilli cultivation practices from:	Yes	No	If yes, how many times during the last 5 years
1.	Extension agencies from Horticulture department			
2.	KVK			
3.	ATMA			
4.	CIH			
5.	Farmers' Association			
6.	Mass media (Newspaper/ Television/Magazine/ SMS/ Mobile apps			
7.	Training/ Seminar/ Workshop/ Field trip			
8.	Friends			
9.	Neighbours			

3. Environmental / Ecological dimension

3.1 Integrated Nutrient Management

Do you practice INM during Naga king chilli cultivation? Yes/ No

If yes, which of the following are used in your Naga king chilli field?

Sl. No.	Nutrients	Dosage	No. of times applied
1.	Urea		
2.	DAP		
3.	Superphosphate		
4.	Rock phosphate		
5.	Murate of potash		
6.	Farm Yard Manure		
7.	Oil cakes (Neem, castor)		
8.	Green manuring (cowpea, sunhemp, etc)		
9.	Biofertilizers (azotobacter,		
10.	Azolla		

What component of INM are you using for Naga king chilli cultivation:

....

2.5 Soil organic matter

Do you apply organic matter in your field for sustainable Naga king chilli cultivation? Yes/ No

If yes, which of the following do you use?

Sl. No.	Type of organic matter	No of times applied in a season	Total amount applied (kg/bigha)
1.	Cow-dung manure		
2.	Mulches made of dried leaves and paddy straw		
3.	Poultry litter		
4.	Vermicompost		
5.	Green manure or compost		
6.	Neem oil cake		
7.	Others		

2.6 Water conservation measures:

Do you conserve water for irrigation purposes? Yes/ No

If yes, which of the following means do you practice?

Sl. No.	Conservation measures	Yes	No
1.	Harvest rainwater		
2.	Set up well in the field		
3.	Set up bore well in the field		
4.	Source out water from nearby stream/ river		
5.	Store water in Jalkhund/pond/tank		
6.	Others		

2.7 Drainage system

Do you maintain drainage system in your field to prevent stagnation of water? Yes/ No

2.8 Soil erosion

Sl. No.	Statements	Yes	No
1.	Do you prepare proper trenches in your field to prevent soil erosion?		
2.	Do you construct proper trenches in your field?		
3.	Do you leave crop residues on the soil surface after harvest to conserve the soil?		
4.	Do you mulch with black polythene to prevent soil erosion?		
5.	Do you mulch with black dry leaves and grasses to prevent soil erosion?		
6.	Do you plant trees/shrubs surrounding your field to decrease the magnitude of splash erosion?		

2.9 Biodiversity in field

Sl. No.	Statements	Yes	No
1.	Do you preserve beneficial insects like ladybird, bees, spider, etc in your field?		
2.	Do you plant beetle nut trees, neem trees and other herbaceous trees surrounding your field?		

2.10 Use of pesticide/fungicide/herbicide/insecticide

Do you apply pesticide/insecticide in your field during Naga king chilli cultivation? Yes/No

If yes, give the following details:

Sl. No.	Pesticide/fungicide/herbicide/insecticide	Dosage	No. of times applied

2.11 Crop rotation

Do you practice crop rotation in your Naga king chilli field? Yes/ No

If yes, which are the crops used in crop rotation?...

2.12 Integrated Pest Management (IPM)

For pest management, do you practice Integrated Pest Management (IPM)? Yes/ No

If yes, do you follow the following and give details.

Sl. No.	Management	Yes	No	If yes, no of times practiced in season/ Dosage
1.	Weeding			
2.	Infected plants and plant parts removed			
3.	Cover crops are planted			
4.	Sticky insect traps are prepared			
5.	Drainage system is well maintained			
6.	Trap crops are planted			
7.	Any others			

2.13 Recycling of nutrients

Do you recycle the waste in your field? Yes/No

If yes, do you follow these practices?

Sl. No.	Practice	Yes	No	If no, why
1.	Setting up vermicompost pit			
2.	Setting up compost pit			
3.	Farm Yard Manure (FYM) is prepared			
4.	Dry leaves and grasses, paddy straw, weeds are used as mulches			
5.	Poultry litter is utilized as manure			
6.	Any others			

4. Institutional Sustainability:

4.1 Adequacy

A. Whether local institutions have been formed: Yes / No

If Yes, Indicate type of Institution, objectives and functions

Sl. No.	Type of Institution	No.	Objectives	Functions
1.	Village committee/ association			
2.	SHGs			
3.	Farmer interest Group (FIGs)			
4.	Others			

B. Indicate representation from different families:

Sl. No.	Type of Institution	Men (No.)	Women (No.)	No. of Family
1.	Village committee or association			
2.	SHGs			
3.	FIGs			
4.	Others			
	Total			
	Total No. of families in the village			
	% Representation			

4.2 Linkages:

Is the committee/group maintaining the functional linkage Yes/No

If yes nature and mode of linkage:

Sl. No.	Type of Institution	Y/N	No. of times contacted in a year	Purpose
1.	Dept. of Agriculture			
2.	Dept. of Horticulture			
3.	Dept. of Land Resources			
4.	Dept. of Soil and Water Conservation			
5.	Banks/ Financial institutions			
6.	Krishi Vegyan Kendra (KVK)			

4.3 Performance:

Meeting Frequency: Indicate meetings conducted

Sl. No.	Type of Institution	Meeting Frequency (Weekly/ Forthnightly/ Monthly)	Members Present		Purpose
			Men	Women	
1.	Village committee/ association				
2.	SHGs				
3.	FIGs				
4.	Others				

Constraints faced by the farmers in adoption of Sustainable cultivation practices of Naga king chilli

Sl. No.	Constraints	Level of Constraints			Intra Rank	Inter Rank
		S	M	NC		
A.	**Land /Soil Related Constraints**					
1.	Soil infertility					
2.	Poor land preparation					
3.	Steep and undulated land					
4.	Soil erosion					
B.	**Input Supply Constraints**					
1.	Non-availability of seeds and planting materials in time					
2.	High requirement of manure and fertilizer for sustainable cultivation					
3.	Non-availability of fertilizers and bio pesticides in time					
4.	Lack of irrigation facility					

C.	**Biotic and Abiotic Constraints**					
1.	Occurrence of showers during harvest					

2.	Epidemics of pest and diseases					
3.	Weed infestation					
4.	Floods/ drought during crop period					
5.	Fluctuation of temperature					
D.	**Technical Constraints**					
1.	Lack of knowledge about seed/seedling treatment					
2.	Lack of knowledge about insect-pest and disease management					
3.	Lack of mechanization of farm					
4.	Lack of knowledge about value addition of Naga King chilli					
E.	**Labour constraints**					
1.	Scarcity of labour					
2.	High cost of labour					
3.	Low labour productivity					
4.	Unskilled labour					
F.	**Economic Constraints**					
1.	Labour intensive crop					
2.	High cost of inputs					
3.	Lack of credit facilities					
4.	High cost of planting material					
G.	**Marketing Constraints**					
1.	Lack of proper market					
2.	Fluctuation in market price					
3.	High charges on transportation					
4.	Poor access of market information					
5.	Exploitation by middle men					
6.	Distressed sale					
H.	**Post-harvest Constraints**					
1.	Lack of proper storage facility					
2.	Lack of processing facility at local level					
3.	Lack of knowledge about storage pests and diseases					
4.	Increasing processing costs					
I.	**Extension Constraints**					
1.	Extension agents not available for consultation					
2.	Insufficient extension activities like training, demonstrations, kisan melas etc by extension agencies					
3.	Lack of technical guidance from extension staff					
4.	Untimely visit of extension agents					
J.	**Social Constraints**					
1.	Younger generation not interested in farming					
2.	Farmers have poor resource base					
3.	Poor educational status					
4.	Lack of motivation for Naga king chilli cultivation					
5.	No institutional support for commercial chilli cultivation from the grass root organizations					