Indigenous Technical Knowledge in Agriculture of *Mishmi* Tribe of Anjaw District, Arunachal Pradesh

Thesis

submitted to

NAGALAND UNIVERSITY

in partial fulfillment of requirements for the Degree

of

DOCTOR OF PHILOSOPHY

in

AGRICULTURAL EXTENSION EDUCATION

by

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Nagaland
2024

Dedicated

To

My Family Members,

My Respected Supervisor

And to

Mishmi Community

DECLARATION

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

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

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CERTIFICATE – I

This is to certify that the thesis entitled "**Indigenous technical knowledge in agriculture of *Mishmi* tribe of Anjaw District, Arunachal Pradesh**" submitted to Nagaland University in partial fulfillment of the requirements for the award of degree of Doctor of Philosophy (Agriculture) in Agricultural Extension Education is the record of research work carried out by ALEXSO NGADONG Registration No. Ph.D/AEX/00108 under my personal supervision and guidance.

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

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CERTIFICATE – II

VIVA VOCE ON THESIS OF DOCTOR OF PHILOSOPHY IN AGRICULTURAL EXTENSION EDUCATION

This is to certify that the thesis entitled "Indigenous technical knowledge in agriculture of *Mishmi* Tribe of Anjaw District, Arunachal Pradesh" submitted by ALEXSO NGADONG, Admission No. Ph-208/16 Registration No. Ph.D/AEX/00108 to the NAGALAND UNIVERSITY in partial fulfillment of the requirements for the award of degree of Doctor of Philosophy in Agricultural Extension Education has been examined by the Advisory Board and External examiner on …….

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

Member	Signature
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2. Dr. (External examiner)	…….
3. Pro –Vice Chancellor's nominee (Dean, SAS: NU)	…….
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Date :
Place: Medziphema (Alexso Ngadong)

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LIST OF ABBREVIATIONS

%	Per cent
◦	Degree
etc.	*et cetera*
et al.	*Et alli* (and other)
viz.	videlicet (namely)
sp.	Species
Sq.	Square
km	Kilo meter
Msl	Mean Sea Level
Fig	Figure
&	And
Rs	Indian Rupees
ITK	Indigenous Technical Knowledge
IHP	Indigenous Horticulture Practices
N	Sample size
UNESCO	United Nations Educational, Scientific and Cultural Organiation
CD	Community Development

ABSTRACT

Indigenous Technical Knowledge (ITK) refers to the specific knowledge that is inherent to a particular culture or society. ITK forms an essential component of the community's culture and historical background and involves the knowledge that individuals within a specific community have acquired through their experiences, which have been tested and refined over time. It is deeply rooted in the local culture and environment, constantly evolving, and prioritizes risk reduction rather than solely focusing on maximizing financial gains. The rapid changes occurring in the state due to reasons of globalization and economic development is leading to the erosion of local knowledge and practices across the tribes in the state, therefore a study was conducted in Anjaw district of Arunachal Pradesh during the period of 2018 to 2020 and 2021 to 2022 with the objective to identify and document the indigenous technical knowledge employed by farmers in the field of agriculture following a descriptive and multistage purposive cum random sampling design. Anjaw district was purposively selected to ensure comprehensive data representation, encompassing all four blocks in the study. A total of 44 villages, with 11 randomly selected from each block, with a sample size of 220 respondents.

The findings of the study indicate 57.72 per cent of the participants were classified as middle-aged, 60.91 per cent were male, and 68.64 per cent were found to be illiterate. In terms of farming experience, 61.81 per cent of respondents had between 12 to 28 years of experience. A significant proportion (74.54%) possessed medium-sized landholdings. The majority of respondents were primarily involved in agriculture, with a mere 0.45 per cent participating in both agriculture and livestock activities. The study revealed that 88.63 per cent of respondents had medium income level category, and 77.73 per cent had a medium income level derived from farming activities. Mass media exposure and extension contact was low and 59.55 per cent of respondents had medium level of scientific orientation. Only 5.00 per cent of respondents reported to have attended agricultural related training during the past 5 years.

A comprehensive compilation of 32 traditional agricultural practices were identified. Most of the identified ITKs were mainly related to *jhum* cultivation practices. Seven traps for rodents and other animals were identified: *Handam*/*Düye*, *Tawan*/*Takü*, *Kaiwoh*, *Dhiawoh*/*Thu*, *Hakapp*/*Kapoh*, *Khyet*/*Takhrek*, and *Bappaih*/*Talũ*. Five different types of scarecrow and other

devices identified were used to deter birds and animals: *Biyomai*/*Byũme*, *Hakap*/*Kapo*, *Hambrung*/*Tadap*, *Taiphungg*/*Halyang garã*, and *Atiphang*/*Machik kapo*. Another 14 ethno-veterinary medicinal plants were identified in the study. Additionally, 6 number of plants were identified which were important source of food and nutrition during natural uncertainties.

The adoption index of ITK revealed that 68.63 per cent of the respondents were in the medium level category. The effectiveness of the identified practice was categorized as less, moderate and high based on the mean per effectiveness index. It was revealed that most of the ITKs practiced had medium level of effectiveness according to the respondents.

The study revealed that age and farming experience had positive correlation with effectiveness. Similarly, age, farming experience, operational land holding and occupation had positive correlation with extent of adoption of ITK.

It is recommended that concentrated efforts are required to document Indigenous Technical Knowledge (ITK) in all districts before it is lost. It is also recommended that concerned agencies should undertake extensive scientific validation and field trials to integrate the valuable insights from both the scientific world and Indigenous Technical Knowledge (ITK).

Keywords: *Anjaw, effectiveness, ethno veterinary, ITKs.*

CHAPTER I

INTRODUCTION

INTRODUCTION

For centuries, humans have relied on agriculture as their primary means of sustenance. Initially, agriculture was carried out on small plots of land using basic tools. This form of farming relied on the rainfall patterns during monsoon seasons, the inherent fertility of the soil, and favorable environmental conditions for crop growth. However, the yields obtained through these agricultural practices were limited. In response to these challenges, a process of observation, experimentation, understanding, and innovation emerged. Individuals began to make efficient use of the available natural resources and drew upon their accumulated experiences to adapt to various situations. This accumulated knowledge, which has stood the test of time and embodies environmentally friendly practices, is commonly referred to as "Indigenous Technical Knowledge", "traditional knowledge" or "local knowledge". This knowledge is tightly interwoven with their beliefs, norms and culture so that it could maintain its identity (Gupta *et al.*, 1994). For few decades the indigenous knowledge's have been studied, more understood and had received growing interest and appreciation even among scientist and development practitioners worldwide.

Indigenous Technical Knowledge (ITK) encompasses knowledge that is specific to a particular culture or society, representing a valuable aspect of their heritage. It is deeply intertwined with the culture and historical context of the local community, forming an integral part of their identity (Borthakur & Singh, 2012). Indigenous Technical Knowledge (ITK) is a form of knowledge that arises within a specific community through practical experiences. It is frequently refined and validated over time, reflecting a long history of use and

adaptation to the local culture and environment (Haverkort, 1995). This knowledge is dynamic and subject to change, with a primary focus on reducing risks rather than maximizing profits.

Indigenous Knowledge is referred to by various terms, including local knowledge, indigenous traditional knowledge, folk knowledge, traditional ecological knowledge, local wisdom, people's science, and community knowledge. Additionally, it can pertain to the knowledge held by a specific ethnic group. Numerous definitions have been proposed for indigenous traditional knowledge systems, but they vary depending on the specific case and aspects being considered. This lack of a standardized definition highlights the diverse nature and contextual specificity of indigenous knowledge.

Indigenous knowledge refers to a type of knowledge that is distinct and specific to a particular culture or society (Warren 1989). Indigenous knowledge encompasses a structured knowledge system acquired by local communities through the accumulation of experiences, informal experimentation, and a deep understanding of the environment within a specific culture (Rajasekaran, 1993). According to Haverkort and Zeeuw, 1992, indigenous knowledge is also associated with use of modern technologies. Indigenous Technical Knowledge places a strong emphasis on the cultural values within a community and encompasses the technologies that farmers have developed over generations through experimentation and learning from their mistakes. These technologies are specifically tailored to adapt to the local agro-climatic and social conditions prevailing in the community (VenkataRamaiah & Rama Raju, 2004).

As agriculture undergoes modernization to facilitate large-scale production, the connection between agriculture and the environment appears to be weakening, resulting in the neglect of ecological principles. Consequently, indigenous communities worldwide are facing on going challenges in

preserving their rights, traditions, and invaluable knowledge amidst these changes (Sultana *et al*. 2018). Given this context, it is logical to anticipate that the nature and dynamics of agricultural production have undergone transformations over time. According to Alteiri (1995), a consensus among agricultural scientists suggests that modern agriculture is facing an environmental crisis. Concerns have arisen regarding the long-term sustainability of the current food production system. Accumulating evidence indicates that although capital and technology-intensive farming systems have demonstrated high productivity and competitiveness, they also give rise to a range of economic, environmental, and social issues. On the other hand, indigenous knowledge, derived from agro-ecological and ethno-ecological approaches, highlights that these systems are characterized by productivity, sustainability, ecological soundness, and alignment with the social, economic, and cultural aspects of farmers (Singh & Sureja, 2008).

In recent years, the detrimental environmental and social consequences of high-input agriculture have become increasingly evident. As a result, there is growing recognition and focus on the wisdom of farmers, indigenous knowledge systems, and local knowledge systems worldwide. This knowledge serves as a foundation for identifying ecologically sustainable approaches to resource utilization. Achieving sustainable grassroots development may necessitate a combination of approaches and methods derived from various knowledge systems. The significance of Indigenous Technical Knowledge (ITK) is multifaceted: it offers problem-solving strategies for local communities, particularly those facing poverty; it contributes significantly to the global knowledge base for development; however, these systems are at risk of being lost over time; they hold relevance for the overall developmental process; and yet, they remain an underutilized resource in the broader development efforts.

1.1 Statement of the problem

Arunachal Pradesh is a frontier state of North East India and is situated in the extreme North-Eastern tip of the Union of India in the Trans-Himalayan region between the latitude of 26^{o} 28' N and 29^{o} 33' N and longitude of 91^{o} 30' E and 97^{o} 30' E. It spreads over an area of 83,743 sq. km approximately. The state is thinly populated in the mountainous region and is predominantly tribal state characterized by rich ecological, cultural and linguistic diversity. Arunachal Pradesh has 26 major tribal groups and 110 sub-groups, 80 per cent of whom are primarily agriculturists practicing shifting cultivation on the community owned lands. The entry of outsiders, including the Indian nationals from outside of Arunachal Pradesh has been restricted by the Inner Line Permit, enacted by British in 1873. This region was declared as Union Territory in January 20, 1972 and emerged as a full-fledged state from 1987. The 96 per cent landscape of the state is covered by hills that create the natural boundaries for different communities of Arunachal Pradesh. The state of Arunachal Pradesh is also known to be one of the magnificent multilingual tribal areas of the world as it is home for many different indigenous communities.

In Arunachal Pradesh, a tribal land, the local population relies heavily on forests for their daily needs. The connection between the people and the forests is deeply rooted in their culture, with strong ties to wildlife and a close interdependence that is closely intertwined with their animistic religion. (Aiyadurai, 2014). The *Mishmi* tribe is one of the major tribes of Arunachal Pradesh. It consists of 3 sub-tribes. They are *Kaman (Miju) Mishmi*, *Tawrah (Digaru) Mishmi* and *Idu Mishmi.* The *Kaman* and *Tawrah Mishmi* people inhabit in Lohit and Anjaw District. The *Idu Mishmi* people inhabit in Dibang Valley and Upper Dibang Valley District with few population in Upper and East Siang District of Arunachal Pradesh. Each of the three sub-tribes in the

region speaks a distinct dialect, but there are observable similarities in other cultural patterns among them.

The district of Anjaw was created on 16th February 2004 having been split from Lohit district. The headquater of the district is Hawai, which is at an altitude of 1296 msl. The district borders Lower Dibang Valley district in west, Changlang and Lohit in south, China in north and Myanmar in the east. The major tribes of the district are *Kaman Mishmi*, *Tawrah Mishmi* and *Zakhring* (formerly called as *Meyor*). The total population of the district is 21,167 (Census 2011) and is one of the least populated districts in the country.

The *Mishmi* tribe residing in Anjaw district traditionally practices *Jhum* cultivation, cultivating crops such as maize (corn), buckwheat, finger millet (Ragi), barley, and rice. Rice cultivation primarily takes place in the foothills, and the harvested produce is predominantly used for household consumption. Historically, the *Mishmi's* have maintained a close connection with nature, acknowledging its kindness. However, with the introduction of modern development processes, the *Mishmi* community has gradually abandoned traditional practices in order to adapt to the new way of life. Consequently, significant changes have occurred in their lifestyle and culture, potentially leading to the loss of their intangible cultural heritage. The traditional culture of the *Mishmi* tribe has become vulnerable to the influences of the modern world, heightened by the widespread accessibility of advanced communication technology. The language of the *Mishmi* tribe has also been identified as endangered by UNESCO.

The rapid changes occurring in the state due to reason of globalization and economic development is also leading to the erosion of local knowledge and practices across the tribes in the state. The identification and documentation of these indigenous practices in the field of agriculture can help to increase the sustainability of developmental efforts because of its integration

process provides for mutual learning and adaptation, which in turn contributes to the empowerment of local communities. So there is an immediate necessity to gather, safeguard, authenticate, and embrace indigenous knowledge. This is crucial for diminishing reliance on external inputs, lowering cultivation costs, and promoting environmentally friendly agriculture.

The objective of the current study is to identify and document the indigenous technical knowledge employed by farmers in the field of agriculture. Additionally, the study aims to uncover the challenges and limitations they encounter. The findings of this research will provide valuable insights to various stakeholders, including professionals, extension workers, and researchers, contributing to their understanding of indigenous knowledge and its significance. Therefore present study entitled, **"Indigenous technical knowledge in agriculture of Mishmi tribe of Anjaw district, Arunachal Pradesh"** was undertaken with the following objectives:

1.2 Objectives of the study

1. To study the profile of indigenous technical knowledge users of *Mishmi* tribe of Arunachal Pradesh.
2. To identify and document the indigenous technical knowledge in agriculture used by *Mishmi* tribe of Arunachal Pradesh.
3. To study the constraints faced by the indigenous technical knowledge users in practice of indigenous practices in agriculture.

1.3 Significance of the study

The study will allow for the preservation of cultural heritage by safeguarding the traditional knowledge and practices that have been passed down through generations within indigenous communities. By studying and documenting ITK, it can prevent the loss of valuable knowledge systems deeply rooted in indigenous cultures.

ITK often encompasses sustainable agricultural practices that are adapted to local environments and ecosystems. By understanding and integrating ITK practices, we can promote sustainable farming methods such as organic agriculture, soil and water conservation techniques, natural pest management, and crop diversification. This contributes to the development of resilient and environmentally friendly agricultural systems. Furthermore, the study of ITK in agriculture plays a vital role in biodiversity conservation.

Moreover, ITK provides localized and context-specific solutions for agricultural challenges. The knowledge systems are intricately tied to specific local conditions, such as climate, soil types, and biodiversity. By studying ITK, we gain access to practical and effective solutions tailored to the unique needs and circumstances of specific ecosystems. This knowledge can inform the development of sustainable agriculture practices that are relevant and effective at the local level.

Studying ITK also empowers indigenous communities by recognizing and valuing their contributions. It promotes cultural identity, self-determination, and social and economic empowerment.

The study of Indigenous Technical Knowledge in agriculture is significant for preserving cultural heritage, promoting sustainable practices, conserving biodiversity, adapting to climate change, providing localized solutions, and empowering indigenous communities.

1.4 Limitations of the study

1. Given that the study was conducted exclusively in four blocks within a district, the findings can be reasonably extrapolated to other areas where similar conditions prevail.
2. Despite taking various precautions, it is important to acknowledge that complete elimination of bias in the study may not have been possible. However, sincere and thoughtful efforts were made to ensure that the study was conducted in an objective, definitive, and systematic manner to the best extent possible.
3. The survey study's sample size was limited due to focusing on a specific tribe in one district. A small sample size could affect the representativeness of the findings and limit the ability to draw comprehensive conclusions about the larger population.
4. Similar to other research studies, this study was also subject to limitations arising from constraints such as time, financial resources, availability of transportation, and other physical facilities for the investigator. These limitations need to be considered when interpreting the findings and understanding the scope and constraints of the study.

CHAPTER II

REVIEW OF LITERATURE

REVIEW OF LITERATURE

This chapter deals with the review of literature based on the studies of indigenous knowledge on agriculture, keeping in view the objectives of the present studies. The literatures reviewed are present under the following sub-heads:

2.1 Profile characteristics of the indigenous technical knowledge users

2.2 Identification and documentation of indigenous technical knowledge in agriculture

2.3 Constraints faced by the ITK users in practice of indigenous technical knowledge

2.1 Profile characteristics of the indigenous technical knowledge users.

Age

Somasundaram (1995) studied indigenous farming system practiced in Tamil Nadu and reported that 78.61 per cent of the respondents were of old age group.

Nirban (2006) studied on indigenous technique followed in rice cultivation and bovine health management in Konkan region of Maharashtra and reported that 71.83 per cent of the respondents belonged to the category of old age group.

Kalita (2007) studied on indigenous technical knowledge prevalent among fishers and aquaculturists in Karbi-Anglong district of Assam and revealed that majority of the respondents were of middle age category.

Kumari (2008) studied on indigenous knowledge practiced by tribal farmers in agriculture of Jharkhand state and concluded that majority of tribal farmers belong to the category of middle age.

Maravi (2009) depicted Indigenous Technological Knowledge (ITK) in agricultural aspects prevailing in Gwalior region of Madhya Pradesh and reported that 45.83 per cent of the respondents forming the majority belong to the category of middle age groups.

Patidar (2013) studied the use of ITK on plant protection in vegetable in eastern part of UP and reported that most of the respondents were of middle aged group.

Rakesh (2014) studied on indigenous knowledge of tribal farmers of Arunachal Pradesh and concluded that 60 per cent of the respondents belong to the old age group.

Benjongtoshi (2014) studied on indigenous pest control method in *jhum* field crops in Mokokchung district, Nagaland and outlined that 40 per cent of the respondents were between the age group of 56 - 65 years.

Khatri (2014) carried out analytical study about indigenous health management practices of livestock among the dairy farmers in Hanumana block of Rewa district of Madhya Pradesh and recorded 51.66 per cent of the respondents were under the middle age group.

Sariya (2015) depicted indigenous knowledge in agricultural aspects prevailing in Tarana block of Ujjain district of Madhya Pradesh and reported that 42.22 per cent of farmers were under middle age group.

Jallaraph (2016) conducted survey on awareness and adoption of indigenous technical knowledge in paddy cultivation in Bastar district of

Chhattisgarh and reported that majority of paddy growers were in the category of middle age group with 54.17 per cent.

Kumar (2016) studied on Indigenous Technical Knowledge prevalent in Saidpur block of Ghazipur district, Uttar Pradesh revealed that 45.78 per cent of the respondents were under the category of old age group.

Ahmed (2020) studied on indigenous knowledge used by farm women for homestead vegetables production and reported that 52.80 per cent were middle aged farmers.

Sharma (2020) conducted survey on identification of indigenous knowledge and its utilization in contemporary modern agriculture at Shajapur district of Madhya Pradesh and stated that majority 43.33 per cent of respondents were found to be middle age group

Educational status

Somasundaram (1995) studied indigenous farming system and reported that 66.31 per cent of the respondents were in the category of primary to high school level education.

Nirban (2006) studied in Konkan region of Maharashtra and reported that 66.20 per cent of the respondents were educated up to or below middle school level.

Kalita (2007) studied on indigenous technical knowledge in Karbi-Anglong district of Assam and revealed that majority of the respondents were having low level of education.

Kumari (2008) studied in Jharkhand state and concluded that majority of tribal farmers belonged to the category of illiterate.

Maravi (2009) studied on Indigenous Technological Knowledge (ITK) in agricultural aspects prevailing in Gwalior region of Madhya Pradesh and reported that 33.33 per cent of the respondents were educated up to primary level.

Patidar (2013) studied the use of ITK on plant protection in vegetable in eastern part of UP and reported that about 69.00 per cent of the respondents had education of different levels while 31.00 per cent of the respondents had no education.

Rakesh (2014) studied on indigenous knowledge of tribal farmers of Arunachal Pradesh and reported that 42.5 per cent of respondents had studied up to primary school level.

Benjongtoshi (2014) studied on indigenous pest control method in *jhum* field crops in Mokokchung district, Nagaland and outlined that 40.8 per cent of the respondents were illiterate.

Khatri (2014) carried out analytical study about indigenous health management practices of livestock among the dairy farmers in Hanumana block of Rewa district of Madhya Pradesh and reported that 38.33 per cent of the respondents belong to illiterate category in educational status.

Sariya (2015) studied indigenous knowledge in agricultural aspects prevailing in Tarana block of Ujjain district of Madhya Pradesh and revealed that 37.78 per cent of the farmers had education up to medium level.

Jallaraph (2016) conducted survey on awareness and adoption of indigenous technical knowledge in paddy cultivation in Bastar district of Chhattisgarh and reported that 81.67 per cent of the respondents were illiterates.

Kumar (2016) studied on Indigenous Technical Knowledge prevalent in Saidpur block of Ghazipur district, Uttar Pradesh revealed that 46.31 per cent of the respondents were under the category of medium education.

Madhukar (2017) studied on farmers perception about indigenous knowledge in plant protection in Latur district of Marathwada region of Maharashtra and revealed that majority (32.50 %) of the respondents belonged to primary school level education category.

Ahmed (2020) studied on indigenous knowledge used by farm women for homestead vegetables production and reported that 44.30 per cent farmers were under secondary level education category.

Sharma (2020) conducted survey on identification of indigenous knowledge and its utilization in contemporary modern agriculture at Shajapur district of Madhya Pradesh and stated that 35.83 per cent respondents were in middle education group.

Farming experience

Somasundaram (1995) studied indigenous farming system and reported that 55.08 per cent had low level of farming experiences.

Kumari (2008) studied in Jharkhand state and concluded that majority of tribal farmers were having medium level of farming experience.

Talisosang (2012) studied on indigenous rodent management by the *Ao-Nagas* of Nagaland and revealed that 60.41 per cent of the respondents had more than 20 years of farming experience.

Benjongtoshi (2014) studied on indigenous pest control method in *jhum* field crops in Mokokchung district, Nagaland and outlined that 78.33 per cent of respondents had farming experience more than 20 years.

Madhukar (2017) studied on farmers' perception about indigenous knowledge in plant protection in Latur district of Marathwada region of Maharashtra and revealed that 60.84 per cent of farmers had medium farming experience.

Ahmed (2020) studied on indigenous knowledge used by farm women for homestead vegetables production and revealed that 56.60 per cent were under medium level field experience category.

Operational land holding

Somasundaram (1995) in his study in indigenous farming system reported that 68.45 per cent of the respondents belonged to marginal or small farmer category in Tamil Nadu.

Nirban (2006) studied in Konkan region of Maharashtra and reported that 57.55 per cent of the farmers were in the category of marginal land holdings.

Kumari (2008) studied in Jharkhand state and concluded that majority of tribal farmers belonged to small farmer category.

Maravi (2009) studied in agricultural aspects of ITK prevailing in Gwalior region of Madhya Pradesh and reported that 50 per cent of the respondents had medium size of land holdings.

Patidar (2013) studied on the use of ITK and lead to the understanding that most of the respondents were small to medium farm size group.

Sariya (2015) studied on indigenous knowledge in agricultural aspects prevailing in Tarana block of Ujjain district of Madhya Pradesh and reported that 38.89 per cent of the farmers had medium land holdings.

Jallaraph (2016) studied on awareness and adoption of indigenous technical knowledge in paddy cultivation in Bastar district of Chhattisgarh and reported that majority (52.50 %) of the respondents were having small sized land holding.

Kumar (2016) conducted survey on Indigenous Technical Knowledge prevalent in Saidpur block of Ghazipur district, Uttar Pradesh revealed that 42.63 per cent of respondents were under the category of small land holding.

Madhukar (2017) studied on farmers' perception about indigenous knowledge in plant protection in Latur district of Marathwada region of Maharashtra and revealed that 47.50 per cent of the respondents had semi medium land holding.

Ahmed (2020) studied on indigenous knowledge used by farm women for homestead vegetables production and revealed that 91.50 per cent were small land holder.

Sharma (2020) conducted survey on identification of indigenous knowledge and its utilization in contemporary modern agriculture at Shajapur district of Madhya Pradesh and reported that 59.17 per cent belonged to small farmer group.

Occupational status

Somasundaram (1995) reported that 93.58 per cent of the respondents were engaged in agriculture alone or dairy as subsidiary occupation.

Kalita (2007) studied in Karbi-Anglong district of Assam and revealed that agriculture was primary occupation along with fishing as secondary activity.

Maravi (2009) studied in agricultural aspects of ITK prevailing in Gwalior region of Madhya Pradesh and reported that 63.33 per cent of

respondents were engaged in farming and rest of them involved in one subsidiary occupation.

Sariya (2015) studied indigenous knowledge in agricultural aspects prevailing in Tarana block of Ujjain district of Madhya Pradesh and revealed that 47.78 per cent were performing agriculture as the main occupation.

Nagi (2019) studied on indigenous technical knowledge on farming practice of *Angami* tribe of Kohima district, Nagaland and reported that 61.67 per cent of the respondents were in the category of farming alone under occupational status.

Annual income

Somasundaram (1995) reported that 72.73 per cent of the respondents were in the category of low annual income.

Nirban (2006) studied in Konkan region of Maharashtra and reported that 85.92 per cent of the respondents belonged to medium income category.

Kalita (2007) studied in Karbi-Anglong district of Assam and revealed that majority of the respondents were having low level of income.

Kumari (2008) studied in Jharkhand state and concluded that majority of tribal farmers had medium level of annual income.

Maravi (2009) studied in agricultural aspects of ITK prevailing in Gwalior region of Madhya Pradesh and reported that 44.17 per cent of the respondents had low annual income.

Patidar (2013) studied on the use of ITK and lead to the understanding that most of the respondents were of low and medium income level group.

Rakesh (2014) studied on indigenous knowledge of tribal farmers of Arunachal Pradesh and reported that 28 per cent of the respondents belonged to the upper middle income category.

Khatri (2014) studied about indigenous health management practices of livestock among the dairy farmers in Hanumana block of Rewa district of Madhya Pradesh and reported that 50.83 per cent of the respondents had low level of annual income.

Sariya (2015) studied indigenous knowledge in agricultural aspects prevailing in Tarana block of Ujjain district of Madhya Pradesh and reported that 37.78 per cent belonged to the category of medium income level.

Jallaraph (2016) studied on awareness and adoption of indigenous technical knowledge in paddy cultivation in Bastar district of Chhattisgarh and revealed that 41.67 per cent of the respondents were under the category of medium annual income.

Kumar (2016) conducted survey on Indigenous Technical Knowledge prevalent in Saidpur block of Ghazipur district, Uttar Pradesh revealed that 40 per cent of the respondents were under medium income group.

Madhukar (2017) studied on farmers' perception about indigenous knowledge in plant protection in Latur district of Marathwada region of Maharashtra and reported that 90.83 per cent of the respondents had medium level of annual income.

Ahmed (2020) studied on indigenous knowledge used by farm women for homestead vegetables production and revealed that 59.40 per cent of the respondents were under medium income level category.

Sharma (2020) conducted survey on identification of indigenous knowledge and its utilization in contemporary modern agriculture at Shajapur

district of Madhya Pradesh and reported that 60.00 per cent of the respondents belonged to medium annual income.

Social participation

Somasundaram (1995) stated that 62.03 per cent of the respondents had low social participation.

Maravi (2009) studied in agricultural aspects of ITK prevailing in Gwalior region of Madhya Pradesh and reported that 44.44 per cent of respondents were under medium social participation group.

Rakesh (2014) studied on indigenous knowledge of tribal farmers of Arunachal Pradesh and reported that 40 per cent of the respondents were not engaged in any formal organizations while 40 per cent of the respondents had membership of at least one organization.

Khatri (2014) studied about indigenous health management practices of livestock among the dairy farmers in Hanumana block of Rewa district of Madhya Pradesh and reported that 48.33 per cent of the respondents indicated low level of social participation.

Sariya (2015) studied on indigenous knowledge in agricultural aspects prevailing in Tarana block of Ujjain district of Madhya Pradesh and reported that 43.33 per cent belonged to the category of medium social participation group.

Jallaraph (2016) studied on awareness and adoption of indigenous technical knowledge in paddy cultivation in Bastar district of Chhattisgarh and revealed that 48.33 per cent of the respondents were under medium level of social participation category.

Madhukar (2017) studied on farmer's perception about indigenous knowledge in plant protection in Latur district of Marathwada region of

Maharashtra and reported that 89.17 per cent of the respondents were under medium level of social participation.

Sharma (2020) conducted survey on identification of indigenous knowledge and its utilization in contemporary modern agriculture at Shajapur district of Madhya Pradesh and reported that 40.83 per cent of the respondents were found to have low social participation.

Extension contact

Somasundaram (1995) stated that 56.15 per cent of the respondents had low extension agency contact.

Kumari (2008) studied in Jharkhand state and concluded that majority of tribal farmers were having medium level of extension contact.

Talisosang (2012) studied on indigenous rodent management by the *Ao-Nagas* of Nagaland and revealed that 67.71 per cent of the respondents had no contact with the extension agencies.

Rakesh (2014) studied on indigenous knowledge of tribal farmers of Arunachal Pradesh and reported that extension contact was poor and extent of use of newspaper, agricultural publication, television and radio was low.

Benjongtoshi (2014) studied on indigenous pest control method in *jhum* field crops in Mokokchung district, Nagaland and outlined that 78.33 per cent of the respondents had no contact with extension agencies.

Khatri (2014) reported that 53.33 per cent of the respondents among dairy farmers in Hanumana block of Rewa district of Madhya Pradesh had low extension agency contact.

Jallaraph (2016) studied on awareness and adoption of indigenous technical knowledge in paddy cultivation in Bastar district of Chhattisgarh and

reported that 55.83 per cent of the respondents had medium level of extension participation.

Madhukar (2017) studied on farmer's perception about indigenous knowledge in plant protection in Latur district of Marathwada region of Maharashtra and reported that 75.00 per cent of the respondents had medium level of extension contact.

Sharma (2020) conducted survey on identification of indigenous knowledge and its utilization in contemporary modern agriculture at Shajapur district of Madhya Pradesh and reported that 62.50 per cent of respondents had medium extension contact.

Scientific orientation

Sundaramari and Ranganathan (2003) studied on the scientific orientation of indigenous agricultural practices in Palani, Nilakottai and Reddiarchatramin, Kodaikanal blocks of Dindigul district of Tamil Nadu implied that majority (73.29 %) of the respondents had low to medium level of scientific orientation

Yedida *et al.* (2020) in their study on economic, scientific and management orientation of coconut growers of east Godavari district of Andhra Pradesh reported that 69 per cent of the respondents were under medium level, 16 per cent of the respondents with high level and 15 per cent of the respondents with low level of scientific orientation.

Maloth *et al.* (2020) in their study on socio-economic profile of fish farmers of Nizamabad district, Telangana revealed that 60 per cent of farmers had medium level, 10 per cent had high level and 30 per cent had low level of scientific orientation.

Mass-media exposure

Kumari (2008) studied in Jharkhand state and concluded that majority of the tribal farmers had medium level of mass media exposure.

Talisosang (2012) studied on indigenous rodent management by the Ao-Nagas of Nagaland and reported that 47.92 per cent of the respondents had no mass media exposure.

Patidar (2013) studied on the use of ITK and led to the understanding that most of the respondents were having medium level of mass media contact.

Benjongtoshi (2014) studied on indigenous pest control method in *jhum* field crops in Mokokchung district, Nagaland and outlined that 67.80 per cent of the respondents had contact with mass media *viz*., mobile, T.V and radio.

Jallaraph (2016) studied on awareness and adoption of indigenous technical knowledge in paddy cultivation in Bastar district of Chhattisgarh and reported that 59.17 per cent of the respondents were under medium level of mass media exposure category.

Sharma (2020) conducted survey on identification of indigenous knowledge and its utilization in contemporary modern agriculture at Shajapur district of Madhya Pradesh and reported that 62.50 per cent of respondents had medium mass media exposure.

Maloth *et al*. (2020) in their study on socio-economic profile of fish farmers of Nizamabad district, Telangana reported that 54.00 per cent of farmers had medium level of mass media exposure, 26.00 per cent with low and 20.00 per cent with high level of mass media exposure.

Training exposure

Ahmed (2020) studied on indigenous knowledge used by farm women for homestead vegetables production and revealed that 51.90 per cent of the respondents were under medium level category for training received.

Maloth *et al*. (2020) in their study on socio-economic profile of fish farmers of Nizamabad district, Telangana reported that 95.00 per cent of the farmers did not receive any training while only 5.00 per cent of the farmers received training.

2.2 Identification and documentation of indigenous technical knowledge in agriculture.

Dubey *et al.* (1993) studied on methodologies for tapping and documenting indigenous technologies and reported that several techniques like case study method, oral history method, key informant means, making diagrams, case histories, critical incidents, preference ranking and inventory of farmers indicators could be used for eliciting and documenting the knowledge from local people.

Karter (1993) outlined that verbal style of investigation does not yield satisfactory results always. He argued that observation became more important and asserted further that real insight could be obtained only by prolonged observation.

Nirban (2006) studied on indigenous technique followed in rice cultivation and bovine health management in Konkan region of Maharashtra and reported that farmers were not using chemical fertilizers and insecticides *etc*. They were of the opinion that such chemicals killed the frogs and fishes in the field. These frogs and fishes feed on the insects like armyworm, and even young one of crabs. Consequently, a natural control is achieved. It was also reported that almost all the farmers did not drive away the cranes in the

ploughed field, which feeds on the insects. Also the application of fresh cow dung was avoided by the farmers to keep the crop free from pest and disease. For control of Karapa (Rice blight) at later stage of crop growth, almost all the farmers dusted cow dung ash uniformly all over the field by hand.

Lal and Verma (2006) in their study on use of certain bio-products for insects-pest control stated that farmers commonly use ash against chewing and sucking type of insect pests. They also reported the use of bio products *viz*. aged cow urine, *Vitex negundo* Linn., *Ferula assafoetida* Linn, Aloe *barbadensis* Mill and *Nicotiana tabacum* Linn. were found to be very effective against the insect pests of cabbage, wheat, peas, grams and other crops. The indigenous bio-insecticide had been found to be effective as well as eco-friendly.

Kumari (2008) conducted survey on indigenous knowledge practiced by tribal farmers in agriculture of Jharkhand state and identified 35 ITKs related to paddy which constitutes 29.62 per cent followed by 23 ITKs related to horticultural crops constituting 17.69 per cent, 21 ITKs for pulses constituting 16.15 per cent, 13 ITKs related to maize constituting 10 per cent, 12 ITKs related to wheat making 9.24 per cent, 11 ITKs for groundnut making 8.46 per cent and 15 ITKs were reported about the weather forecasting which constitutes 11.54 per cent, respectively.

Sarangi *et al.* (2009) studied on rat proof grain storage by *Adi* tribes of Arunachal Pradesh and revealed three scientific features of this structure used as rat proof grain storage. This included use of stone pad at the bottom, wooden plate at the middle and airtight compartment at the top makes it a unique and innovative storage structure.

Subba (2009) studied on indigenous knowledge on bio-resources management for livelihood of the people of Sikkim stated that people of

Sikkim were rich in indigenous knowledge on bio-resources and identified fifteen types of indigenous farming systems.

Karthikeyan *et al.* (2009a) documented various types of indigenous storage structures used by the farmers of Tamil Nadu at farm level. Among these, Kodambae (large sized cylindrical structures), Kuthir (medium capacity bins) and mud pots Paanai (small capacity storage) are common types of storage systems. It was also reported that grains are stored in conventional granary rooms and bamboo structures called Urai indigenously oven are also in use. These structures were designed to enable the grain to be loaded and unloaded, with the possibility of periodic removal of limited quantities of grain, after which the unloaded part was sealed. By this way, the quality of grain was maintained in good condition.

Karthikeyan *et al.* (2009b) conducted survey on traditional tools in agricultural practices used by the farmers of Tamil Nadu and documented 21 traditional agricultural tools.

Chanu *et al.* (2010) identified and documented indigenous rice varieties and their management practices against pest and concluded that traditional management practices such as the use of botanicals, creating prey-predators attraction environment in the rice field, recycling agricultural wastes and other indigenous agronomic practices were found effective against pest/pathogens of rice in traditional organic farming system.

Dhaliwal and Singh (2010) studied on traditional food grain storage practices of Punjab to identify the traditional practices and to know the scientific basis of these practices, if any. Traditional practices were identified from well experienced farmers from 12 villages through interviews and focused group techniques. And reported that scientific basis was discussed with biological scientist on three point continuum. Majority of the identified

indigenous practices were said to be scientifically agreeable, having scientific basis which needs further standardization.

Lakra *et al.* (2010) conducted survey among the tribal farmers in Jharkhand and found out that tribal farmers are known to have rich knowledge of indigenous technology pertaining to agricultural practices and an attempt was made to document the indigenous knowledge. About 26 indigenous knowledge on soil management and weed management was identified in the study area.

Chandola *et al*. (2011) studied on indigenous pest management practices prevalent among the hill farmers of Uttarakhand and stated that the farmers are still managing pests with indigenous methods in Uttarakhand hills and identified various indigenous pest management practices and scientific basis of practicing them.

Chinlampianga (2011) studied on traditional knowledge, weather prediction and bioindicators practiced in Mizoram, Northeastern India and stated that tribal people of Mizoram formerly forecasted the weather through applications of long-standing traditional ecological knowledge and documented 16 distinct bioindicators. The bioindicators were based mainly on the recognition of unique situations, the behaviour of insects, birds and mammals, characteristics of plants, and location, timing and patterns of clouds, lighting, wind, moon, sun and stars.

Dey and Sarkar (2011) documented some of the indigenous knowledge related to agricultural practices, including land preparation, manuring, soil treatment, cropping systems, input management, water resource management and utilization, and soil and water conservation practices used especially by tribal farmers of the region. Related research and policy issues essential for successful amalgamation of such indigenous knowledge in resource conservation and climate change adaptation were also discussed.

Mao and Hynniewta (2011) in their study examined the agricultural practices of the *Mao Naga* tribe in Manipur, India. They reported that agriculture was the primary livelihood of the tribe and uncovered an interesting method they employed to determine the appropriate planting seasons for various crops. The tribe relied on observing the flowering patterns of specific plants to identify the optimal time for planting, identified four plants—peach (*Prunus persica*), wild cherry (*P. carmesina*), camel foot (*Bauhinia purpurea*), and dancing girl (*Mantisia spathulata*) that served as indicators for the agricultural seasons.

Rizwana and Lyaqet (2011) studied on traditional knowledge used in paddy cultivation in Raipur district, Chhattisgarh and described the indigenous technologies used by the farmers in paddy cultivation for seed germination, preventing the crop from insect/pest attack in field and storage.

Talisosang (2012) studied on indigenous rodent management by the Ao-Nagas of Nagaland and identified five indigenous practices *viz*., *Longnen*, *Merang sang*, *Konglen*, *Tsungtem* and *Tongi*. It was reported that all indigenous practices were considered effective except *Tongi* by the farmers.

Talukdar *et al.* (2012) identified and documented the utilization of indigenous knowledge system by farmers in the production of *boro* rice in Assam. Total of 57 ITKs under nine selected cultivation practices were documented. The maximum number (33) of ITKs were identified and documented under plant protection and least number (only one) recorded in fertility management. Majority of the identified ITKs (43.86%) were found to be moderately effective as respondents view. The rationale behind the use of ITKs identified in the investigation was purely based on free opinion of the respondents as they have observed the results in their own situation.

Barman *et al.* (2014) identified and documented 24 biopesticides plant species which serve the purpose of botanical pesticides in rice and other crop

field by *Garo* tribe in West Garo Hill district, Meghalaya. Bioresources utilization forms an inseparable part in the life among the tribal communities in the management of insect and pest in rice cultivation.

Benjongtoshi (2014) in his study on agricultural indigenous pest control method in *jhum* field crops in Mokokchung district, Nagaland identified and recorded 10 indigenous pest control method, which were considered effective by the respondents and 90.00 per cent of the respondents seldom used the indigenous pest control method.

Gopi *et al.* (2016) conducted survey on traditional pest and disease management practices in Sikkim Himalayan region to identify different traditional pest and disease control measures adopted by farmers. Different ITKs were identified like the use of wood ash, kerosene, table salt, lime, cow urine, cow dung, some unique indigenous plants and indigenous techniques like insertion of bamboo pegs were used by the farmers for the management of various pests and disease in Sikkim.

Jallaraph (2016) studied on awareness and adoption of indigenous technical knowledge in paddy cultivation in Bastar district of Chhattisgarh and identified 28 important indigenous technical knowledge that were practiced among the paddy growers in the study area. These practices were divided into 9 categories *viz*., field preparation and sowing, pre-sowing seed treatment, sowing methods, selection of seeds, manure application practices, weed control, irrigation management, plant protection measures and storage of seeds.

Gogoi *et al.* (2017) reported in their study that farmers of Central Brahmaputra Valley in Assam region collected few numbers of ghundhi bug from the field and made paste of it. This paste was mixed with water and sprinkled in the field so that smell of ghundhi bug acted as repellent of ghundhi bug itself.

Nath *et al.* (2017) in their study on Indigenous technological knowledge for pest management in Tinsukia district of Assam concluded that identification of scientifically sound indigenous practices may serve as the input for valid scientific management for large scale use of insect pest management and in generation of low cost, location specific and appropriate technology. All in about 30 ITKs were collected and documented. The percentage of farmers practicing different ITKs ranged from 11.00 per cent to 78.65 per cent.

Nagi (2019) studied on indigenous technical knowledge on farming practice of *Angami* tribe of Kohima district, Nagaland and identified 44 indigenous technical knowledge, 11 wild edible vegetables and 16 indigenous tools and implements.

2.3 Constraints faced by the ITK users in practice of indigenous technical knowledge.

Balasubramanian (1992) studied on Indigenous knowledge used in dry lands and outlined that high cost of preparatory cultivation (12.50 %), time consuming and difficult to follow sowing procedure during rainy season and the pest problem were the main constraints.

Ranganatha (2002) studied on indigenous farm practices followed by Soliga tribals and reported the constraints perceived by tribals in the extent of use of indigenous practices were improper water management practices, more of animal menace, less land holding, improper basic facilities, lack of regular extension service, more of crop failure during bende flowering and no proper storage facilities to them.

Shahu (2002) in his study on Indigenous technologies in selected crops of tribal area of Vizianagaram district outlined the following constraints as the most important in adoption of Indigenous Technical Knowledge; labour

intensive nature of Indigenous Technical Knowledge, non-availability of inputs, attractive nature of modern practices, fear of getting labeled as backward, farmers hold a view that the Indigenous Technical Knowledge as inferior to modern practices.

Kumari (2008) in her study on Indigenous Technical Knowledge of tribal farmers in agriculture of Jharkhand state reported that poor water retention capacity of the soil, high cost of neem related products *etc*, traditional belief, lack of proper technology for integrated pest management, poor contact of extension worker with farmers found major bio-physical, thematic, micro-level, technological, administrative and extension constraints in agriculture respectively.

Husain and Sundaramari (2013) in their study on constraints faced by farmers in adoption of indigenous horticultural practice revealed that preference for sophistication with reliance on readymade inputs, lack of expert guidance/extension support for the adoption of IHPs, labour intensive nature of IHPs, absence of financial support from government/other agencies, more time required to get desired results from IHPs, over reliability on the external chemical inputs as compared to indigenous inputs, lack of chances for exposure towards IHPs, lack of availability of required inputs for the adoption of IHPs, difficulty in handling of bulky inputs, lack of proper and institutional information sources on IHPs in agriculture were the most important constraints faced by the farmers in the adoption indigenous horticultural practices.

Devi *et al*. (2014) in their study on assessment of applicability of indigenous technical knowledge in aquaculture as perceived by fish farmers in Assam documented nine constraints as reported by farmers. The main constraint reported was that 'ITK alone is not complete panacea for fish production practices' while 'elderly, experienced farmers do not transfer their knowledge to any other person, except their sons' ranked the last.

Khatri (2014) in his study on analytical study of management of indigenous technical knowledge regarding livestock health practices among the dairy farmers in Hanumana block of Rewa district of Madhya Pradesh stated following constraints; educated people gives less recognition to this knowledge, without ascertaining its importance (52.50 %), extinct due to non-practice by younger generations (51.66 %), preparation of medicine is time consuming (50.84 %), lack of sufficient number of plants for treatment (43.33 %), long time to control disease (35.00 %), many herbs are extinct (32.50 %) and lack of ability to identify right plants (24.16 %).

Rakesh *et al.* (2015) studied on constraints faced by farmers in indigenous cropping and ethno veterinary practices in Arunachal Pradesh stated that local varieties which are pest and disease resistant are vanishing in the study area. And in ethno veterinary practices unavailability of sufficient number of plants at the time of treatment was reported.

Kanagasabapathi and Sakthivel (2016) in their study on constraints in the adoption of indigenous farming practices concluded that indigenous agriculture were being adopted by the farmers of Kolli Hills in centre Tamil Nadu for different reasons. However, a lot of constraints prevent the farmers in adopting indigenous farming practices that include poor yield, poor marketing facilities, higher production cost and urbanization.

Khateeb *et al.* (2017) reported the constraints perceived by the pastoralists of hilly regions of Jammu and Kashmir in the utilization of indigenous technical knowledge. The constraints perceived by the practitioners while managing their indigenous knowledge were inability to identify the right plant, no scientific validation, modification and optimization of indigenous technical, perception about indigenous technical knowledge that it is out dated, inconvenient and time consuming nature were the serious constraints perceived by the practitioners

Jallaraph (2016) in his study on awareness and adoption of indigenous technical knowledge in paddy cultivation in Bastar district of Chhattisgarh revealed that majority (88.33 %) of the respondents faced difficulty in control of pests and disease control, followed by lack of labour for agricultural purpose (83.33 %), no facility provided by the government to adopt ITK (72.50 %), low level of education (69.17 %), no complete literature available regarding ITK (66.67 %) were major constraints encountered by the respondents.

Sujeetha and Asokhan (2020) in their study on constraints faced by the Nilgiris tribal women while adopting indigenous practices concluded that majority (92.78 %) of the tribal farmers expressed poor soil fertility as a major constraint for the adoption of indigenous technologies. The major problems faced by the tribal farmers in the adoption of indigenous technologies were uneven topography of land (82.22 %), and less yield and income (85.56 %).

CHAPTER III

RESEARCH METHODOLOGY

RESEARCH METHODOLOGY

This chapter deals with the details of the research methodology adopted for the present investigation. The present chapter deals with the concise description of the data collection and analytical methods used in the light of stated objectives. The research methods and procedures taken up in the present study for conducting the investigation are given under the following heads.

3.1 Area of investigation and sampling design

3.2 Selection of the respondents

3.3 Selection of variables

3.4 Relevant variables and their empirical measurements

3.5 Methods of data collection

3.6 Statistical tools used for data analysis

3.1 Area of investigation and sampling design

The study was conducted in Anjaw district of Arunachal Pradesh during the period of 2018 to 2020 and 2021 to 2022.

A research design is a general blueprint which involves collection, measurement and analysis of data to complete the research (Triparthi, 1987). It includes an outline of what the investigator will do. According to Kerlinger (1987), research design is a plan, structure, and strategy of investigation conceived so as to obtain answers to research questions and to control variance.

The research design was descriptive and multistage purposive cum random sampling design was followed for the study. A diagrammatic representation of the area of study as well as sampling design followed in this study has been depicted in the fig 3.1 and fig 3.2 respectively.

Map of Anjaw District

Fig 3.1 Map of Anjaw district

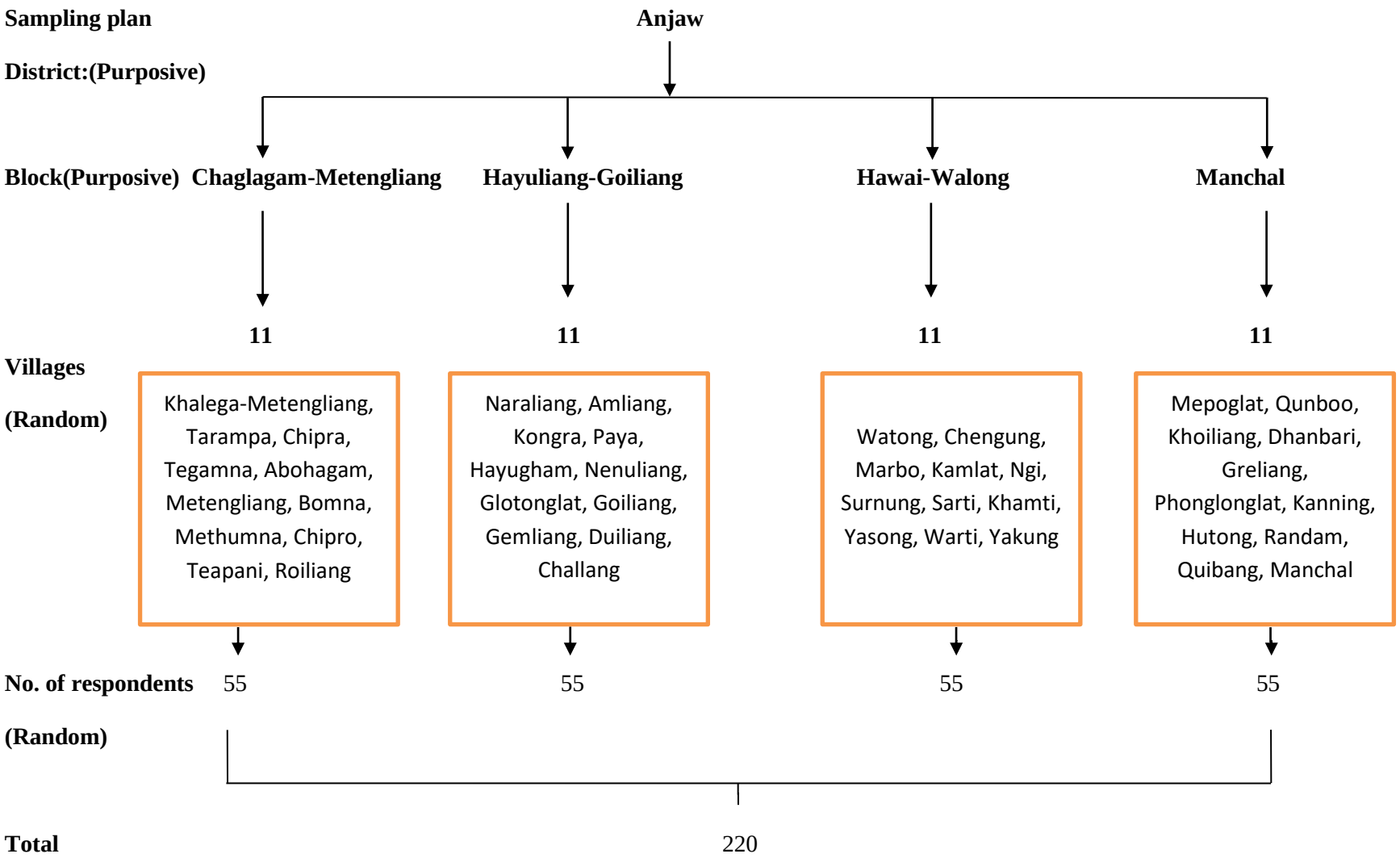

Fig 3.2 Sampling plan

3.1.1 Selection of the district

At present, there are 26 districts in the state of Arunachal Pradesh. The *Kaman* and *Taraon*/*Tawrah Mishmi* people inhabit in Lohit and Anjaw district while *Idu Mishmi* people inhabit in Dibang Valley and Upper Dibang Valley District with few population in Upper Siang and East Siang district of Arunachal Pradesh. Out of these, Anjaw district was purposively selected for the present study on the basis of following criteria.

No prior systematic research study has been undertaken on "Indigenous Technical Knowledge" of farmers regarding cultivation practices of any crop.

Mishmi tribe is rich in culture and indigenous traditions. Unfortunately, due to modernization much of the indigenous knowledge are fast becoming extinct, therefore there is an urgent need to document it.

The present study mainly focussed on ITKs adopted by *Kaman* and *Taraon/Tawrah Mishmi* sub-tribe of *Mishmi* tribe. Anjaw district is inhabited by both subtribes.

3.1.2 Selection of agricultural blocks

The district of Anjaw consists of 4 CD-blocks *viz*, Hayuliang-Goiliang CD-block, Manchal CD-block, Chaglagam-Metengliang CD-block and Hawai-Walong CD-block. Since both tribe inhabit in different blocks, all blocks were considered for the study for better representation of data.

3.1.3 Selection of villages

Taraon/Tawrah Mishmi people mainly inhabit in Hayuliang-Goiliang block and Chaglagam-Metengliang blocks while *Kaman Mishmi* people inhabit in Manchal block and Hawai-Walong block. Based on the major sub-tribe inhabiting in the area, 11 villages from each block were randomly selected for this study. Thus, 44 numbers of villages were selected for this study.

Sl no.	CD-Block	VILLAGE
1	Hayuliang-Goiliang	Naraliang, Amliang, Kongra, Paya, Hayugham, Nenuliang, Glotonglat, Goiliang, Gemliang, Duiliang, Challang
2	Chaglagam-Metengliang	Khalega-Metengliang, Tarampa, Chipra, Tegamna, Abohagam, Metengliang, Bomna, Methumna, Chipro, Teapani, Roiliang
3	Manchal	Mepoglat, Qunboo, Khoiliang, Dhanbari, Greliang, Phonglonglat, Kanning, Hutong, Randam, Quibang, Manchal
4	Hawai-Walong	Watong, Chengung, Marbo, Kamlat, Ngi, Surnung, Sarti, Khamti, Yasong, Warti

3.2 Selection of the respondents

For the present study, respondents are the farmer from *Kaman* and *Taraon/Tawrah Mishmi* sub-tribe who are ITK practitioners. From each selected villages, a list of names of the farmers involved in ITK practices in agriculture was prepared in consultation with concerned head of the village. Then, 5 farmers from each list were randomly selected for the purpose of collection of information and data. Thus, 220 respondents constituted final sample for this study.

3.3 Selection of variables

After reviewing available literature relevant for the study and receiving constructive opinion from the experts, 11 profile characteristics and 1 descriptive variable was selected for this study.

3.3.1 Profile characteristics

i. Age
ii. Sex
iii. Educational status
iv. Farming experience
v. Operational land holding
vi. Occupation
vii. Annual income
viii. Social participation
ix. Extension contact
x. Scientific orientation
xi. Mass media exposure
xii. Training exposure

3.3.2 Descriptive variable

i. ITK identification and documentation

3.4 Relevant variables and their empirical measurements

3.4.1 Profile characteristics

3.4.1.a Age

Age refers to the chronological age of the respondents in terms of completed years at the time of interview. The respondents were categorized as young age group, middle age group and old age group under the following ranges. The empirical measures used for this variable was mean and standard deviation.

Sl no.	Category	Categorization method
1.	Young age group	Up to ($\bar{X}$ – SD)
2.	Middle age group	Between ($\bar{X}$ – SD) and ($\bar{X}$ + SD)
3.	Old age group	($\bar{X}$ + SD) and above

3.4.1.b Sex

Sex refers to the biological and physiological characteristics that define male and female. The respondents were classified as male and female and scores of 1 and 2 were given as shown in table.

Sl no.	Category	Score
1.	Male	1
2.	Female	2

3.4.1.b Educational status

Educational status in this study was operationalized as the ability of the respondents to read and write and formal education possessed by them at the time of enquiry. The respondents were categorized based on the score suggested by Trivedi and Pareek (1963) with slight modification. They were classified into eight categories, *viz*. illiterate, can read only, can read and write, up to primary level, up to middle level, up to secondary level, up to higher secondary and graduate and above. The empirical measures used for this variable was frequency and percentage.

Sl no.	Category	Score
1	Illiterate	0
2	Can read only	1
3	Can read and write	2
4	Up to primary level	3
5	Up to middle level	4
6	Up to secondary level	5
7	Up to higher secondary	6
8	Graduate and above	7

Based on the score obtained, the respondents were further categorized as

Sl no.	Category	Score range
1	No education	0
2	Low education	1-2
3	Medium education	3-4
4	High education	5-7

3.4.1.c Farming experience

Farming experience refers to the number of years of experience in farming by the respondents. The respondents were categorized as low experience, medium experience and high experience. The empirical measures used for this variable was mean and standard deviation.

Sl no.	Category	Categorization method
1	Low experience	Up to ($\bar{X}$ – SD)
2	Medium experience	Between ($\bar{X}$ – SD) and ($\bar{X}$ + SD)
3	High experience	($\bar{X}$ + SD) and above

3.4.1.d Operational land holding

Operational land holding refers to the land areas expressed in acres operated by a farmer respondent for cultivation of crops at the time of enquiry. The size of operational land holding was calculated as follows

Size of operational land holding (Acre) = (Land owned) + (Land leased in) – (land leased out)

On the basis of operational land holding, the respondents were categorized as small, medium and big farmers as shown in the table.

The empirical measures used for this variable was mean and standard deviation.

Category	Range
Small	Up to ($\bar{X}$ – SD)
Medium	Between ($\bar{X}$ – SD) and ($\bar{X}$ + SD)
Big	($\bar{X}$ + SD) and above

3.4.1.e Occupational status

Occupational status is referred to the nature of work done by the respondents. This included both primary activity as well as secondary activity for which the respondent was depended for income. Combinations of different occupations were listed. The scoring procedure followed by Somasundaram (1995) was adopted with slight modification. The respondents were classified into five categories based on the occupational status as shown in the table. The empirical measures used for this variable was frequency and standard percentage.

Sl no.	Category	Score
1	Farming alone	5
2	Farming + Agricultural Labour	4
3	Farming + Livestock	3
4	Farming + Independent Profession	2
5	Farming + Service	1

3.4.1.f Annual income

Annual income refers to the total earnings obtained from farming, animal husbandry, off-farming activities *etc.* from the respondents in one

calendar year. The empirical measures used for this variable was mean and standard deviation.

The respondents were classified as follows.

Category	Score
Low	Up to ($\bar{X}$ – SD)
Medium	Between ($\bar{X}$ – SD) and ($\bar{X}$ + SD)
High	($\bar{X}$ + SD) and above

3.4.1.g Social participation

Social participation refers to the degree of involvement of the respondents in formal organizations as a member, as an office bearer and both. The degree of involvement taken into consideration includes both present and past involvement for quantifying the variables. The scoring procedure followed by Trivedi 1963 and Somasundaram 1995 was adopted. The total score was derived by adding up scores of the past and present involvement. The respondents were classified into low, medium and high using the cumulative frequency method.

Sl no.	Degree of involvement	Score
1	Member in one organization	1
2	Member in more than one organization	2
3	Office bearer in one organization	3
4	Office bearer in more than one organization	4
5	No involvement	0

3.4.1.h Extension contact

Extension contact refers to the extent to which respondents maintained contact with change agents for obtaining agricultural and non-agricultural information. (Gohain, 2006) (Talukdar *et al*., 2012).

The scoring procedure followed was

Sl no.	Category	Score
1	No contact	0
2	Yearly	1
3	Half-yearly	2
4	Monthly	3
5	Weekly	4

The given extension personnel were assigned with different weightage value, which as follows

Sl no.	Category	Weightage
1	Agricultural Scientist	5
2	Agricultural Development Officer	4
3	Agricultural Field Assistant	3
4	Block Extension Personnel	2
5	Input Dealer/NGO/Progressive Farmer	1

The final scores were calculated by multiplying the extent of contact scores with the corresponding weightage values. The respondents were further categorized as low, medium and high using cumulative frequency method.

Category	Score
Low	Upto ($\bar{X}$ – SD)
Medium	Between ($\bar{X}$ – SD) and ($\bar{X}$ + SD)
High	($\bar{X}$ + SD) and above

3.4.1.i Scientific orientation

Scientific orientation was operationalized as the degree to which a farmer is oriented towards scientific techniques and thinking in his outlook. The scale developed by Supe and Singh, 1969 was used to study scientific orientation of the respondents. The scale consists of six statements of which five are positive statement and one negative statement.

The statements are as follows.

Sl no.	Statements
1	New method of farming gives better result to farmer than traditional method.
2	Even a farmer with lots of experience should use new methods of farming
3	Though it takes time for a farmer to learn new methods I farming it is worth the effort.
4	A good farmer experiments with the new ideas in farming.
5	Traditional methods of farming have to be changed in order to raise the level of living a farmer.
6	The way the farmer's forefather farmed is still the best way to farm today.

The response was measured in five point continuum. The scoring procedure adopted was

Response	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
Positive Statement	7	5	4	3	1
Negative Statement	1	3	4	5	7

The score for each statement was used to sum up to get individual score. The respondents were classified in to low, medium and medium and high using cumulative frequency method.

Category	**Score**
Low	Up to ($\bar{X}$ – SD)
Medium	Between ($\bar{X}$ – SD) and ($\bar{X}$ + SD)
High	($\bar{X}$ + SD) and above

3.4.1.j Mass media exposure

This variable was measured in terms of acquiring agricultural information through radio listening behavior, reading or listening to reading of newspaper, magazines, leaflets, folders and bulletins and also based on the exposure to films, demonstrations and field days of respondents. The measurement was done according to the procedure followed by Somasundaram (1995). The statements were assigned as follows.

Sl. No.	**Statements**	**Responses**		
		Regularly	Rarely	Never
1.	Listening to agricultural programmes in radio.			
2.	Reading or listening to reading of agricultural news in newspaper.			
3.	Reading or listening to reading of agricultural news in magazines, leaflets, folders and bulletins.			
4.	Viewing of agricultural programmes in television.			
5.	Seeing of agricultural films.			
6.	Participation in agricultural demonstrations and field days.			

The scoring was given as ‘2’ for regularly, ‘1’ for rarely and ‘0’ for never category.

Categorization was done considering total score and based on cumulative frequency method as low, medium and high.

Category	**Score**
Low	Up to ($\bar{X}$ – SD)
Medium	Between ($\bar{X}$ – SD) and ($\bar{X}$ + SD)
High	($\bar{X}$ + SD) and above

3.4.1.k Training exposure

Training exposure is the extent to which the farmer respondents are exposed to the training related to organic farming and different aspects of agricultural technology under department of agriculture or any other extension agency during last five years. The farmer respondent who received training or attended training were assigned with score '1' and respondent who has not received training or attended were assigned with score '0'.

Sl no.	**Category**	**Score**
1	Training not attended	0
2	Training attended	1

3.4.2 Descriptive variable

3.4.2.a Identification and documentation of indigenous technical Knowledge

For collecting information on indigenous technical knowledge practiced in shifting cultivation, field survey was conducted in the study area during the year 2018-2019.

Identification and documentation of indigenous technical knowledge was done by using the structured interview schedule to find out the effectiveness and rationality of the indigenous practices. The effectiveness of the indigenous practices was purely based on the respondent's opinion.

Effectiveness is the capability of a material or non-material object to produce something or to lead to come to some consequences. In the present study, effectiveness of indigenous technical knowledge refers to the extent to which those are operative or fit in producing intended results in various agricultural practices and thereby contribute towards enhancement of yield in crops as perceived or experienced by the farmer.

In this study, the effectiveness of indigenous technical knowledge practiced in shifting cultivation was assessed by using a structured schedule developed by Talukdar *et al.* (2012) with five options, *viz*., no success, up to 25% success, up to 50% success, up to 75% success, up to 100% success. Each respondent was asked to put his/her opinion against each ITK known and practiced as per his/her experience in any one of the above mention alternatives.

The effectiveness scores were collected only for those practices and traps that were still practiced at the time of survey.

Sl no.	Category of response	Score
1	No success	0
2	Up to 25% success	1
3	Up to 50% success	2
4	Up to 75% success	3
5	Up to 100% success	4

The score thus obtained for a particular ITK and for a particular respondent was considered as individual respondent-wise score.

The effectiveness score of each ITK for the total number of respondents was computed using the following formula:

$$E_x = \frac{\sum X_i}{n}$$

Where,

X_i = effectiveness score of ith respondent for a particular ITK (say, X)

$\sum X_i$ = summation of individual respondent-wise effectiveness score for a particular ITK

n = number of respondents who furnished response as to effectiveness of a particular ITK (say, X)

E_x = effectiveness score of a particular ITK (say, x)

On the basis of the effectiveness score calculated, all the ITKs identified during the present study were categorized in three levels as follows:

Sl no.	Category	Score range
1	Less	Up to ($\bar{X}$ – SD)
2	Moderate	Between ($\bar{X}$ – SD) and ($\bar{X}$ + SD)
3	High	($\bar{X}$ + SD) and above

3.4.2.b Extent of adoption of indigenous technical knowledge

Rogers (1983) defined the adoption as the decision to make full use of a new idea as the best course of action available. In this study, adoption was operationalized as whether an individual respondent had practiced any of the indigenous technical knowledge in the field of agriculture.

The respondents were enquired whether the traditional practices were followed/used in the previous years. If the answer was 'Yes', a score of one was given and if the answer was 'No', zero score was given. The scores obtained were summed up for those respondents following/using traditional practices and adoption score was obtained.

$$\text{Adoption index} = \frac{\text{Number of traditional practices adopted}}{\text{Number of traditional practices available}} \text{ X } 100$$

Based on the extent of adoption, the respondents were classified as low, medium and high users.

3.4.3 To identify the constraints faced by indigenous technical knowledge users

In this study, constraint is referred to the problems, hindrance or barriers which come in the way of acceptance and adoption of indigenous technical knowledge. A list of constraints was prepared after the pilot study conducted in the study area. The constraints were further reviewed and reconsidered to finalize as recognized constraints for the study. Altogether, 7 constraints were included in the study and respondents were allowed to rank the statement. Based on the response provided, garrett ranking technique was used for the study.

3.5 Methods of data collection

Primary and secondary data's were collected for the purpose of the study. An interview schedule was prepared based on the objectives set for the study. Primary data was collected from the respondents through personal interview and group discussion. Secondary data was collected from relevant text books, journals, internet sources *etc*. the collected data were coded, tabulated and analyzed to get the result.

3.6 Statistical tools used for data analysis

For drawing valid conclusion, the data's were processed, classified, tabulated and systematically analyzed with appropriate statistical tools. Following are statistical tools used for analysis of available data's.

3.6.1 Percentage

Percentage is a way of expressing a number as a fraction of 100.

$$\text{Percentage (\%)} = \frac{Number\ of\ observations}{Total\ number\ of\ observation} \text{ X } 100$$

3.6.2 Arithematic mean

Arithemetic mean of a set of values is the quantity commonly called the mean or the average. It is defined as the sum total of all observations divided by the number of cases.

$$\text{Mean} = \frac{Sum\ total\ of\ all\ observations}{Number\ of\ observation}$$

3.6.3 Standard deviation

Standard deviation is defined as the square root of the sum of squared deviation about the mean divided by the number of cases.

$$SD = \sqrt{\frac{\sum(x-\bar{x})2}{n-1}}$$

Where, SD = Standard Deviation

x = Individual Score

N = Number of Observations

3.6.4 Garrett ranking

An attempt has been made to study the problems faced by the farmers in continuing indigenous technical knowledge practiced in shifting agriculture. For this purpose Garrett's Ranking Technique was used. 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. It is used to find the most significant factor which had influenced the respondent in their practices. As suggested by Garrett for converting rank into scores, when the preference of a particular problem different from respondent to respondent. The conversion method was as follows

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

Where,

R_{ij} = Rank given for the i^{th} variable by the j^{th} respondents.

N_j = Number of variable ranked by the j^{th} respondents.

With the help of Garrett's table, the per cent position estimated is converted into scores by referring to the table given by Garrett and Woodworth (1969).

3.6.5 Pearson's correlation coefficient

Pearson's correlation coefficient was used to measure the extent of the relationship prevailing between the variables which can be expressed as

$$\rho xy = \frac{\text{cov (XY)}}{\sigma X \sigma Y}$$

where,

cov is the covariance

σX is the standard deviation of X

σY is the standard deviation of Y

3.6.6 Multiple linear regression

Stepwise regression under multiple linear regression was used to predict the outcome of the dependent variable and multiple independent variable which can be expressed as

$$Y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n + €$$

where,

Y_i is the dependent variable

$x_1, x_2 \ldots x_n$ is the independent variable up to n^{th} value

$\beta_1, \beta_2 \ldots \beta_n$ is the coefficient up to n^{th} value

β_0 is the y-intercept (constant term)

$€$ is the model's error term

CHAPTER IV

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

The collected data for the present study have been organized and analyzed keeping in view the objectives of the study. The results and discussions of the present study are given under the following headings:

4.1 To study the profile of indigenous technical knowledge users of *Mishmi* tribe of Arunachal Pradesh

4.2 To identify and document indigenous technical knowledge in agriculture used by *Mishmi* tribe of Arunachal Pradesh

4.3 To study the constraints faced by the indigenous technical knowledge users in practice of indigenous practices in agriculture

4.4. Association and influence of independent variables with dependent variable.

4.1 Profile characteristic of the respondents

The purpose of the selection of this objective was to study the status of the indigenous technological users in respect to their profile characteristics. All the possible considerations related to profile characteristics were included and discussed accordingly under this objective.

4.1.1 Age

Age is considered to be one of the most important factor for taking decision about different aspects. It plays a vital role in decision making because of the mental maturity and psycho-physical energy associated with age. Thus, age has been considered as one of the variables in this study and is presented in the Table 4.1.1.

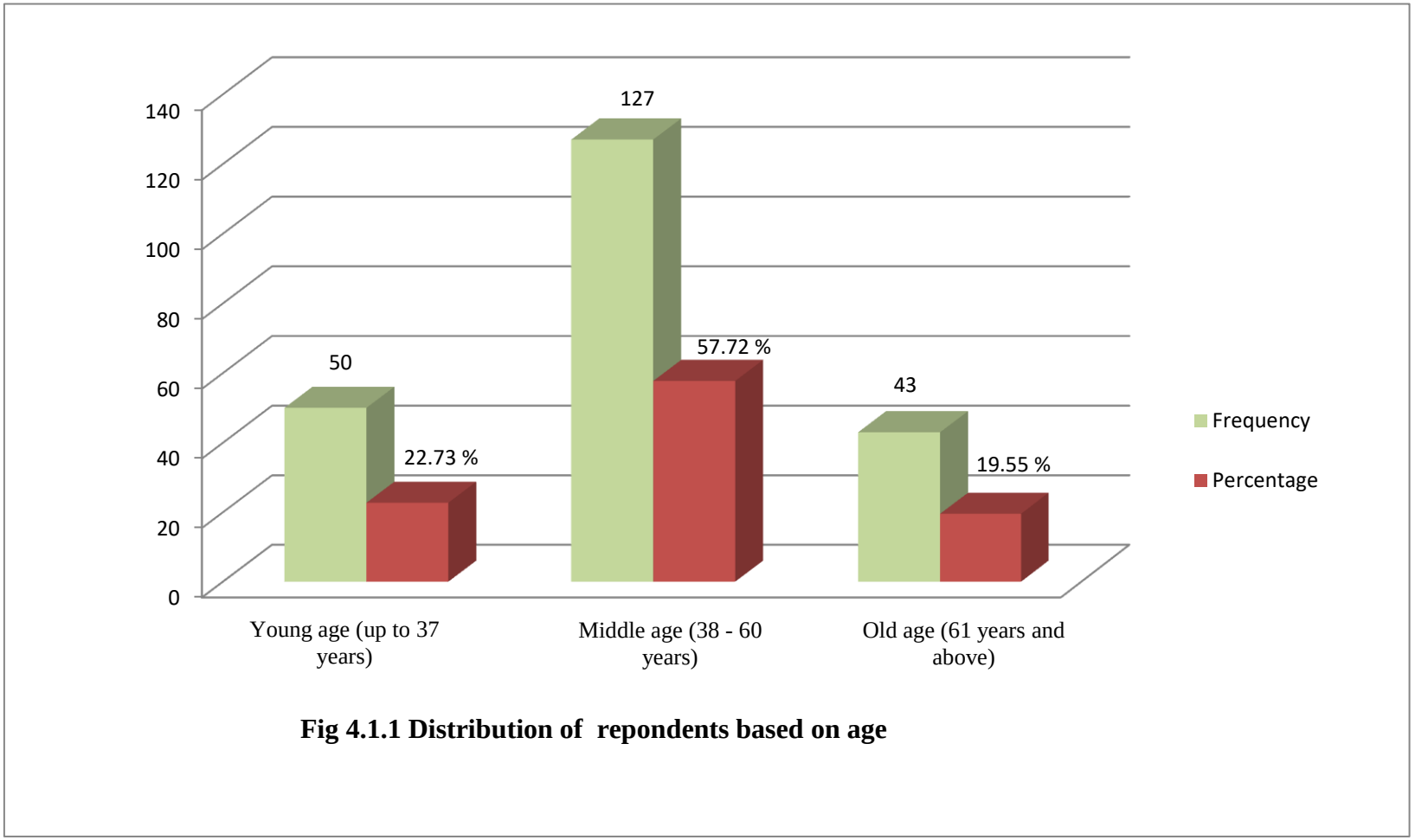

Fig 4.1.1 Distribution of repondents based on age

Table 4.1.1 Distribution of respondents based on age

N=220

Sl no.	Age	Frequency	Percentage	Mean	SD
1	Young age (up to 37 years)	50	22.73	48.51	11.97
2	Middle age (38 - 60 years)	127	57.72		
3	Old age (61 years and above)	43	19.55		
Total		220	100		

The distribution of the respondents as seen from the Table 4.1.1 and Fig 4.1.1 revealed that majority of the respondents belonged to the category of middle age group with 57.72 per cent followed by young age group with 22.73 per cent and old age group with 19.55 per cent. The mean age of the respondent was 48.51 with standard deviation of 11.97. Similar type of finding was reported by Khatri, (2014) and Sharma, (2020).

It can be inferred from the result that middle age farmers were mostly involved in agricultural activities. The old age categories of farmer were lesser which may be due to their physical inability to perform farm activities at an older age.

4.1.2 Sex

Sex is a primary social differentiation of a society. It is cultural construct related to the behaviour learned by men and women which affects what they do and how they do within a specific social group. The distribution of the respondents based on sex is presented in Table 4.1.2

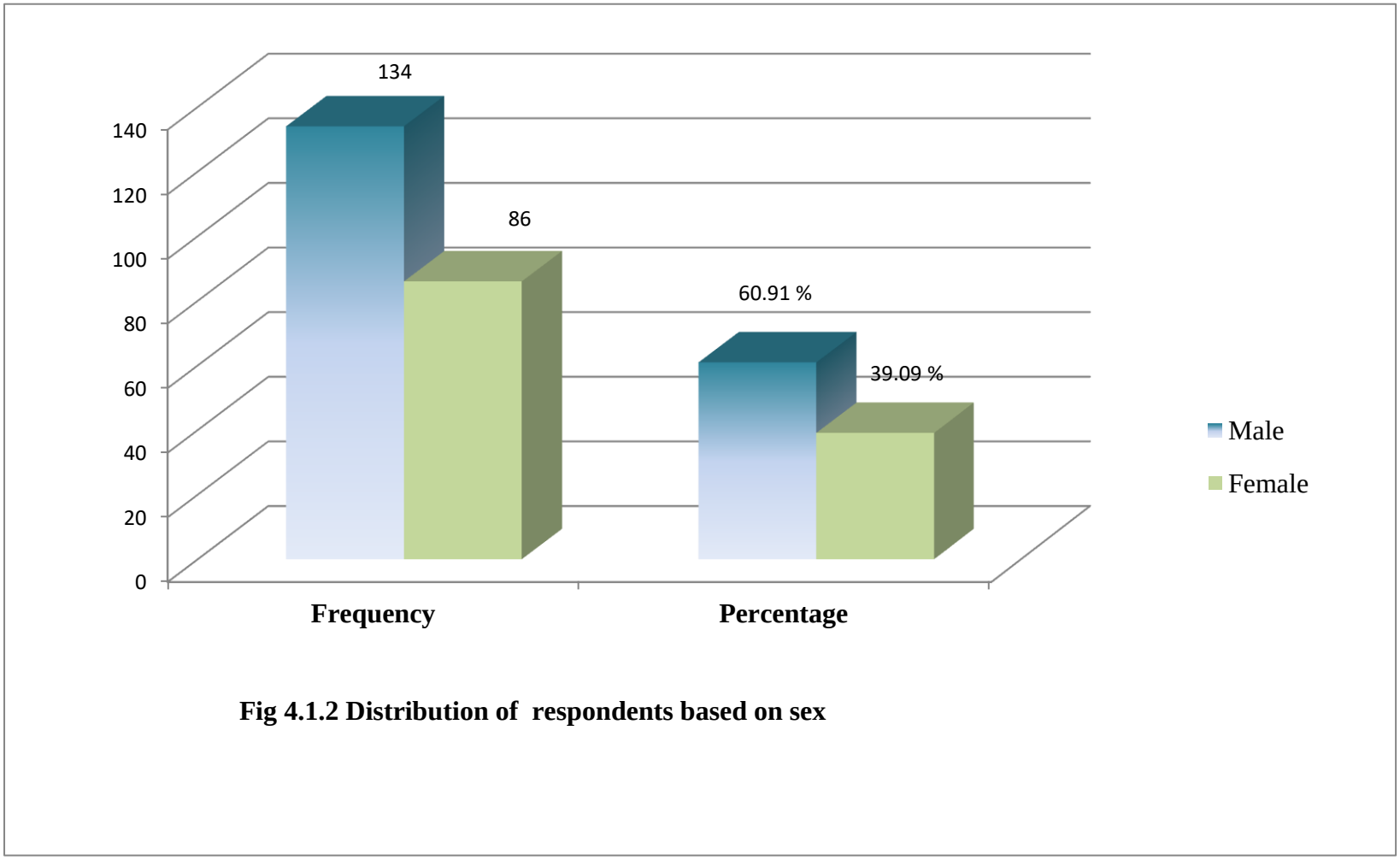

Fig 4.1.2 Distribution of respondents based on sex

Table 4.1.2 Distribution of respondents based on sex

N=220

Sl no.	Category	Frequency	Percentage
1	Male	134	60.91
2	Female	86	39.09
Total		220	100

Under this variable, sex of the respondents was calculated and it was found that 60.91 per cent of the respondents were male and 39.09 per cent of the respondents were female. Though *Mishmi* community is patriarchal in nature, both men and women have their own spheres of responsibility towards agriculture related activities.

4.1.3 Educational status

Education has always been linked with the mental and psychological ability of the individual to comprehend, make decisions, and embrace new ideas for action. Education is one of the important factors which accelerate growth and development in all aspects of life. The information collected regarding the educational qualification of the respondents has been presented in the Table 4.1.3a.

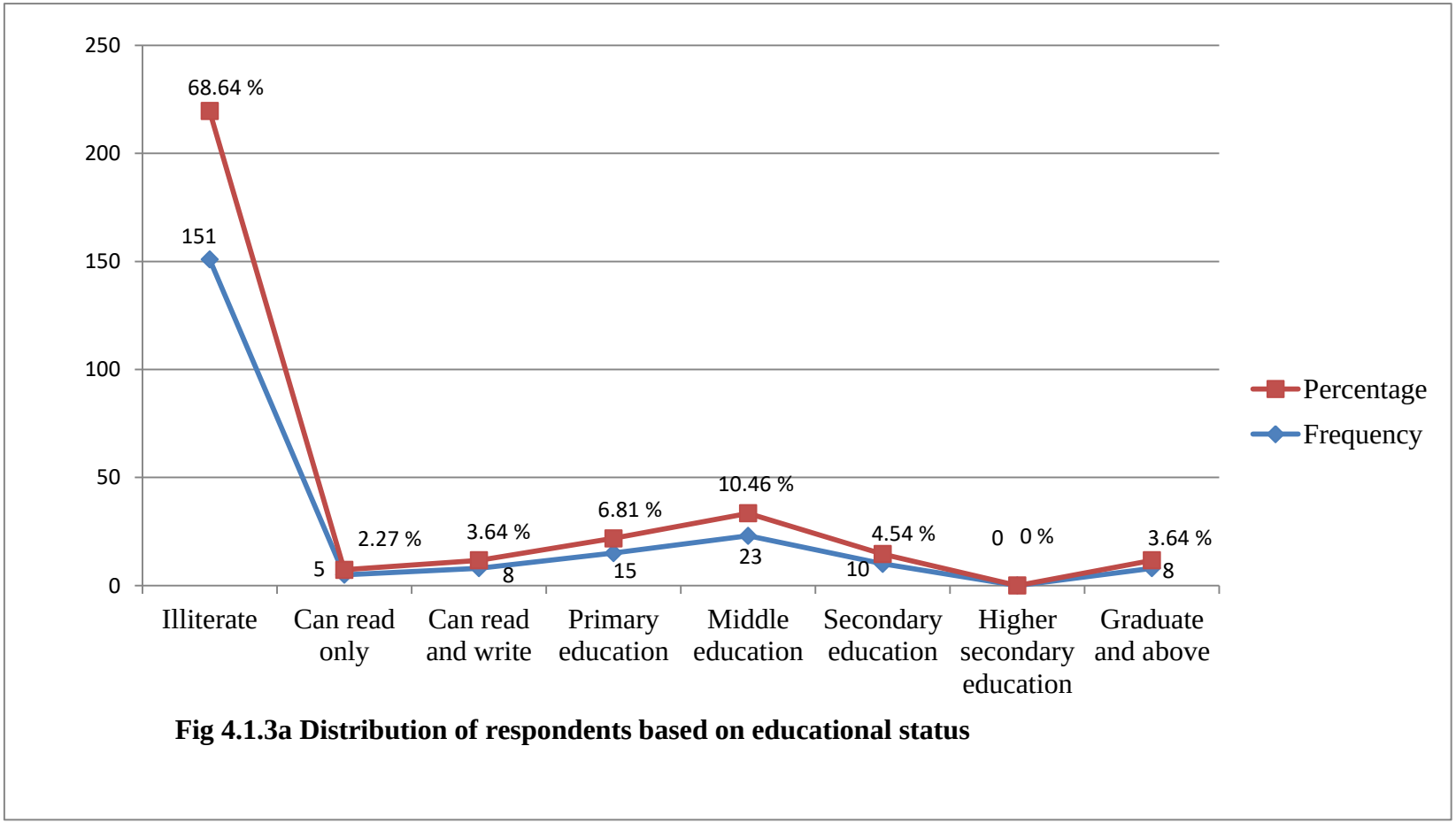

Fig 4.1.3a Distribution of respondents based on educational status

Table 4.1.3a Distribution of respondents based on educational status

N=220

Sl no.	Category	Frequency	Percentage	Mean	SD
1	Illiterate	151	68.64	1.2	1.98
2	Can read only	5	2.27		
3	Can read and write	8	3.64		
4	Primary education	15	6.81		
5	Middle education	23	10.46		
6	Secondary education	10	4.54		
7	Higher secondary education	0	0		
8	Graduate and above	8	3.64		
Total		220	100		

From the Table 4.1.3a and Fig 4.1.3a indicated that 68.64 per cent of the respondents were illiterate followed by 10.46 per cent under middle level education, 6.81 per cent with primary level education, 4.54 per cent with secondary level education, 3.64 per cent under graduate and above, 3.64 per cent under can read and write category and 2.27 per cent respondents were under can read only category. The respondent under higher secondary level education category was nil. The mean of educational status of the respondents was 1.2 with standard deviation of 1.98.

Table 4.1.3b Distribution of the respondents based on education level

N=220

Sl no.	Category	Frequency	Percentage	Mean	SD
1	No education	151	68.64	1.2	1.98
2	Low education	13	5.91		
3	Medium education	38	17.27		
4	High education	18	8.18		
Total		220	100		

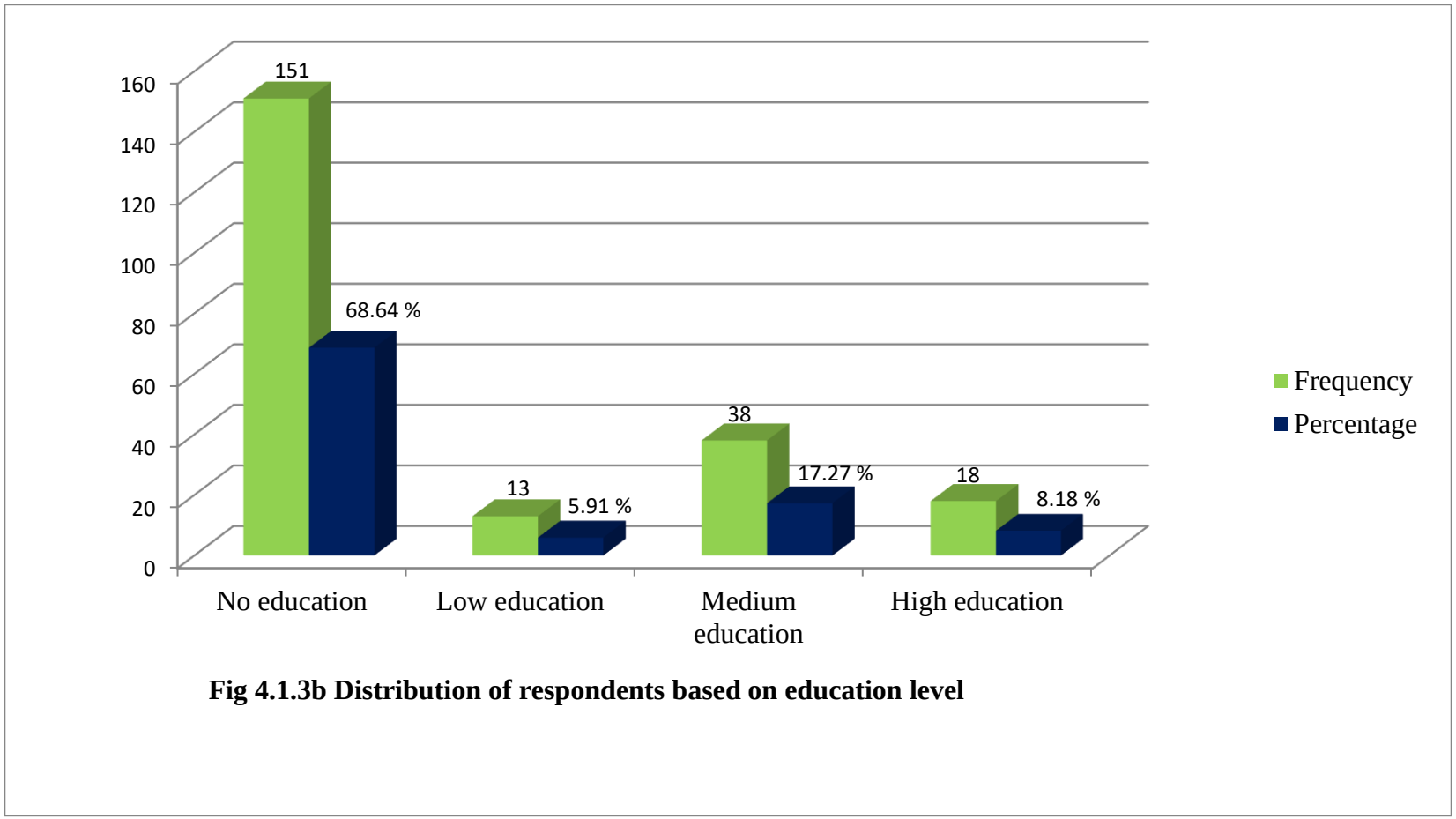

Fig 4.1.3b Distribution of respondents based on education level

Based on categorization, Table 4.1.3b and Fig 4.1.3b revealed that 68.64 per cent of the respondents were under the category of no education forming the major group. It was also reported that 17.27 per cent of the respondents were under medium education level category, followed by 8.18 per cent with high education level and 5.91 per cent with low education. Similar type of finding was reported by Kumar (2016).

The findings from Table 4.1.3a and Table 4.1.3b revealed that majority of the respondents were illiterate. As shown in Table 4.1.1, middle aged group along with old aged group formed majority of the respondents. Due to hilly terrain in the study area, road connectivity to villages was a major problem. This was the reason for limited number of schools or no schools in the village vicinity. The problem of road connectivity coupled with school facilities located at a great distance compels the parents not to send their children to schools. It was also learned that the lack of relevance with education they perceive to their farming practices or daily lives, which lead to lack of interest in pursuing education. This was the reason for low education and higher drop outs among the majority of the respondents.

4.1.4 Farming experience

Farming experience acquired over a period of years could enable the farmers to take rational decision in acceptance and adoption of farm technologies. Farmer is the best scientist of his farm. From farm experience he learns about farm soil fertility nature, staying in farm for years together gives him knowledge regarding climate change and crop demands. In view of this, data pertaining to farming experience were collected. The distribution of the respondents based on farming experience is presented in the Table 4.1.4.

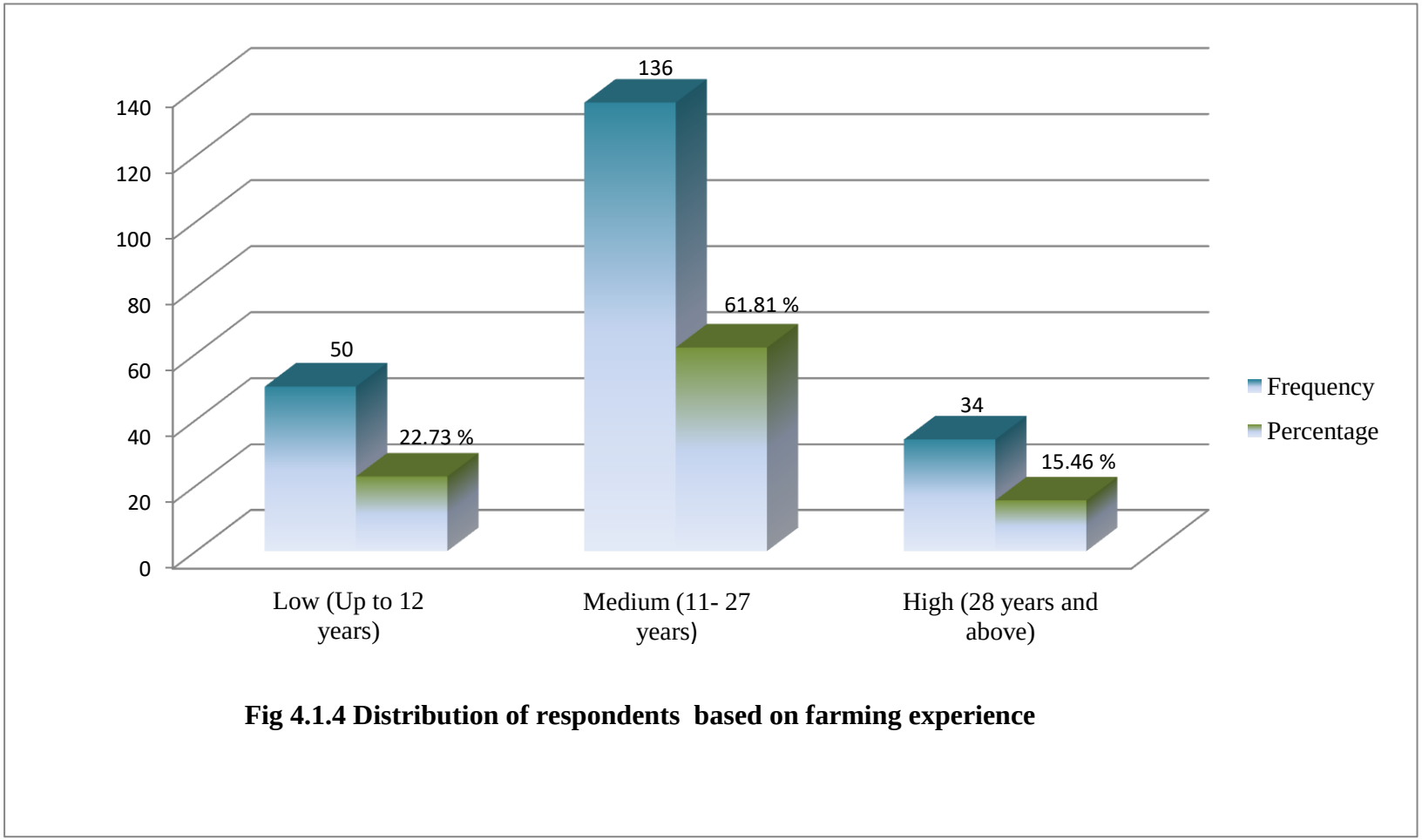

Fig 4.1.4 Distribution of respondents based on farming experience

Table 4.1.4 Distribution of respondents based on farming experience

N=220

Sl no.	Farming experience	Frequency	Percentage	Mean	SD
1	Low (Up to 12 years)	50	22.73	19.74	7.99
2	Medium (11- 27 years)	136	61.81		
3	High (28 years and above)	34	15.46		
Total		220	100		

Table 4.1.4 and Fig 4.1.4 reported that 61.81 per cent of the respondents had medium farming experience followed by 22.73 per cent respondents with low farming experience and 15.46 per cent respondents with high farming experience respectively. The mean of farming experience of the respondent was found to be 19.74 with standard deviation of 7.99.

Majority of the respondents had high farming experience which may be due to engagement of the farmers in agriculture related activities from the very young age. Since most of the respondents were higher age groups with no education to low education, thus devoid of school facilities and sharing the responsibility at very young age might have compelled the respondents to get involved in agriculture related activities for their livelihood.

4.1.5 Operational land holding

Operational land holding is the area of land which is possessed by the farmer and is under cultivation practices. Land is an important factor of production which plays an important role in innovation decision process. The distribution of the farmers based on operational land holding is presented in the Table 4.1.5.

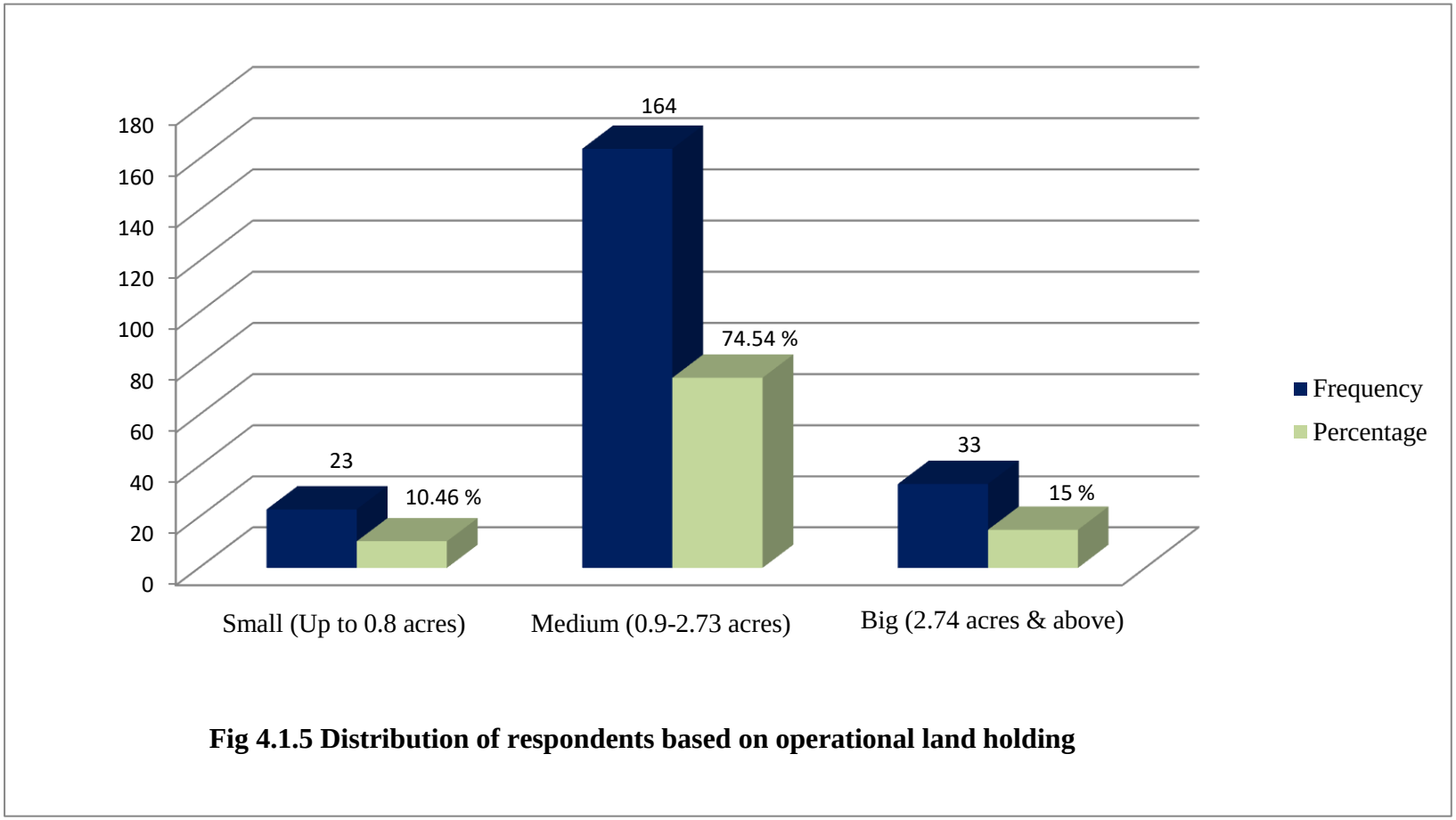

Fig 4.1.5 Distribution of respondents based on operational land holding

Table 4.1.5 Distribution of respondents based on operational land holding

N=220

Sl no.	Category	Frequency	Percentage	Mean	SD
1	Small (Up to 0.8 acres)	23	10.46	1.77	0.97
2	Medium (0.9-2.73 acres)	164	74.54		
3	Big (2.74 acres & above)	33	15.00		
Total		220	100		

Table 4.1.5 and Fig 4.1.5 revealed that respondents with medium land holding category formed the major segment with 74.54 per cent followed by large land holding category with 15.00 per cent and small land holding category with 10.46 per cent respectively. The mean of operational land holding of the respondents was 1.77 with standard deviation 0.97.

The findings from the Table 4.1.5 reported that greater majority of the respondents were in the category of medium operational land holding. This leads to the understanding that the phenomena with regard to use of ITK would be relatively used more by the small scale farmers. It was also found that lesser cultivable plain areas for cultivation practices along hilly terrain makes it difficult to cultivate in larger areas and this is the reason study found that maximum number of farmers have small type of operational land holding in the study area.

4.1.6 Occupational status

Occupational status refers to an individual's position or rank within the social structure based on their employment or occupation. It reflects the level of prestige, authority, and socioeconomic standing associated with a particular job or profession. In many societies, occupational status plays a significant role

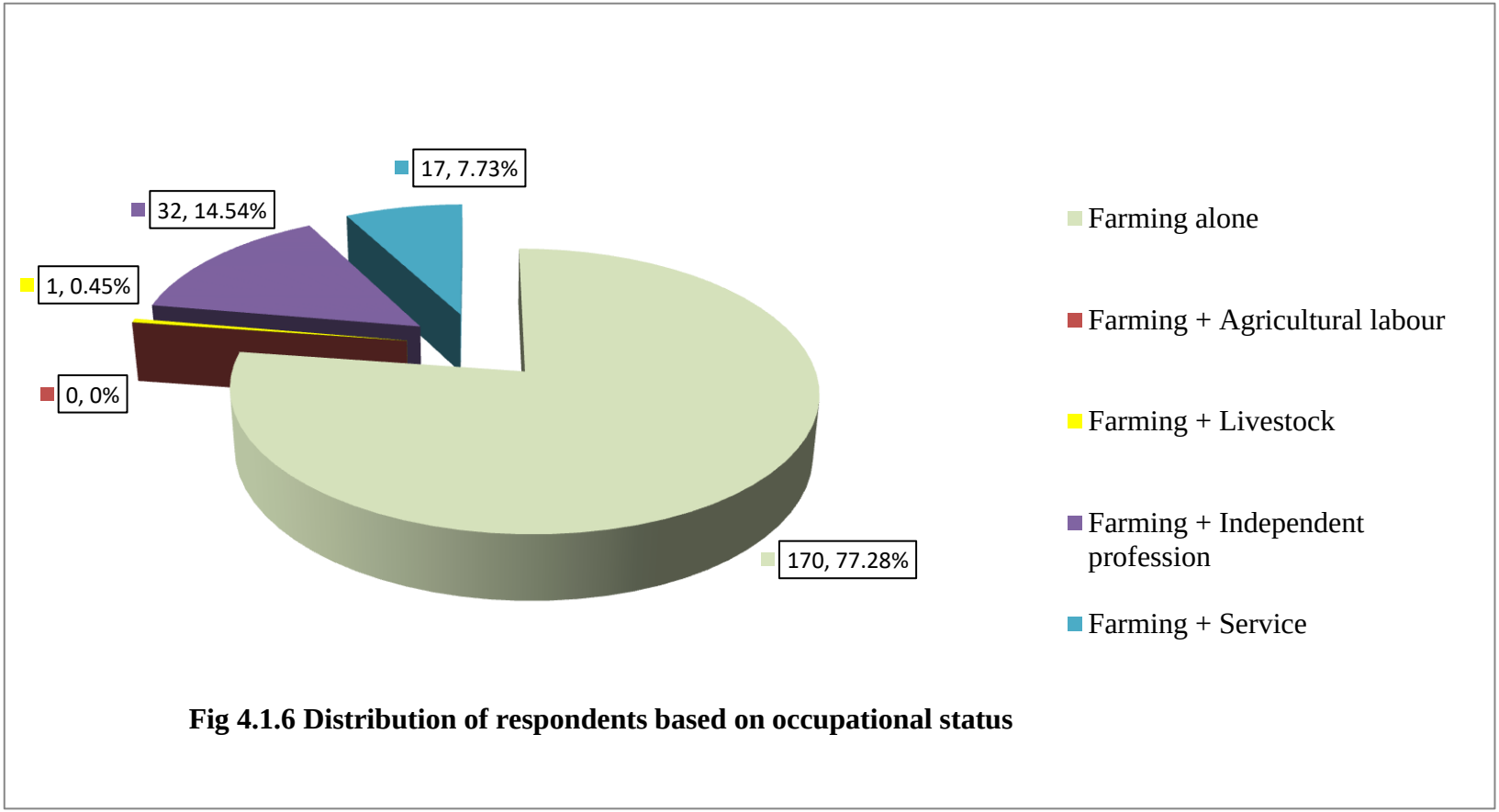

Fig 4.1.6 Distribution of respondents based on occupational status

in defining an individual's social identity and can impact various aspects of their lives, including social interactions, access to resources, opportunities for advancement, and overall quality of life. The distribution of the farmers based on occupational status is presented in the Table 4.1.6.

Table 4.1.6 Distribution of respondents based on occupational status

N=220

Sl no.	Category	Frequency	Percentage
1	Farming alone	170	77.28
2	Farming + Agricultural labour	0	0
3	Farming + Livestock	1	0.45
4	Farming + Independent profession	32	14.54
5	Farming + Service	17	7.73
Total		220	100

Table 4.1.6 and Fig 4.1.6 reported that respondents under farming alone category formed the major segment with 77.28 per cent followed by farming plus independent profession with 14.54 per cent, farming plus service with 7.73 per cent, farming plus livestock with 0.45 per cent respectively. None of the respondents were found under the category of farming plus agricultural labour.

It indicated that agricultural activity was the main occupation and source of income for the respondents in the study area. The study area has limited non-agricultural opportunities, such as industrial or service sectors. As a result, farming becomes a primary economic activity and source of income for many rural residents. Farming serves as a means of subsistence, providing food and sustenance for the local population. Independent profession of the respondents involved in agriculture included running small petty shop business in village, weaving, local craftsmen and shaman respectively. While respondents involved in farming along with service group included village

level school teachers, anganwadi workers, village level health care workers and other contractual staff.

4.1.7 Annual income

To quantify this variable, the total annual earnings of each individual respondent were assessed in rupees, considering all income sources. The distribution of farmer based on yearly income is presented in Table 4.1.7a.

Table 4.1.7a Distribution of the respondents based on total annual income

N=220

Sl no.	Total annual income	Frequency	Percentage	Mean	SD
1	Low (Upto Rs 0.40 lakh)	3	1.37	1.81	1.41
2	Medium (Rs 0.41 to Rs 3.21 lakh)	195	88.63		
3	High (Rs 3.22 lakh & above)	22	10.00		
Total		220	100		

Table 4.1.7a and Fig 4.1.7a reports that respondents with medium income category having income between Rs 0.41 lakh to Rs 3.21 lakh formed the major segment with 88.63 per cent, followed by high income category of Rs 3.22 lakh & above with 10.00 per cent and lastly low income category up to Rs 0.40 lakh with 1.37 per cent respectively. The mean of annual income of the respondents was 1.81 with standard deviation 1.41. The main source of income for farmers was identified as income through horticultural crops. Other sources include non-timber based forest products, animal husbandry and financial assistance provided through government schemes.

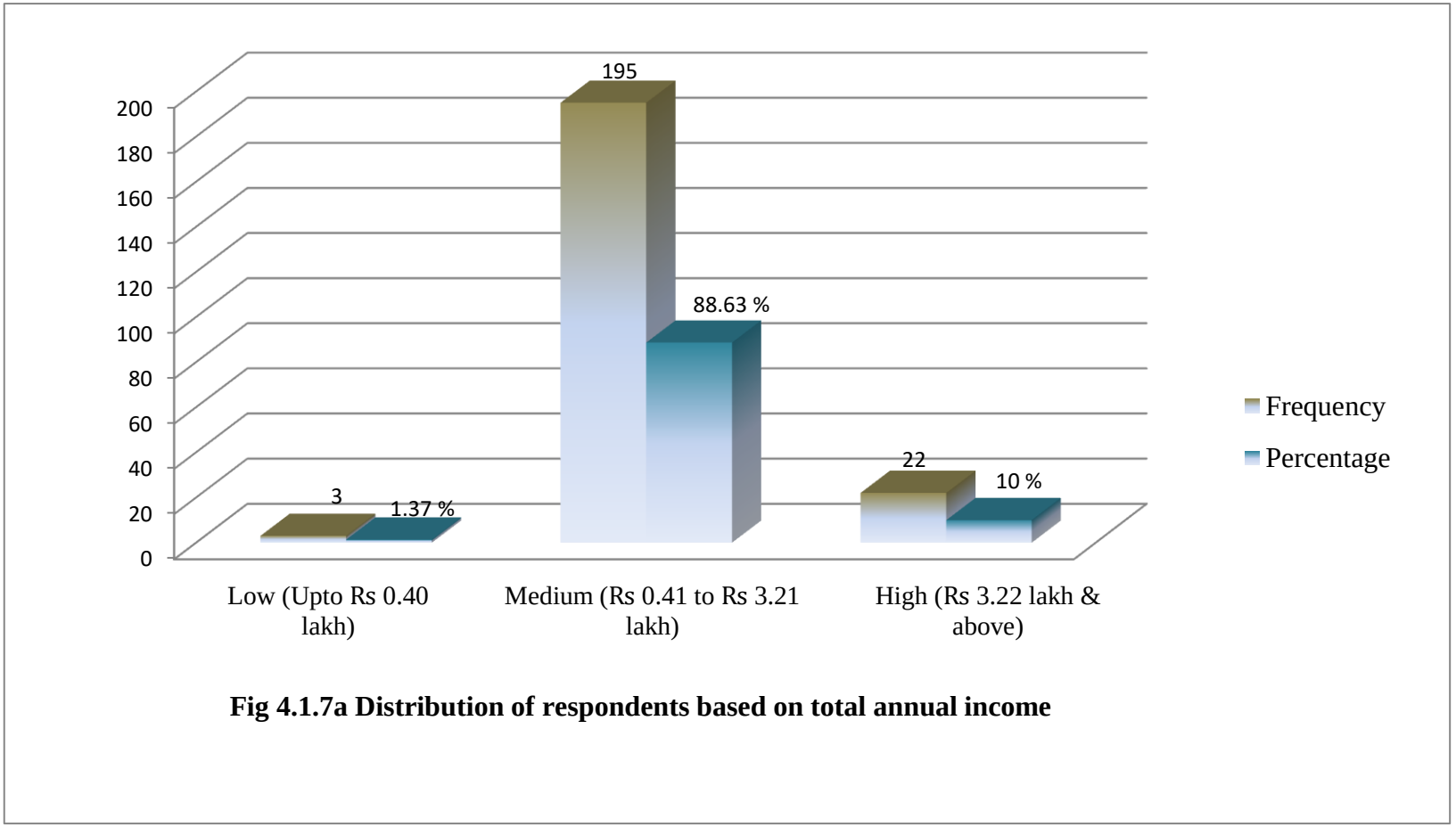

Fig 4.1.7a Distribution of respondents based on total annual income

Table 4.1.7b Distribution of respondents based on farm income

N=220

Sl no.	Category	Frequency	Percentage	Mean	SD
1	Low (Up to Rs 0.69 lakh)	16	7.27	1.21	0.52
2	Medium (Rs 0.70 to Rs 1.72 lakh)	171	77.73		
3	High (Rs 1.73 lakh & above)	33	15.00		
Total		220	100		

The result presented in Table 4.1.7b and Fig 4.1.7b reveals that out of total farmers, the highest proportion of the farmers 77.73 per cent belonged to the medium income group followed by high income group with 15.00 per cent and low income group with 7.27 per cent respectively. The mean of the farm income was found to be 1.21 with standard deviation 0.52.

The finding reveals that 77.73 per cent of the respondents which forms the majority were in the medium level income group, and Table 4.1.6 also states that 77.28 per cent of the respondents were involved in agriculture alone category of occupation. Farmers in the study area mainly practiced subsistence farming, they primarily produce rice and millets for their own consumption rather than sale in the market. This focus on self-sufficiency results in lower levels of income. Limited diversification in agricultural activities also leads to lower income level. Lack of infrastructure, proper disease management strategies, value addition and market linkages limits their ability to access higher value markets for their horticultural crops. Hence, it is reasonable to presume that farmers have restricted access to modern, high-cost technologies which could help them to increase their crop production and ultimately high returns.

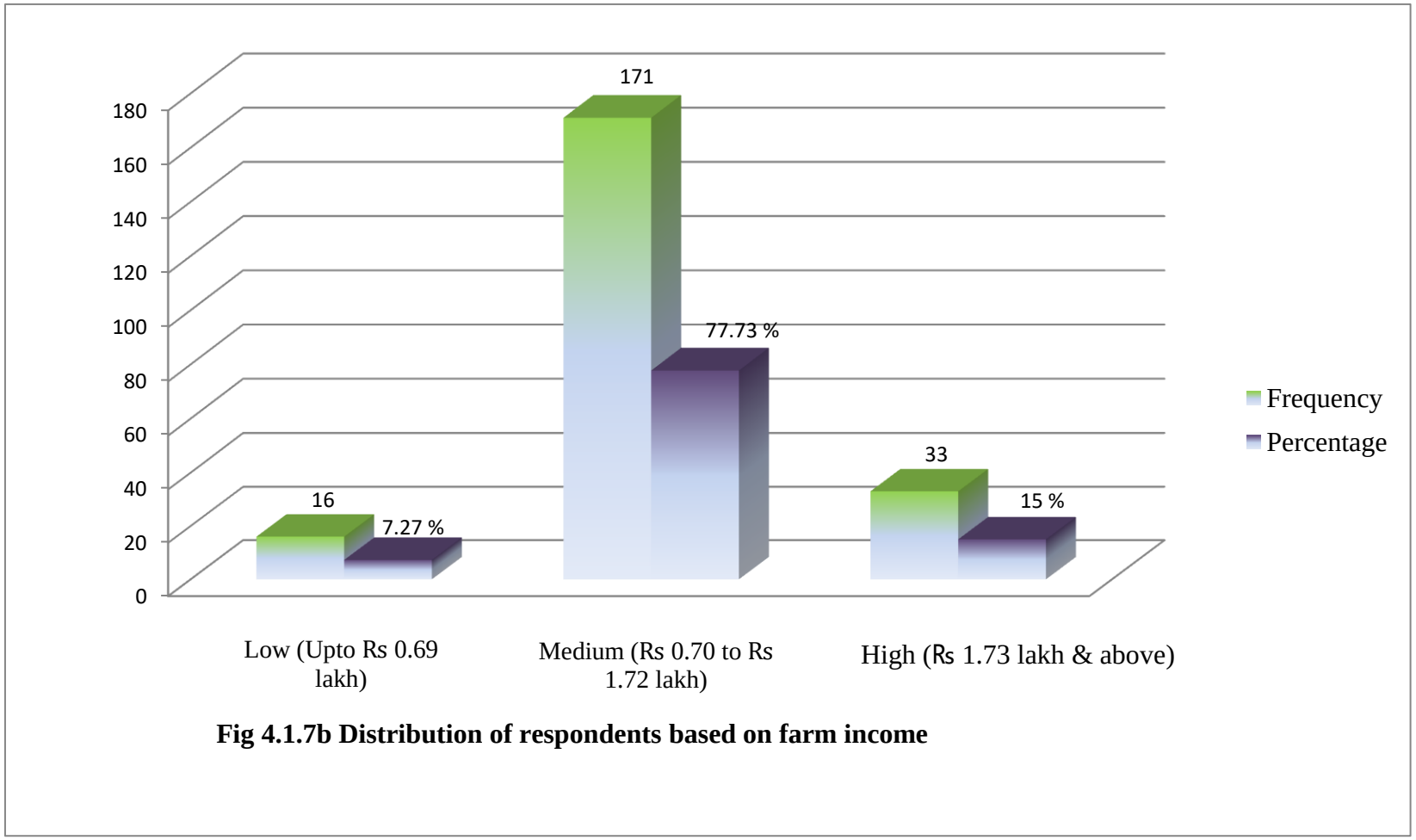

Fig 4.1.7b Distribution of respondents based on farm income

4.1.8 Social participation

Social participation denotes the extent to which respondents engage in formal and informal organizations within and around the village. It brings an individual in close contact with other members of the social organization. This provides an opportunity to exchange ideas, information and expectations. Social participation enhances the contact of the respondents which enables them to increase their level of adoption and finally leads to success of any program. The distribution of the respondents based on social participation is presented in Table 4.1.8a.

Table 4.1.8a Distribution based on social participation

N=220

Sl no.	Degree of involvement	Frequency	Percentage
1	Member in one organization	20	9.09
2	Member in more than one organization	0	0
3	Office bearer in one organization	19	8.64
4	Office bearer in more than one organization	0	0
5	No involvement	181	82.27
Total		220	100

Table 4.1.8a and Fig 4.1.8a reported that majority of the respondents that accounts for 82.27 per cent had no involvement in social participation, while 9.09 per cent were found to be member in one organization and 8.64 per cent were found to be office bearer in one organization.

Table 4.1.8a inferred that 82.27 per cent of the respondents were not part of any organization which indicated lower social participation in the study area. In the study area, it was found that most villages were located far away from the urban centers, resulting in limited access to transportation and

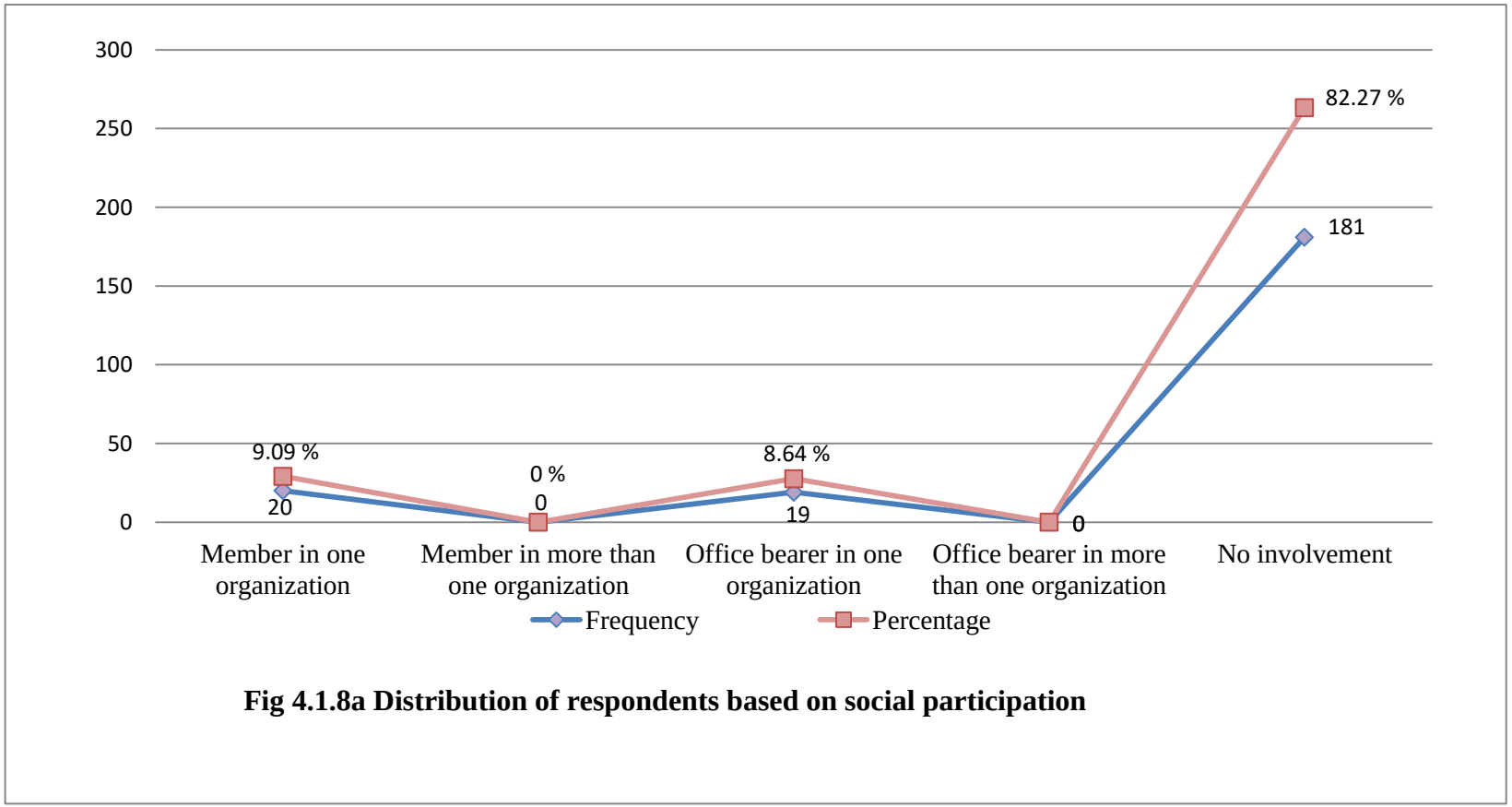

Fig 4.1.8a Distribution of respondents based on social participation

infrastructure. Due to limited access to information channels, such as the internet or local media, rural residents may be unaware of the social opportunities available to them. Socioeconomic factors such as low income and education also limits their participation in social activities. Moreover, migration of young people to lower plains for search of education and employment opportunities, further contribute to low social participation. Traditional values and mindsets that prioritize privacy, self-reliance, close-knit relationships within immediate families or small social circles create a social environment where individuals are less inclined to participate in broader community activities outside their immediate social networks.

Table 4.1.8b Distribution of respondents based on level of social participation

n=39

Sl no.	Level of social participation	Frequency	Percentage	Mean	SD
1	Low (Up to 0.96)	0	0	1.97	1.01
2	Medium (0.97 to 2.97)	20	51.28		
3	High (2.98 & above)	19	48.72		
Total		39	100		

Table 4.1.8b and Fig 4.1.8b revealed that only 39 out of 220 respondents were found to be involved in social participation. It was found that 51.28 per cent of the respondents involved in social participation were in the medium participation category. This group of respondents includes members of political related organizations and other social organization. While 48.73 per cent of respondents were found to be in higher participation category. This group of participants were mainly office bearers like *gaonburas*, members of panchayati raj institutions and office bearer of other organizations. The mean of the respondents was 1.97 with standard deviation 1.01.

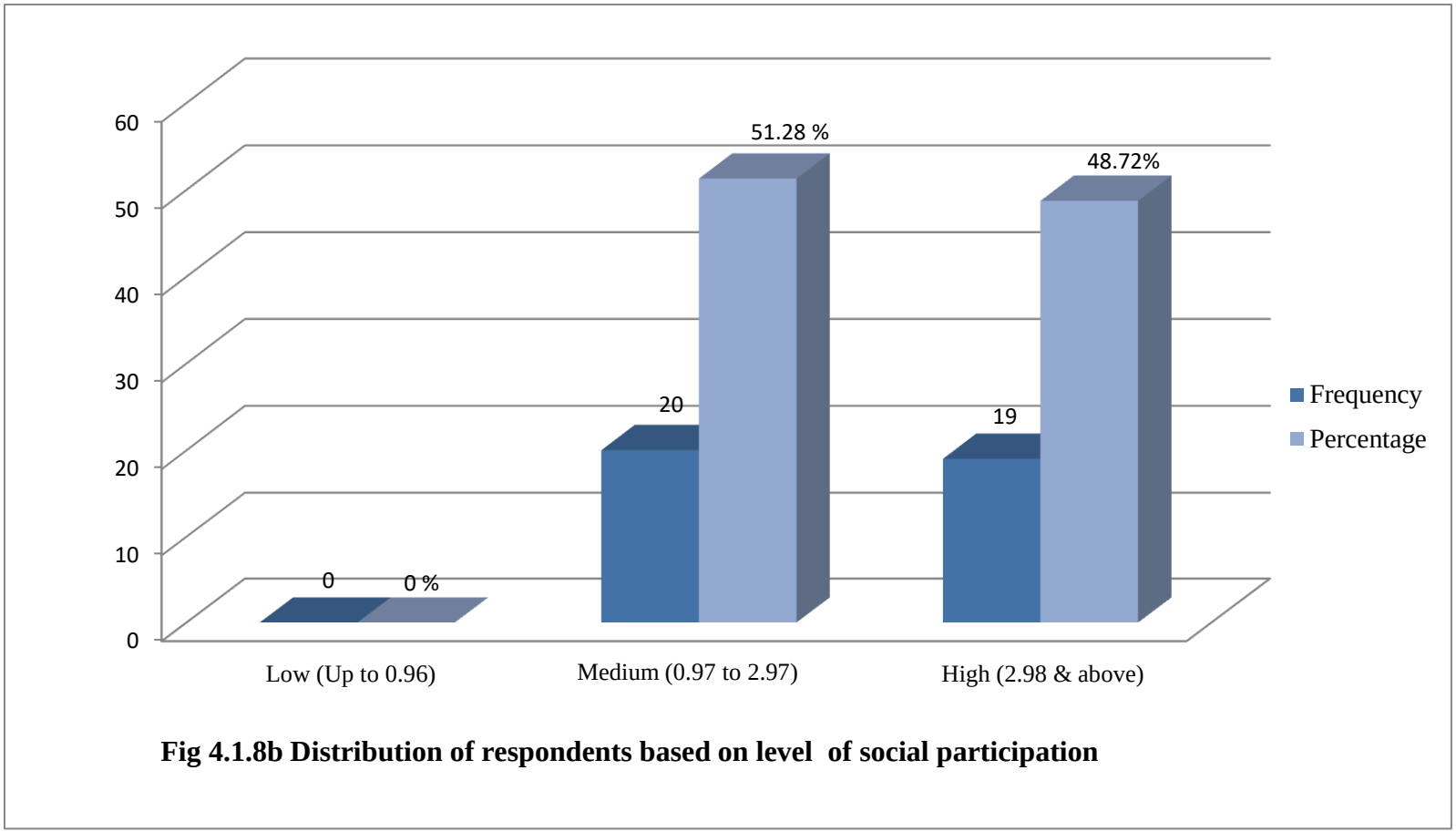

Fig 4.1.8b Distribution of respondents based on level of social participation

Table 4.1.9a Distribution of respondents based on frequency of extension contact

N=220

Sl no.	Extension agent	Frequency of contact									
		No contact	%	Yearly	%	Half - yearly	%	Monthly	%	Weekly	%
1	Agricultural Scientists	196	89.09	17	7.72	7	3.18	0	0	0	0
2	Agricultural Development Officer	172	78.18	20	9.09	25	11.36	3	1.37	0	0
3	Agricultural Field Assistant	195	88.63	13	5.90	12	5.46	0	0	0	0
4	Block Extension Personnel	156	70.90	25	11.36	34	15.46	5	2.27	0	0
5	Input Dealer / NGO / Progressive farmer	215	97.72	2	0.90	3	1.37	0	0	0	0

4.1.9 Distribution of respondents based on extension contact

The extent of extension contact was assessed based on the frequency of interactions with different categories of extension personnel. The distribution of the respondents based on frequency of extension contact was presented in Table 4.1.9a and Fig 4.1.9a.

Table 4.1.9a reported that 89.09 per cent of the respondents had never made contact with agricultural scientist while 7.72 per cent of respondents had made contact once in a year and 3.18 per cent of respondents had made contact once in six months respectively. But none of the respondents had made contact monthly or weekly. It was learned many village peoples have limited access to information about the services provided by the agricultural scientist or KVKs. The limited transportation facilities, socioeconomic factors and KVK being far way for most of the villages often become challenge for the village people to visit agricultural scientist. The language barrier creates difficulty in effectively communicating and seeking advice. Additionally, the cultural differences also hinder village people from actively engaging with outside experts.

It was found that 78.18 per cent of the respondents had never made contact with agriculture development officer while 9.09 per cent of the respondents had made contact once in a year, 11.36 per cent once in six months and 1.37 per cent in month respectively. No respondents made contact on weekly basis. It was learned that department officials have limited resources and staffs which makes it difficult to cover vast areas with difficult terrain where connectivity is an additional issue, resulting in less frequent contact and interaction with village residents. Limited resources and capacity prevents officers from proactively engaging with village people, leading to less contact with the villages. This discourages village people from seeking contact with department officers. Village people also prefer to rely on their own expertise of local agriculture practices which was passed down through generations.

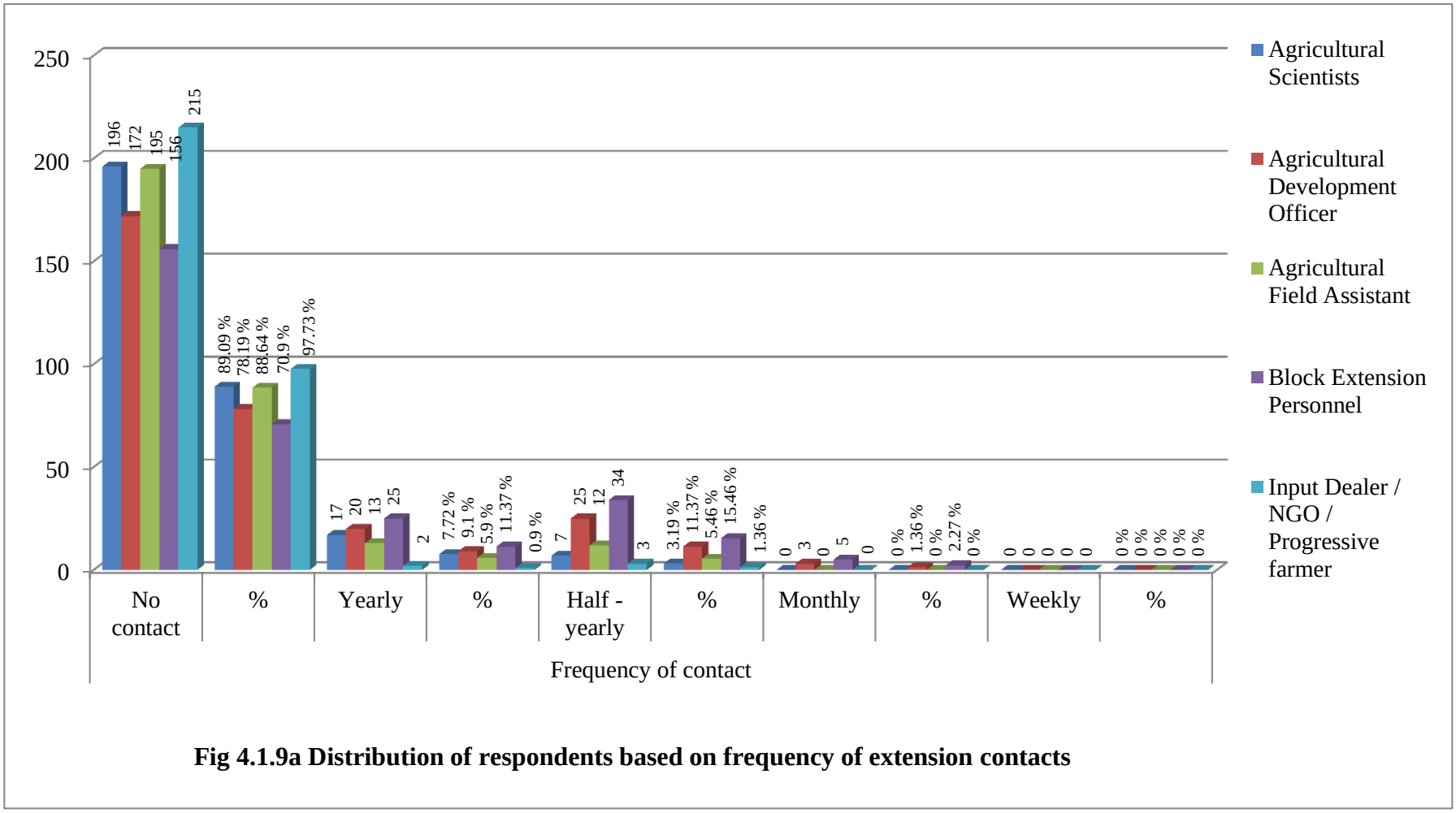

Fig 4.1.9a Distribution of respondents based on frequency of extension contacts

It was learned that 88.63 per cent of the respondents had never made contact with agriculture field assistant while 5.90 per cent of respondents made contact once in a year and 5.46 per cent on six monthly basis respectively. No respondents made contact on monthly and weekly basis. Due to limited resources and capacity, the village people may have experienced a lack of support or ineffective services from the department in the past, leading to diminished trust in their ability to address their needs. Further, self-reliance on traditional knowledge for agricultural practices also discourages village people from seeking contact with department officials.

It was found that 70.90 per cent of the respondents never made contact with block development officer, but 11.36 per cent of respondents had made contact once in year, 15.46 per cent on six monthly and 2.27 per cent of respondents on monthly. As stated in Table 4.1.1 and 4.1.3, most of the respondents were middle age to old age groups with no education. And, most of the village were far away from urban settlements with difficult terrain and dispersed population. Therefore, it becomes challenging for the aging population to visit offices for seeking extension services. Further assuming, demand for extension services reduces as older demographic profiles have less need for agricultural or rural development support.

It was also found that 97.72 per cent of respondents never made contact with input dealers, NGOs and progressive farmers, while 0.90 per cent of respondents had contact once in a year and 1.37 per cent had contact once on six months respectively. As discussed earlier, village people mostly rely on deep rooted traditional beliefs and practices which have been passed down through generations, which have often been successful makes them sceptical about embracing progressive farming practices. The gap is further increased due to limited socioeconomic conditions such as financial conditions and time

availability, which affect their willingness or ability to contact progressive farmers and others.

Table 4.1.9b Distribution of respondents based on level of extension contact

n=74

Sl no.	Level of extension contact	Frequency	Percentage	Mean	SD
1	Low (Up to 4)	20	27.03	11.12	7.53
2	Medium (5 to 18)	41	55.40		
3	High (19 & above)	13	17.57		
Total		74	100		

Table 4.1.9b and Fig 4.1.9b indicated that medium level of extension contact category formed the majority with 55.40 per cent followed by low level of extension contact category with 27.43 per cent and high level of extension contact category with 17.57 per cent of the respondents respectively. The mean of the respondents was 11.12 with standard deviation 7.53.

From Table 4.1.9a and Table 4.1.9b revealed that only 74 out of 220 were found to be involved in extension contact. Therefore, it can be concluded that respondents in the study area had very low extension contact. Similar type of finding was reported by Benjongtoshi (2014). The reason for low extension contact can be attributed to the low education the farmer possesses. Farmers are not enough confident to meet the extension agencies and extension personnel for information seeking. Also, extension agencies being far away from the village vicinity makes it difficult for the farmers to visit them. This low extension contact leads to the understanding that they do not possess sufficient knowledge on modern cultivation practices and there is every possibility of use of ITKs.

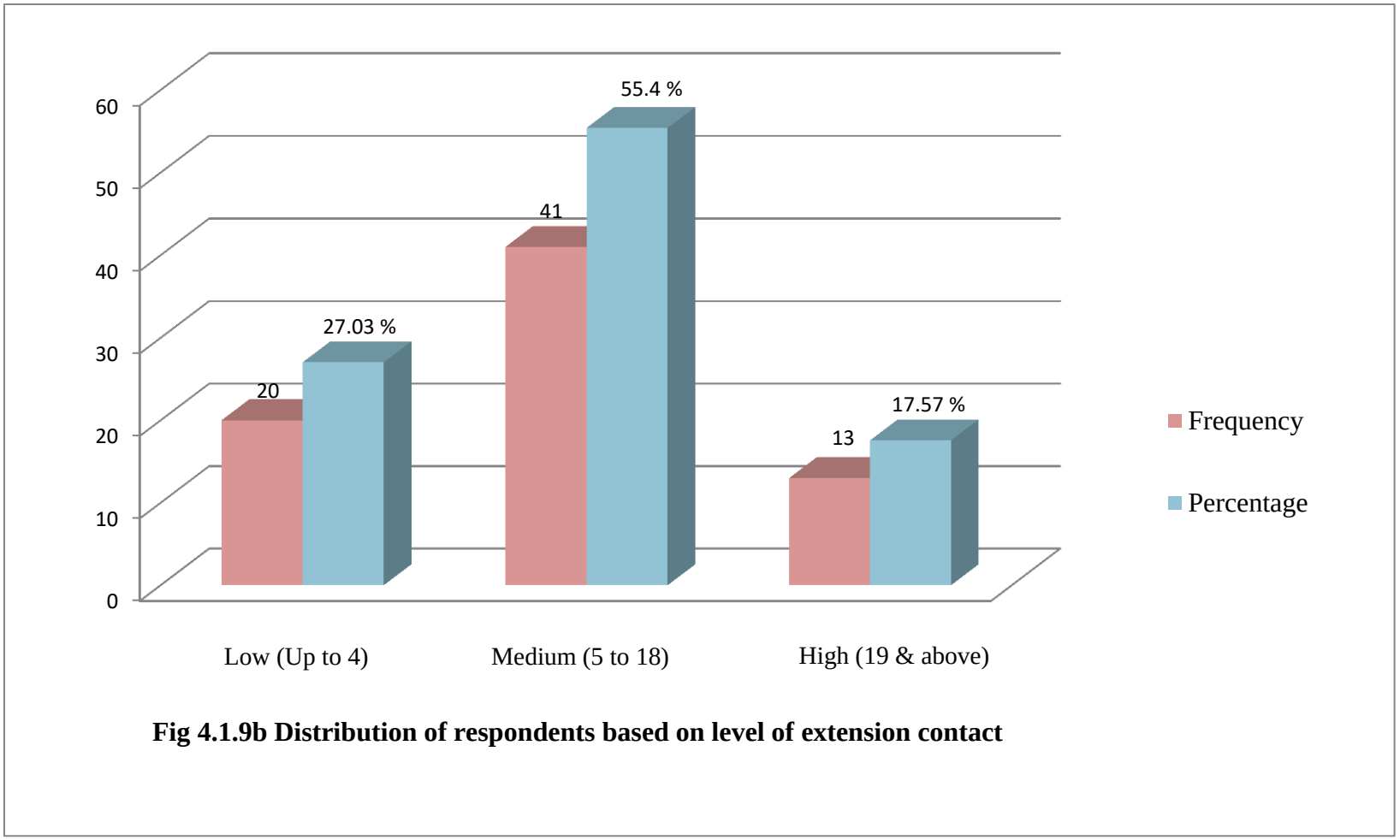

Fig 4.1.9b Distribution of respondents based on level of extension contact

4.1.10 Scientific orientation

Scientific orientation refers to the application of scientific principles, methods and approaches to the study of social phenomena. It involves employing systematic enquiry, rigorous research methods, and empirical evidence to understand social structures, processes and behaviors.

Table 4.1.10 Distribution of respondents based on scientific orientation

N=220

Sl no.	Category	Frequency	Percentage	Mean	SD
1	Low (Up to 23)	46	20.90	25.86	2.98
2	Medium (24 to 28)	131	59.55		
3	High (29 & above)	43	19.55		
Total		220	100		

Table 4.1.10 and Fig 4.1.10 indicated that majority of the respondents were found to be under medium level category of scientific orientation with 59.55 per cent followed by low level of scientific orientation with 20.90 per cent. The respondents with high level of scientific orientation were 19.55 per cent. The mean of the respondents was 25.86 with standard deviation 2.98. Therefore, it can be concluded that scientific orientation of the respondents were found to be low to medium. Villagers were found to be aware of the modern approaches of farming, but often face challenges related to limited financial condition, access to research institutions and modern farm machineries. This lack of exposure to scientists and professionals contribute to lower scientific orientation. As most of the villagers often have deep-rooted traditional belief and practices that may have deeply ingrained in their cultural fabric. Therefore, traditional belief may not always align with scientific explanations or principles, leading to a lower emphasis on scientific orientation.

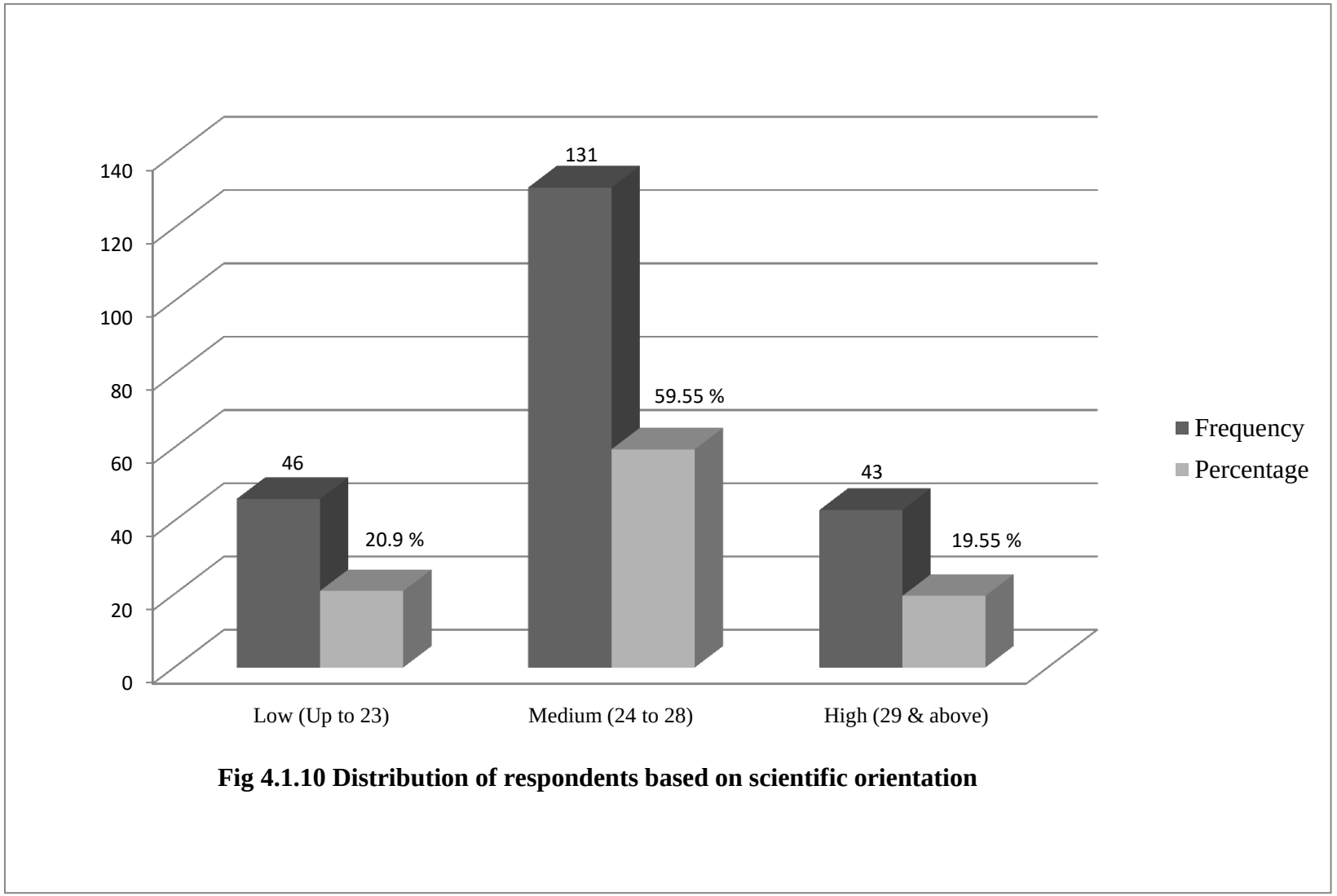

Fig 4.1.10 Distribution of respondents based on scientific orientation

4.1.11 Mass media exposure

The level of mass media exposure is determined by the extent to which individuals come into contact with different mediums such as television, radio, newspapers, magazines, and the internet. It measures the frequency and duration of an individual's interaction with mass media content.

Mass media exposure plays a significant role in shaping individual's knowledge, attitudes, beliefs and behavior. It can influence public opinion, social norms, consumer choices and political participation. Mass media act as a platform for information dissemination, entertainment, cultural representation, and advertising, influencing individual's perceptions and understanding of various issues.

Table 4.1.11a Distribution of respondents based on mass media exposure

N=220

Sl. No.	Statement	Regularly		Rarely		Never	
		F	%	F	%	F	%
1	Listening to agricultural programs in radio.	0	0	4	1.82	216	98.18
2	Reading or listening to reading of agricultural news in newspaper.	0	0	0	0	220	100.00
3	Reading or listening to reading of agricultural news in magazines, leaflets, folders and bulletins.	0	0	6	2.73	214	97.27
4	Viewing of agricultural programs in television.	0	0	8	3.64	212	96.36
5	Seeing of agricultural films.	0	0	0	0	220	100.00
6	Participation in agricultural demonstrations and field days.	0	0	22	10.00	198	90.00

Table 4.1.11a and Fig 4.1.11a revealed that 1.82 per cent of the respondents were found to be rarely listening to agricultural programs in radio

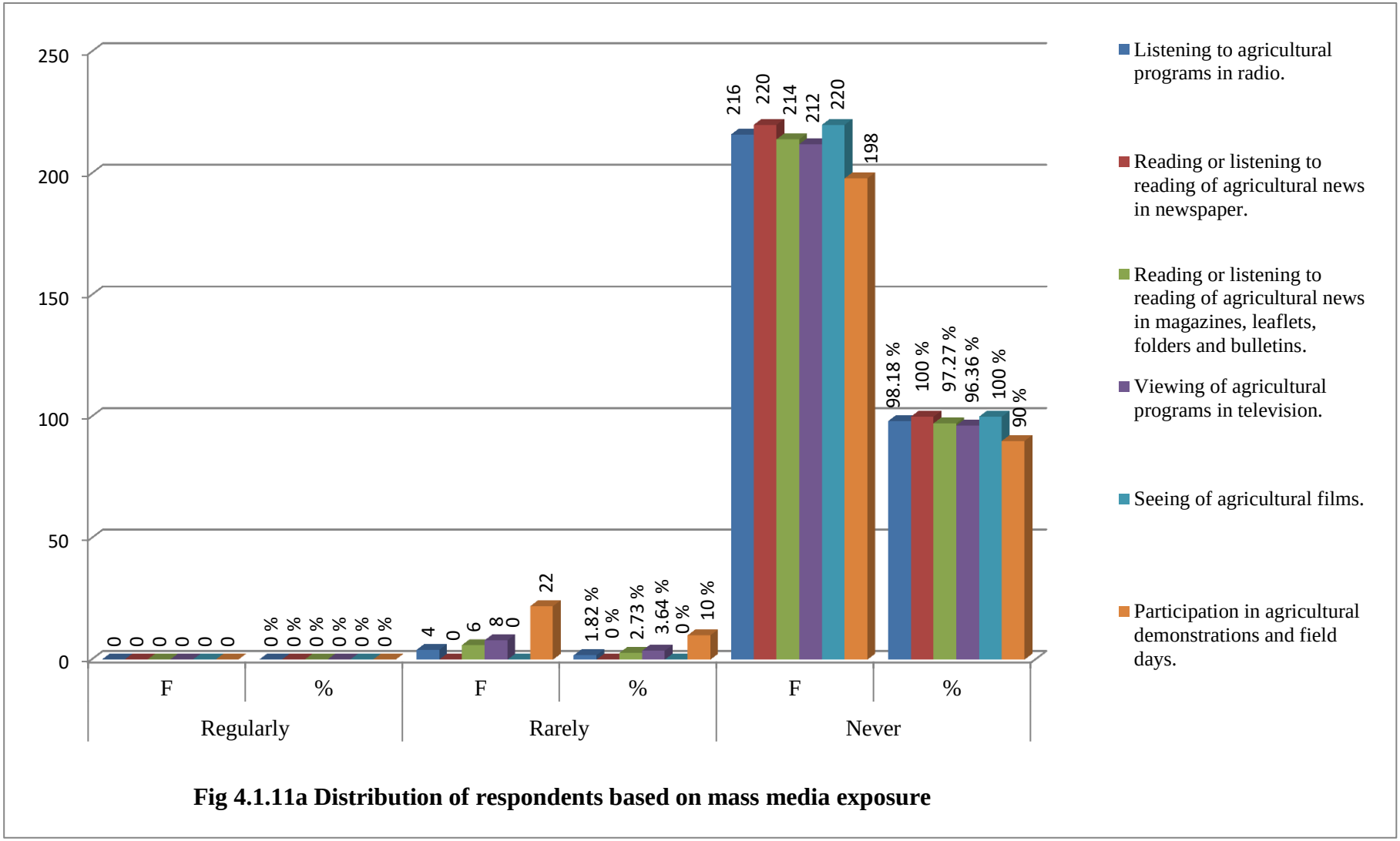

Fig 4.1.11a Distribution of respondents based on mass media exposure

while 98.18 per cent of the respondents have reported to be never using it. It was found that old aged farmers were the only user of the radio.

Table 4.1.11a and Fig 4.1.11a inferred that cent per cent of the respondents reported to be neither reading nor listening to reading of newspaper in the area. It was due to non-availability of the newspaper service in the study area.

Table 4.1.11a and Fig 4.1.11a reported that only 2.73 per cent of the respondents reported to reading or listening of agricultural news in magazines, leaflets, folders and bulletins while 97.27 reported of not using it.

Table 4.1.11a and Fig 4.1.11a inferred that 3.64 per cent of the respondents rarely viewed agricultural programs in television while 96.36 per cent of the respondents had never viewed any.

Table 4.1.11a and Fig 4.1.11a reported that cent per cent of the respondents never viewed any agricultural films.

Table 4.1.11a and Fig 4.1.11a revealed that 10.00 per cent of the respondents rarely participated in agricultural demonstration and field days while 90.00 per cent had never participated.

Table 4.1.11b Distribution of respondents based on level of mass media exposure

n=33

Sl no.	Category	Frequency	Percentage	Mean	SD
1	Low (Up to 0.8)	0	0	1.21	0.41
2	Medium (0.9 to 1.61)	26	78.78		
3	High (1.62 & above)	7	21.22		
Total		33	100		

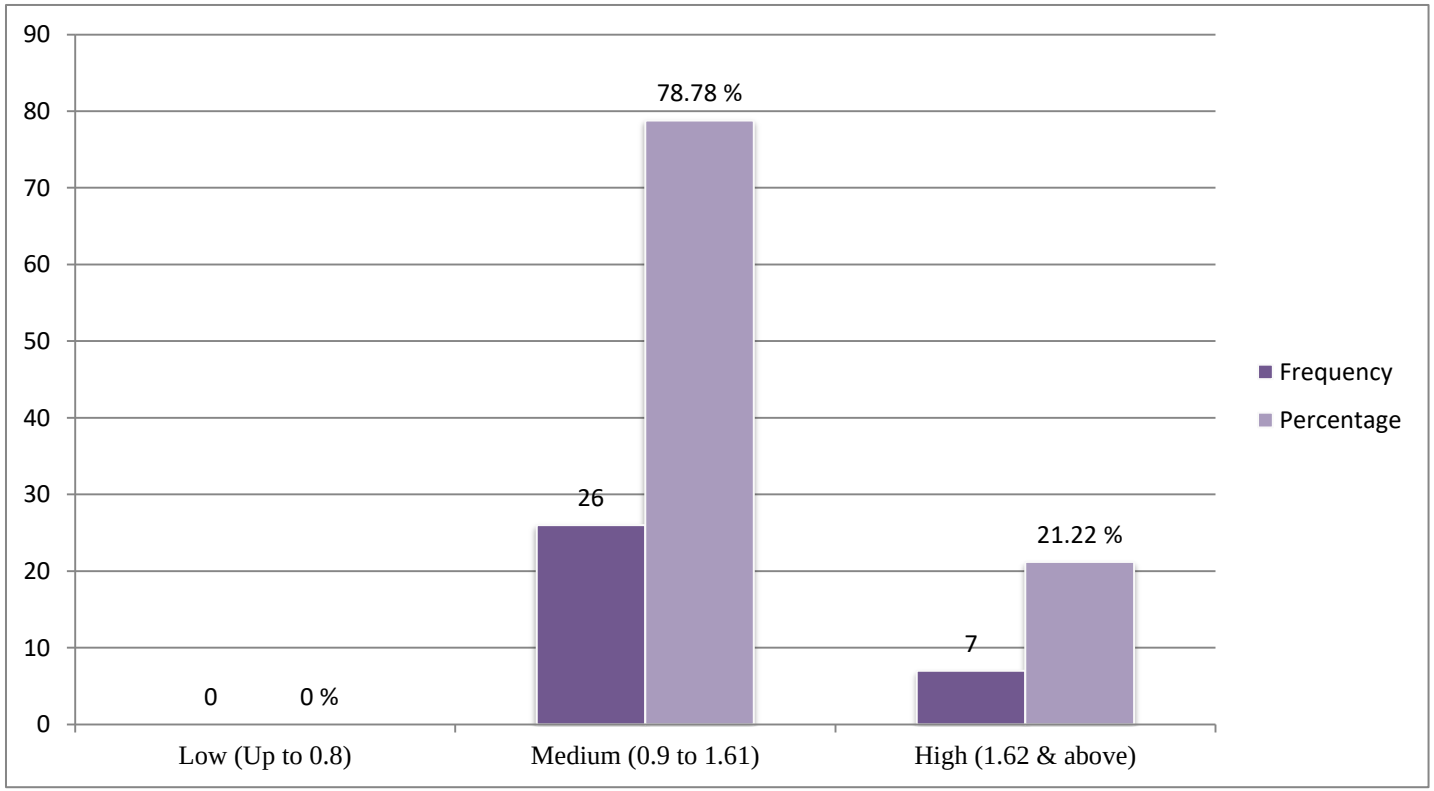

Fig 4.1.11b Distribution of respondents based on level of mass media exposure

From the Table 4.1.11b and Fig 4.1.11b, medium level of mass media exposure category was found to be majority with 78.78 per cent followed by high level category with 21.22 per cent. The mean of the respondents was 1.21 with standard deviation 0.41.

Table 4.1.11b revealed that only 33 out of 220 respondents were found to be involved in the mass media exposure. Therefore, overall level of mass media exposure was found to be very low among the identified respondents. This may be due to reason that most of the farmers were uneducated and also poor connectivity may be the reason for less exposure. Non-availability of the leaflets, folders and other visual aid materials in local language may also be the reason for non-utilization of the mass media. It was also found that respondents falling under the medium and high level category were educated and most of them were aware about the extension agency contact.

4.1.12 Training exposure

Training exposure refers to the extent to which individuals have been exposed to training programs, workshops, courses, or educational interventions designed to develop specific skills, knowledge, or competences. It measures the level and quality of engagement in training activities and the amount of training received by individuals.

Table 4.1.12 Distribution of respondents based on training exposure

N=220

Sl. no	Category	Frequency	Percentage
1	Training attended	11	5.00
2	Training not attended	209	95.00
Total		220	100

Fig 4.1.12 Distribution of respondents based on training exposure

Table 4.1.12 and Fig 4.1.12 revealed that 95.00 per cent of the respondents which constitute majority did not participate in any training while only 5.00 per cent of the respondents have participated in the training during the period of last five years respectively. It was learned that respondents attended training mostly related to the topic of horticultural crops.

The result presented in the Table 4.1.12 inferred that majority of the respondents have not attended any training related to agriculture during the last five years. Majority of the respondents were found to be illiterate or low educated with low to medium income group in the study area. This becomes barrier for the farmers to contact extension agencies which leads to low extension contact. This further widens the communication gap between the farmer and the extension agencies over time. The Anjaw district being a mountainous region with no proper network connectivity, extension agencies being far away from village vicinity hinders the movement of extension personnel and free flow of timely information. Some farmers rely heavily on the traditional farming practices and inherited knowledge, perceiving other methods as additional burden to their already demanding workloads. Also, agriculture being highly seasonal, time commitments required by training program may clash with critical agricultural activities, making it challenging for the farmers to participate in the allocated time of training.

4.2 Identification and documentation of Indigenous Technical Knowledge

4.2.1 Indigenous technical knowledge in agriculture

Variations in socio-economic, cultural, heritage, and ethnic systems among farmers in different regions, combined with diverse agro-climatic conditions in our country, lead to significant differences in farming practices and technological statuses from one place to another. It is commonly observed that farmers in specific regions possess indigenous technical knowledge influenced by geographical diversities and ethnic communities. These indigenous communities offer valuable insights into the sustainable use of natural resources, conservation, and restoration. Unfortunately, the knowledge systems of these farmers are frequently not systematically documented in written form, making them less accessible to agricultural researchers, extension workers, and development practitioners. Despite being overlooked by the development community, numerous indigenous organizations are actively operating in rural communities, striving to identify and implement solutions to community challenges.

Recent research on indigenous agricultural knowledge has started to demonstrate its influence. Notably, it has shaped the viewpoints of policy makers and agricultural development planners in recent years, triggering a renewed interest in this type of knowledge.

Table 4.2.1 Indigenous technical knowledge in agriculture

Sl. no	Cultivation Practices	Description of Identified ITKs	Rational behind the use of ITK
1.	**Field Selection/Preparation**	i. New cultivation is practiced in areas that are characterized by gentle slopes and dense canopies of large trees.	i. Soil fertility is high. ii. Clearing of vegetation is easier because of thin weed growth.
		ii. In rocky areas, land is surveyed and selected where there is less stones/rocks and accordingly prepared for cultivation.	i. Usage of available and arable land.
		iii. Small to medium sized standing trees are left half-cut while clearing the vegetation.	i. It is used as support for growing legumes like local beans. ii. It also holds the soil and prevents major soil erosion in sloppy areas.
		iv. A buffer zone or firebreak measuring approximately 1 to 2 meters is cleared around the field's boundary. Additionally, the direction of the wind is carefully considered prior to igniting the fire.	i. To prevent spread of fire.
2.	**Determination of sowing season**	i. Arrival of seasonal birds such as common cuckoo	i. It indicates sowing season.
		ii. Plant indicators such as peach blossoms, emergence of bamboo shoot	i. It indicates sowing season.
3.	**Determination of time of sowing**	i. Sowing time is determined by following the lunar calendar, with the practice primarily taking place on the full moon day or during the period following the full moon.	i. It is believed that insect infestation is low and yields healthy seeds.

		ii. Sowing seed during evening time.	i. It is believed that sowing seeds in the evening contributes to early germination. ii. It also protects from birds.
4.	**Sowing method**	i. In case of finger millet, seeds are broadcasted before weeding practice. This method is usually practiced in old fields.	i. Weeding after broadcasting uniformly spreads the seeds. ii. Weeding operation also covers the seed under soil and protects it from birds.
5.	**Soil fertility management**	i. *Changwin*/*khlow* plant is chopped and spread over the field. It is usually practiced in small areas for vegetable cultivation. ii. Maize plant materials are fed to the pigs, which are reared near the home gardens. The remaining plant material and pig manure are later used in the home gardens.	i. It is believed that, this plant material softens the hard top layer of soil. ii. It also acts as green manure as it decomposes quickly when compared with other plant materials. i. It improves fertility and texture of the soil.
6.	**Pest and disease management**	A) Cultural Methods i. *Neong ksha totowat/Kalyuõ kabũ goya* is a traditional magico-cultural practice. ii. *Tahmah-sit/Lükap-sik* application.	i. It is believed that this practice prevents further spread of blight like symptoms in leaves and dead heart symptoms in paddy field. ii. It is also believed that this practice controls the spread of brown leaf spot in paddy field. i. It is used against the locust which acts as an insecticide.

		iii.	*Kasak*/*Maku* is carbon soot applied in the leaves of paddy plants around the fields.	i.	Due to the bitterness in taste & smell of *kasak*/*maku*, it was used as repellent against the herbivorous animals and wild boars which may damage the field.
		iv.	*Kasak*/*Maku* is carbon soot applied along with ash & tobacco used against borers in colacasia.	i.	It kills the borer.
		v.	Late sowing of seeds.	i.	It helps to prevent major damage to crops from pest infestation.
		vi.	Cultivating crops in larger area than the required one.	i.	This additional area under cultivation creates a buffer zone that can absorb the impact of uncertainties.
		vii.	Restriction to carry freshly harvested *Shukrah/ Taraw hagrã* through the paddy field during flowering stage.	i.	It is believed that strong smell from freshly harvested *shukrah*/*taraw hagrã* damages flower and leads to production of chaffy grains in rice.
		viii.	*Biyomai/Byũme* scarecrow resembling human, made using the plant straw and cloths.	i.	It is used to scare the monkeys and birds away.
		ix.	*Hakap*/*Kapo* is bamboo clapper device made using bamboos.	i.	It is used to scare birds away.
		x.	*Hambrung*/*Tadap* is a type of scarecrow made using tin cans.	i.	It is used to scare birds away.
		xi.	*Taiphungg/Halyang garã* a light weight dry wooden piece, which produces sound when beating using sticks.	i.	It is used to scare animals and birds away.

		B) Mechanical Methods	
		i. *Atiphang*/*Machik kapo* is a sound making device made by using bamboo and placed near river streams.	i. To scare animals away from the field.
		ii. *Handam*/*Düye* is a trap made using stone and bamboo.	i. This trap is used against rodents in the field.
		iii. *Tawann/Takü* is a triangular trap made using fence wires and bamboo. It is strategically positioned along the paths frequently followed by rodents, such as stream crossings or tree branches near the field.	i. This trap is used against rodents.
		iv. *Kaiwoh* is a trap that utilizes a stone as a weight to trap rodents while they are feeding on the bait.	i. This trap is used against rodents.
		v. *Dhiawoh*/*Thu* is a snare trap constructed using a j-shaped stick and wire.	i. This trap is used against rodents and birds around the field.
		vi. *Hakapp*/*Kapoh* is a trap made using split bamboo.	i. This trap is used against birds and rodents.
		vii. *Khyet*/*Takhrek* is a trap where steel wire is used to make noose.	i. This trap is used against herbivore animals and wild boars which damage the field.
		viii. *Bappaih/Talũ* is trap similar to *Dhiawoh*/*Thu* as mentioned above. The difference can be observed the way the trap is placed.	i. This trap is used against birds.

7.	**Post-Harvest management**	i. *Boh-hari*/*Nabũ lyang* a special structure is made in the field condition to store maize. ii. Seed materials are hung in the ceiling of the room where fire is burned for cooking purpose.	i. Healthy and pest free maize cob are collected and stored in the structure. ii. This structure enables air drying of the maize cob i. Smoke condition prevents damage from insect pest. ii. It also prevents damage from rodents.
8.	**Seed material selection and preservation method**	i. Seed material for paddy is collected separately while harvesting from the field.	i. Healthy and attractive seeds are collected for sowing in coming season.

4.2.2 Description of identified indigenous technical knowledge

4.2.2.1 Field preparation

4.2.2.1a Site selection for new cultivation

Areas covered by large trees were commonly selected for initiating new cultivation due to the presence of fertile soil with a high humus content and sparse vegetation. The dense canopy of these trees in the forest inhibits the growth of numerous weed species through shade suppression. This leads to reduced competition for resources such as water and soil nutrients, limiting their availability to support other plant growth. Moreover, the leaf litter acts as a natural mulching material, covering the entire soil surface and preventing weed seed germination. In the mountainous terrain of Anjaw district, less inclined areas was generally preferred for cultivation. In rocky areas, land is surveyed and selected where there is less stones/rocks and accordingly prepared for cultivation, thus effectively making use of all cultivable and arable land. However, it was observed that with the increasing population, horticultural crops were increasingly occupying the available land, resulting in the decrease in cultivable areas near settled villages. Consequently, the fallow periods have reduced to one to three years.

4.2.2.1b Small to medium sized standing trees

The process of vegetation clearance typically begins during the winter period, spanning from December to March. When cultivating in new areas, vegetation clearance takes place from December to February, taking advantage of the limited weed growth during the winter season. For already cultivated areas, vegetation clearance occurs between February and March, as the height of the weeds is relatively low, making them easier to remove. The vegetation dries up quickly following weeding due to the heat from the sun. During the clearance process, small to medium-sized standing trees are often left

untouched, while the top portion of these trees is cut down. These remaining trees serve as support structures for the growth of local beans. Preserving such trees in the cleared land serves the purpose of preventing soil erosion and maintaining soil stability, which is particularly crucial in hilly areas with rigid terrains.

4.2.2.1c *Tangkat*/*Khri tyoya* preparation

The slashed vegetation was burnt after one or two months gap period. The ashes from burnt vegetation also add up to the soil fertility. To prevent the spread of fire, buffer zones of firebreaks are usually made called *Tangkat*/*Khri tyoya* by clearing field boundary with one to two meter gap. In many instances, dried vegetation is gathered at the center of the field and deliberately set on fire. During the burning process, the wind's direction is taken into account to avoid forest fires. Typically, the fire is initiated from the side facing the wind. A firebreak is created surrounding the entire field area, while the upper portion of the field is adequately cleared to prevent the fire from spreading upward due to gusts of wind. This precaution allows the fire to gradually propagate downward. Additionally, fresh tree leaves are strategically placed in the firebreak to impede the fire's progress.

4.2.2.2 Sowing season

Tribal communities are deeply connected to nature and environment and are well versed about their surroundings in its own ways. Agricultural seasons were identified through observation of bird’s behaviour and phonological pattern of the plants. But with change in time and introduction of the modern calendar, this practice has just become a part of the folklore.

4.2.2.2a Seasonal birds

Local communities have learned to rely on the arrivals of birds, such as the common cuckoo and common hawk cuckoo, as key indicators of the

sowing season. These bird species predominantly arrive during the spring season. The local communities recognize these birds by their distinctive calls and have given them names based on these vocalizations. Similar type of finding was reported by Nagi, (2019).

Kapkung/*Kapku* is common cuckoo (*Cuculus canorus*) indicates *Thamit lai*/*Tha halo* season for growing maize, early sowing of paddy. *Thamit lai*/*Tha halo* indicates the period between March to April which is mainly based on lunar calendar.

Mingbil/*Kaphing* is common hawk male cuckoo (*Hierococcyx varius*) indicates *Halut lai*/*Tachai halo* season for sowing of paddy, finger millet. *Halutlai*/*Tachai* indicates the period between April to May.

Glohgloklah/*Singtaglo* is also the same bird common cuckoo (*Cuculus canorus*) known to change their tune, which changes in late spring season. This indicates *Yashi lai*/*Puoi halo* season for late sowing of paddy. *Yashi lai*/*Puoi halo* is the period between May to June.

4.2.2.2b Plant indicator

The tribal people rely on agriculture as their primary occupation. They possess extensive knowledge of their environment and have developed a distinctive method of determining seasons through careful observation. The study revealed that the flowering of *aman-sit/haqum-sik* (*Prunuspersica*) and the emergence of *hamah gloh/bra tapũ* (bamboo shoots) were also recognized as indicators for the sowing season in the study area. Similar finding was reported by Mao and Hynniewta, (2011).

4.2.2.3 Time of sowing

Time of sowing refers to the specific period or season when seeds are planted or sown in the soil for the purpose of germination and crop growth. It

is an important consideration in agriculture as it determines the timing of initiating the plants life cycle and influences its overall development and productivity. The following are some of the ITK described below.

4.2.2.3a Time of sowing based on lunar calendar

The use of lunar calendars in agriculture is deeply rooted in traditional knowledge and practices that have been transmitted across generations. The sowing of seeds was meticulously carried out by observing the phases of the moon. It was firmly believed that the optimal time for sowing seeds was during or after the full moon, ensuring completion before the moon reached its final stage. Local communities held the belief that sowing seeds during this specific period reduced the risk of pest infestation in crops and resulted in the production of healthy seeds that could be used for subsequent cropping seasons. Similar finding was reported by Benjongtoshi (2014) and Nagi (2019).

4.2.2.3b Sowing of seeds during evening time

In the study area, farmers used to follow the practice of sowing seeds during the evening hours. As their fields were situated at a considerable distance from the village, and during peak agricultural seasons, farmers would construct small huts and stay in the fields themselves. This proximity allowed them to easily adopt the practice of sowing seeds in the evenings. However, over time, significant changes in lifestyle have resulted in this practice becoming increasingly rare. Presently, very few members of the village engage in sowing seeds in their homestead gardens during the evening hours. Sowing seeds during evening hours often comes with higher humidity levels and lower evaporation rates. Therefore, there is less chance of moisture loss from the soil, allowing seeds too maintain proper hydration for germination. This helps the seeds in early germination because of the moisture collected in the soil during night hours. Due to cooler temperature during evening hours, prevents the heat stress on the seeds and newly emerged seedlings. It also protects the seeds

from birds and livestock poultry. Similar finding was identified by Sundaramari and Ranganathan, (2003).

4.2.2.4 Sowing method

Sowing is the process of planting seeds or seedlings in the soil for the purpose of growing crops. It involves placing seeds at a specific depth and spacing to ensure proper germination and growth. Sowing is a critical step in agricultural practices as it establishes the foundation for crop production and plays a significant role in determining the success of the harvest. The following are some of the ITK described below.

4.2.2.4a Sowing by dibbling

Sowing of seed was mostly done by hand dibbling method using simple hand tool called *Tahlang*/*Tasë*. It is made by using bamboo or hard woods which was used mostly for sowing of paddy and maize seeds. Millets like finger millet are sown mainly by broadcasting method.

4.2.2.4b Sowing method of finger millet

In general agriculture, the common practice is to sow seeds after the weeding process. However, in a rare case, it was observed that the tribal people of *Mishmi* communities in the study area followed a different approach to adapt to their specific circumstances. It was discovered that these communities practiced weeding after broadcasting finger millet seeds in the field. This method was believed to ensure even distribution of seeds during the weeding process and also provided natural coverage of the seeds by the soil. Additionally, this approach helped protect the seeds from bird attacks and saved time and energy. The weeds collected during the weeding process were either placed near rocks or left in the field to serve as mulch. It is important to note that the applicability of this practice is limited to lands under short fallow periods

4.2.2.5 Soil fertility management

Soil fertility refers to the inherent capacity of soil to provide essential nutrients and support optimal plant growth and productivity. The following are some of the ITK in soil fertility management:

4.2.2.5a *Changwin*/*Khlow*

Artemisia spp., locally known as *Changwin*/*Khlow*, is a green and tender plant that was previously utilized as green manure by the villagers in the study area, as reported. The tender parts of the plant are chopped into smaller pieces and spread across the field, where they are allowed to decompose effectively.

Due to its tender nature, this plant material decomposes relatively quickly compared to other plant materials in the field. Over time, the hard surface of the soil softens as the plant material decomposes, facilitating the easy growth of crop plants and improving soil fertility. Furthermore, it was discovered that the leaves of these plants were once used as wipes for cleaning the face and as toilet wipes for small children when water was not readily available.

4.2.2.5b Pig manure along with crop residues

In traditional shifting cultivation, a common practice for soil fertility management involves clearing and drying vegetation, followed by controlled burning. This burning process generates nutrient-rich ash that is utilized for crop cultivation. However, in the Chaglagam block study area, cultivating agricultural crops presented challenges due to factors such as difficult topography and hard soil conditions. It was found that cultivating crops far from the village was not sustainable due to the significant damage caused by wild animals and insufficient crop production to sustain the family for more than five to six months, as reported by the villagers. As a result, the same plot

of cultivable land near the village and houses was repeatedly used for growing millets, maize, and vegetable crops. To address soil fertility issues, the village dwellers started utilizing maize crop waste as feed for pigs, which were reared near the fields. The pigs converted the waste into valuable manure, which was then applied to the fields as a nutrient source. This practice helped improve soil fertility and provided a sustainable solution for maintaining soil health and productivity in the local context.

4.2.2.6 Plant protection

Plant protection refers to the various measures and strategies employed to safeguard plants from pests, diseases, weeds, and other factors that can negatively impact their health and productivity. The following are the practices described below.

4.2.2.6a *Neong ksha totowat/Kalyuõ kabũ goya*

The *Mishmi* tribe of Anjaw district follows a magico-cultural practice known as *Neong ksha totowat/Kalyuõ kabũ goya*. This ancient practice has been in existence for generations and is still observed by local communities in few pocket areas. *Neong ksha totowat/Kalyuõ kabũ goya* was primarily carried out to control pests and diseases in rice crops and promote the healthy growth of plants. The practice involves addressing damage symptoms observed in the plants, such as dead heart symptoms and brown discoloration that starts from the leaf tip. The practice of *Neong ksha totowat/Kalyuõ kabũ goya* combines traditional beliefs and cultural rituals to ensure plant health and protect crops from pest and disease infestation. It is a unique approach of plant protection that reflects the deep-rooted knowledge and practices of the *Mishmi* tribe.

The *Mishmi* ethnic tribe commonly engages in animistic religious activities, with magic playing a significant role in their practices. They hold the belief that spirits from the unknown world exert influence over various aspects

of human life and the environment. According to their beliefs, both benevolent and malevolent spirits exist. At the core of their spiritual system, *Amik-Matai*, the supreme creator of nature, represents the highest ethical understanding achieved by the *Mishmi* tribe. This belief system reflects their deep reverence for the spiritual realm and their connection to the natural world.

In the traditional practices of the *Mishmi* tribe, magico-cultural rituals are conducted by a shaman known as *Kambring* or *Gwak*. The shaman acts as a mediator between the people of the present world and the spirits of the unknown world by performing specific rituals and offering ceremonies. *Tamblai*/*Taharũ* is a table constructed using four bamboo or wooden sticks, typically measuring 5 to 6 feet in height. This table serves as a platform for offering items to the spirits of nature. During the ritual, a few samples of diseased plants are tied to each of the four posts, symbolizing the challenges faced in agriculture. As an offering, chickens are sacrificed, and the shaman carries out the ritual. As part of the ceremony, the chicken's intestine is placed on a leaf, which is then carried around the field and later placed on the *Tamblai/Taharũ*. Once the ritual is completed, a mixture of rice and yeast known as *Kambong*/*Kabũ* is placed in the field. *Kambong*/*Kabũ* is used in the preparation of rice beer.

According to tradition, the chicken offered in the ritual should not be taken home. Instead, it is cooked and consumed by the members present in the field. This practice reflects the belief that the ritual offerings should remain within the sacred space of the field, maintaining a connection with the spirits and promoting harmony between the human and spiritual realms.

It has also been discovered that during the early stages of disease symptom appearance, when the number of infected plants is relatively low, a simplified ritual known as *Phangal*/*Tatha kabũ* is performed as a preventive measure. In this case, the presence of a shaman is not required. The

Phangal/Tatha kabũ ritual involves selecting a few infected plants, placing them in a small bamboo basket along with *Langow-chinging*/*Hũi-dũbrum* (*Aspleniumnidus L.*), and hanging the basket from a bamboo pole in the field. Additionally, *Kambong*/*Kabũ* is placed near the bamboo pole. This ritual is believed to help ward off further spread of the disease and protect the remaining plants in the field.

During the practice of these rituals, certain taboos are associated with them. One such taboo is that prior to the commencement of the ritual, only family members should be informed, and no other individuals should be made aware of it. After the completion of the ritual, a practice known as *genah* is observed. *Genah* is indicated by placing elephant grass (*Pennisetum purpureum*) at the entry gate of the field. It signifies that entry is restricted, and during this period, no one is allowed to enter the field. This taboo serves as a way to maintain the sanctity of the ritual and ensure that its effects are preserved without any disturbances or disruptions. Benjongtoshi (2014) also reported that some rituals and beliefs of farmers were associated with the pest management in the *jhum* fields.

The use of fermented rice acts as an insect repellant and in control of disease in the field is a traditional practice that has been employed in traditional agricultural practice has been passed down through generations. This can act as an insect repellant due to the presence of certain compounds and odors that are unattractive or repulsive to certain insects. The fermentation process leads to the production of various metabolites, such as organic acid, alcohols and enzymes which can contribute to its repellant properties. Volatile compounds produced such as organic acids or alcohols may have repellant effect on the insects. Odor produced can interfere with insects olfactory receptors, signaling them area being inhospitable or potentially dangerous.

However, it is difficult to conclude the exact mechanisms and effectiveness of the fermented rice as an insect repellant due to limited research.

The chicken intestine placed in the *Tamblai*/*Taharũ* prepared for offering during ritual process, may also act as control for damage caused by insects in the field. Some studies reported that fixing dead crabs, frogs to bamboo sticks helps in minimizing the damage caused by gundhi bug during dough stage on the rice field (Benjongtoshi, 2014), (Pokhrel & Laskar, 2020).

4.2.2.6b *Tahmah-sit*/*Lükap-sik*

Tahmah-sit/*Lükap-sik* is a paste prepared by decaying process using plant parts of *tahmah-shung*/*Lükap-ashang* (*Gynocardia odorata*) and root of *Chapukk*/*Chikäpum* (*Stephania japonica*),which was once used as an insecticide mainly to control the locust (*Khumb*/*Tükã*).

The leaf, fruit and bark of *tahmah-shung*/*Lükap-ashang* and root of *Chapukk*/*Chikäpum* are collected and chopped into small pieces. This chopped plant materials are collected in big sized leaf and placed in pit dug in the field or in the jungle for decaying. The paste on decaying produces foul smell, which is then applied around the paddy field. It was learned that the paste was effective in killing the locust and also acts as an insect repellent.

Khumb/*Tükã* (locust) was once considered as one of the most destructive pest during early days. They appear in swarms and destroy the field. It was learned that emergence of this pest was mostly seen during the vegetative phase of rice plant. But in recent years, the presence of this pest or the damage caused by this pest is hardly reported. It may be due to the gradual changes observed in agricultural system in the study area which may have indirectly affected in pest control.

4.2.2.6c *Kasak*/*Maku* application

Kasak/*Maku* refers to the carbon soot that is commonly found in traditional kitchens where firewood is burned. This black powdery substance has a bitter taste and a distinct odor. It has been observed that due to the properties of carbon soot, it was traditionally used as a repellent against animals like deer and wild boars in the fields. The carbon soot would be collected and applied around the field perimeter. However, the effectiveness of the applied carbon soot would only last for three to four days unless there was rainfall. It is worth noting that this method is no longer practiced by the villagers. One possible reason for this change could be the significant reduction in the area dedicated to agricultural crops in recent years. Additionally, agricultural cultivation has shifted closer to the village areas. Another factor contributing to the decline of this practice is the expansion of settlement areas due to population growth and new constructions. As a result, animals are less likely to venture into the village vicinity.

4.2.2.6d *Kasak*/*Maku* application with ash and tobacco

It was also learned that *Kasak*/*Maku* was applied along with ash and tobacco against borer in colacasia, which kills the borer. This practice was found to be followed by villagers of Metengliang circle and Manchal circle.

4.2.2.6e Late sowing of crops

The practice of late sowing was primarily adopted as a strategy to avoid the destructive stage of pest insects and minimize crop damage caused by pest infestations. This practice was predominantly observed among a few villagers residing in the lower belt near Hayuliang circle.

4.2.2.6f Cultivating crops in larger area than required area

The practice of cultivating in larger area than the required area was mainly practiced to protect the crop of the required area from the animal damage and other unpredictable factors. Agriculture is influenced by various unpredictable factors such as damage from animals, insects and weather conditions. The attack of animals such as monkeys and bears & wild boars on the crop was quite common and villagers had to adopt different approaches to protect their field. Even though different measures were adopted, some animals manage to damage the field; this additional area under cultivation creates a buffer zone that can absorb the impact of such incidence. This makes win-win situation for both, farmer and the animal.

At present, this practice is not followed anymore and the area under agricultural crops has reduced drastically over time. It is learned that hard earned produce was not able to feed the family for a longer period and moreover rice can be availed easily from the market and through public distribution system which shifts their focus towards earning income.

4.2.2.6g Restriction to carry freshly harvested *Shukrah*/*Taraw hagrã* through the paddy field

Shukrah/*Taraw hagrã* (*Bauhinia vahlii*) is a massive woody climber plant found in the forested regions of mountains, as reported by locals. The bark of this climber plant is stripped away to create traditional rope, which is still utilized by the local communities residing in Anjaw district. This traditional rope is employed in the construction of traditional houses.

It has been discovered that the local communities of the Mishmi tribe in the study area strictly prohibit the transportation of freshly harvested *Shukrah*/*Taraw hagrã* (*Bauhinia vahlii*) into the paddy fields during the flowering stage. When recently harvested, this *Shukrah*/*Taraw hagrã* plant

emits a strong odor, and it is believed by the locals that this smell can adversely affect the paddy flowers, resulting in the production of undesirable, chaffy white grains. The damage of this restricted plant part's transportation can be observed in the field areas through where it cas carried.

4.2.2.6h *Biyomai*/*Byũme*

Biyomai/*Byũme* is a scarecrow made of straw designed to resemble a human figure, dressed in human clothes. It is placed near the field shed with the purpose of deterring monkeys and birds. It was learned that *Biyomai*/*Byũme* should be placed after sunset when monkeys are not present in the vicinity. While monkeys are intelligent animals, the effectiveness of *Biyomai*/*Byũme* lasts until they realize it is not a real human. In recent times, instead of human-like structures, simple scarecrows made from hanging cloth pieces are commonly used.

4.2.2.6i *Hakap*/*Kapo*

Hakap/*Kapo* is a bamboo clapper device, a tool crafted from bamboo to deter birds and animals from the field. It is constructed by splitting bamboo and placing it around the field, with a rope tied to one end of the split and connected to a shed (known as *Khyap*/*Makum*) built in the field. When the rope is pulled, the device acts as a clapper, creating a clapping sound that frightens away birds and animals.

4.2.2.6j *Hambrung*/*Tadap*

Hambrung/*Tadap* is a device created by using empty and available tins. These tins are tied together and suspended from a bamboo stick in the field. When the wind blows, the empty tins collide with each other, producing a sound. This sound serves to scare birds away from the field.

4.2.2.6k *Taiphungg*/*Halyang garã*

Taiphungg/*Halyang garã* is a dried wooden log of medium to large size. It is either hung by a rope or placed on a table near the shed (*Khyap*/*Makum*) in the field. Two sticks are used to strike the wooden log, producing a drum-like sound. This practice was traditionally employed to scare away monkeys, birds, and other animals from the field. *Taiphungg*/*Halyang garã* was typically made using *Luk-shung* (*Makaranga spp*) and *Tahar-shung*/*Hülyang-ashang*, as these tree species are lightweight and produce a loud sound. Additionally, it also served as a source of entertainment for people in the field, functioning as a musical instrument.

Mechanical methods

4.2.2.6l *Atiphang*/*Machik kapo*

This device is specifically designed to deter animals that pose a threat to agricultural fields, typically installed near fields with water streams. It utilizes bamboo to create channels for directing water to the desired location, and the device itself is constructed using bamboo. It consists of a segmented tube that is hinged on one side of its balancing point. In its idle position, the heavier end of the device rests against a sturdy bamboo surface. Water is poured into the upper end of the bamboo tube from the channel, gradually filling it until the tube's center of gravity surpasses the pivot point. This action causes the bamboo tube to rotate, effectively emptying the water. Subsequently, the heavier end of the tube falls back against the hard bamboo, generating a sharp sound. This cycle repeats as the device continues to effectively scare away animals. Similarly Miyazaki and Yamada, (2016) also mentioned about the use of such device to scare birds and animals away by the sound produced.

4.2.2.6m *Handam*/*Düye*

Handam/*Düye* is a simple trap made from readily available stones found in nearby fields. Typically, stones with flat surfaces are chosen for this purpose. It operates as a stone crush trap, where stones or rocks are employed to immobilize the prey. The bait is positioned on the upper surface of the trigger beneath the stone or rock. When rodents or birds, for instance, are attracted by the bait and come into contact with the trigger, it dislodges the supporting stick that holds the weight of the rock or stone, subsequently crushing the prey. This trap is primarily utilized to target rodents. *Handam*/*Düye* is an economical trap and can be reused multiple times. Similar trap was identified by Talisosang, (2012).

4.2.2.6n *Tawan*/*Takü*

Tawan/*Takü* is a triangular trap made using fence wires and bamboo. Thin bamboo or small-sized trees are employed to create tension by bending them. The trigger stick is attached to the wire and secured within the triangle using a support stick. When the prey ventures into this trap, it disturbs the support stick, causing it to become entangled in the triangle. The bent bamboo or trees further tighten the wire, leading to the prey's demise within an hour. This trap is deployed by constructing a wooden log bridge near the field, strategically positioned in areas with challenging terrain. *Tawan*/*Takü* is also strategically placed in tree branches to trap rodents.

4.2.2.6o *Kaiwoh*

Kaiwoh is a trap that utilizes a stone as a weight to entrap rodents while they are feeding on the bait. The trigger wire is positioned above the bait and is triggered when rodents engage with the bait. Similar to *Tawan*/*Takü*, *Kaiwoh* traps are placed in the wooden logs near the field, which acts as a bridge for the movement of rodents, also placed in the tree branches to trap rodents.

4.2.2.6p *Dhiawoh*/*Thu*

Dhiawoh/*Thu* is a snare trap constructed using a j-shaped stick and wire. The j-shaped stick is made using cane or bamboo and serves as the trigger. A nylon thread wire is attached to this stick, forming a loop. This wire is then secured to slender bamboo or small-sized trees, which creates tension when they are bent to set up the trap. The loop is positioned in an upright position along the prey's path, while the j-shaped stick is placed as the trigger stick within the support stick. As the prey passes through the loop wire, it gets trapped in a matter of seconds. This type of snare is specifically employed to target rodents.

4.2.2.6q *Hakapp*/*Kapoh*

The trap is crafted using bamboo and wire. Bamboo is split into two halves and tied to another bamboo, leaving the upper split loosely attached. A separate bamboo split, forming a bow shape, is then fastened onto the upper loose split using wire. This arrangement creates tension, and when the trigger is touched, the prey becomes trapped between the split bamboo. These traps are designed for capturing both rodents and birds. Similar trap was identified by Talisosang, (2012).

4.2.2.6r *Khyet*/*Takhrek*

Khyet/*Takhrek* is another type of indigenous trap, made using strong steel wires with a noose fashioned in the wire. This particular trap is employed to target large animals such as deer and wild boars that cause damage to fields. To set up the trap, the animals' path or route needs to be identified first. The *khyet*/*takhrek* trap is then strategically positioned along this path, selecting a suitable location near the field. The wire trap is placed at head height, and the other end of the wire is tied to a tree or wooden log, allowing the animals to drag the trap only a short distance before the noose tightens. Once the trap is

set, it should be checked by the practitioner every three to four days. *Khyet*/*Takhrek* is one of the simple trap and cost effective to produce.

4.2.2.6s ***Bappaih*/*Talũ***

Bappaih/*Talũ* is a type of spring pull snare that is strategically placed around fields. It is constructed using wire and bamboo. The wire is utilized to form a loop, and a trigger stick is attached to the wire. A small-sized bamboo or a slender standing tree is bent to create tension, and the loop wire of the snare is fastened to it. A small bamboo stick is positioned in the ground at the desired location for the loop wire, serving as support for the trigger stick. The bait is carefully placed in the center of the loop. When the prey comes into contact with the loop wire, it disturbs the trigger, resulting in the prey being quickly strangled. This simple snare was effective in capturing both rodents and birds.

4.2.2.7 Post-Harvest management

4.2.2.7a ***Boh-hari*/*Nabũ lyang***

Boh-hari/*Nabũ lyang* is a special structure made on-site in the field for storage of maize after harvest in field condition. Traditionally *Boh*/*Nabũ* means maize and *hari*/*lyang* means structure for storage. The structure is prepared using bamboo and thatch material and the base of the structure is made above the ground level. After the structure is filled with maize, thatch materials like dried leafs are utilized to cover the top of structure. The structure was mainly prepared in field condition because village settlements were far away from the field and it was difficult to transport the whole harvest at a time because of hilly terrain as observed in the study area. The maize stored in this structure is exposed to natural air circulation, sunlight and low humidity. This exposure facilitates the drying process which reduces moisture content of the maize seeds. Proper drying of maize seeds controls mold growth, seeds deteriotion

and seeds viability. Exposure to sunlight and natural airflow discourages the growth of fungi, insects and other pests that can damage the seed. This help to maintain seeds quality and extend its lifespan. Other advantage includes cost-effectiveness, as it is cost effective method of storage particularly for small scale farmers with limited resources. With the change in time, certain modifications have been noted in the preparation of this structure. Nowadays, wire mesh and CGI sheets are being utilized for easier construction of the structure.

4.2.2.7b Traditional method of preserving produce

Traditionally maize are stored by hanging in the thatch roof of traditional kitchen near the fire place mainly for consuming purpose while millets and paddy are made into bunch and stored for seeds purpose not too far from the fire place. The burning of woods in the traditional kitchen produces smoke which increases nearby air temperature extends the shelf life of the produce. This also prevents the incidence of rodent attack, as it is placed near the fire place and easily visible to the family members of the house.

4.2.2.8 Selection of seed material

Traditional way of selection of seed material was based on the selection of seeds from healthy, disease and pest free and bearing good quality seeds. While harvesting paddy, seed material are selected and harvested separately based on the observation of the farmer. These seed materials are stored separately after the harvest. In case of maize, corns free from pest infestation and healthy ones are selected and stored in *boh-hari*/*nabũ-lyang* for seed material.

4.2.3 Perceived effectiveness of identified indigenous technical knowledge in agriculture

4.2.3.1Field preparation

Table 4.2.3.1 Distribution of respondents based on extent of adoption and perceived effectiveness towards field preparation

Sl. no	Practices	No. of users		Effectiveness									
				No success		Up to 25 %		Up to 50 %		Up to 75 %		Up to 100 %	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Site selection	78	35.46	-	-	-	-	21	26.92	57	73.07	-	-
2	Small to medium sized trees are left half-cut.	67	30.46	-	-	-	-	10	14.92	53	79.10	4	5.97
3	Method to control spread of fire.	108	49.09	-	-	-	-	60	55.55	48	44.44	-	-

Table 4.2.3.1 revealed that the practice of site selection under dense canopy trees and less inclined area for new cultivation was followed by 78 respondents. Mountainous regions typically have limited land suitable for agriculture. With increasing population and most areas covered under horticultural crops, available land for agriculture has become increasingly limited near settled areas leaving fewer options for expanding. Among 78 respondents, 73.07 per cent of the respondents perceived the effectiveness to be up to 75.00 per cent effective while 26.92 per cent of respondents perceived it to be up to 50.00 per cent effective respectively. The 73.07 per cent of the respondents predominantly comprises individuals from middle age to old age groups. Older people often have a wealth of traditional knowledge and

experience passed down through generations. These people have observed and learned from their ancestors that soil under dense canopy trees tends to be more fertile due to the accumulation of organic matter, moisture retention, and nutrient cycling. This traditional knowledge forms the basis for their perception for higher rating. On the other hand, 26.92 per cent of the respondents mostly include young to middle age groups. This group of respondents are more likely to have either received some formal education or had some exposure to modern agriculture practices. With the change in agricultural practices observed over time, they perceive the selection of areas under large canopy of tree as less significant in determining soil fertility.

Table 4.2.3.1 inferred that practice of leaving small to medium sized trees half-cut was followed by 67 respondents. This traditional practice in shifting cultivation where small to medium sized trees are often left half-cut during field preparation phase was mostly observed in Hawai circle and Manchal circle, though practiced by the whole tribe. The practice was mainly adopted in the field preparation of agricultural crops. Among 67 respondents, 79.10 per cent of the respondents perceived the effectiveness to be up to 75.00 per cent, 14.92 per cent of the respondents perceived it as up to 50.00 per cent effective while 5.97 per cent of the respondents perceived it to be 100.00 per cent effective respectively. The disparity in the perceived effectiveness was due to the usability as perceived by the respondents and lack of awareness or knowledge regarding the ecological benefits associated with leaving trees half-cut.

Table 4.2.3.1 reported that method to control spread of fire was practiced by 108 respondents. Among which 44.44 per cent of the respondents perceived it to be up to 75.00 per cent effective while 55.55 per cent perceived it as up to 50.00 per cent effective respectively.

4.2.3.2 Sowing season indicator

Table 4.2.3.2 Distribution of respondents based on extent of adoption and perceived effectiveness towards sowing season indicator

Sl. no	Indicators	No. of users		Effectiveness									
				No success		Up to 25 %		Up to 50 %		Up to 75 %		Up to 100 %	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Birds as seasonal indicator.	156	70.90	-	-	-	-	6	3.84	76	48.71	74	47.43
2	Plants as seasonal indicator.	8	3.63	-	-	-	-	1	12.50	7	87.50	-	-

Table 4.2.3.2 reported that observing birds as season indicator was practiced by 156 respondents. Among which 47.43 per cent of the respondents perceived effectiveness to be up to 100.00 per cent effective, 48.71 per cent of the respondents perceived effectiveness to be up to 75.00 per cent while 3.84 per cent perceived it as up to 50.00 per cent effective respectively. Most of the respondents did not have formal education and resides in remote areas. As a result, people rely more on traditional knowledge and observation cues from the natural environment, including bird species arrival to plan their agricultural activities. It was also learned that, local bird species arrival or behaviour has historically been a reliable indicator for agriculture related activities. Also, observing bird's behaviour is a cost-effective and accessible method in remote areas.

Table 4.2.3.2 revealed that observing plants as season indicator was followed by 8 respondents. Among which 87.50 per cent of the respondents

perceived effectiveness to be up to 75.00 per cent effective while 12.50 per cent perceived it as up to 50.00 per cent effective respectively. It was learned that everyone may not possess detailed knowledge about specific plant species growth patterns and their correlation with seasons. Also climate change and other environmental factors can disrupt the phenology of plants.

4.2.3.3 Sowing time

Table 4.2.3.3 Distribution of respondents based on extent of adoption and perceived effectiveness towards sowing time

Sl. no	Sowing time	No. of users		Effectiveness									
				No success		Up to 25 %		Up to 50 %		Up to 75 %		Up to 100 %	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Lunar calendar.	23	10.45	-	-	-	-	-	-	17	73.91	6	26.08
2	Sowing during evening hours,	2	0.90	-	-	-	-	-	-	2	100.00	-	-

Table 4.2.3.3 reported that following lunar calendar for seed sowing was followed by 23 respondents. Among which 26.08 per cent of the respondents perceived it to be up to 100.00 per cent effective while 73.91 per cent of the respondents perceived it to be up to 75.00 per cent effective respectively. With change of time, not everyone possesses detailed knowledge about the lunar phases and its correlation with agricultural practices. The availability of alternate resources and information contribute to varying adoption of lunar calendar in agriculture.

Table 4.2.3.3 revealed that sowing during evening hours was followed by 2 respondents. And all of the respondents perceived it to be up to 75.00 per cent effective. It was found that majority of the respondents were unaware of

such practice, possibly because the practitioners failed to pass on knowledge about such practice to others. During those days farmers would reside in their fields since the village was situated at a considerable distance, and they would sow seeds during the evening hours, understanding the benefits of this approach. However, as agricultural pattern have changed over time, the tradition of sowing seeds during the evening has become uncommon, likely due to changes in daily activities. This may be the reason for lesser adoption of such practice.

4.2.3.4 Sowing method

Table 4.2.3.4 Distribution of respondents based on extent of adoption and perceived effectiveness towards sowing method

Sl. no	Sowing method	No. of users		Effectiveness									
				No success		Up to 25 %		Up to 50 %		Up to 75 %		Up to 100 %	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Millet sowing method	116	52.73	-	-	-	-	22	18.96	84	72.41	10	8.62

Table 4.2.3.4 revealed that millet sowing method was practiced by 116 respondents. From which 8.62 per cent of the respondents perceived it to be up to 100.00 per cent effective while 72.41 per cent of the respondents perceived it to be up to 75.00 per cent effective and 18.96 per cent of the respondents perceived effectiveness to be up to 50.00 per cent effective respectively. Because of the cultural and traditional significance, millets were still cultivated in marginal areas by many farmers. This is the reason that the practice is still alive and followed by many farmers.

4.2.3.5 Fertility management

Table 4.2.3.5 Distribution of respondents based on extent of adoption and perceived effectiveness towards fertility management

Sl. no	Practices	No. of users		Effectiveness									
				No success		Up to 25 %		Up to 50 %		Up to 75 %		Up to 100 %	
		F	%	F	%	F	%	F	%	F	%	F	%
1	*Changwin / Khlow* application	2	0.90	-	-	-	-	-	-	2	100.00	-	-
2	Pig manure	10	4.55	-	-	-	-	-	-	10	100.00	-	-

Table 4.2.3.5 inferred that *Changwin*/*khlow* application as fertility management was followed by 2 respondents. And all of the respondents perceived it to be up to 75.00 per cent effective. Lack of knowledge and awareness about the practice among the generation must be the reason for low users in the study area.

Table 4.2.3.5 reported that Pig manure along with crop residues application for fertility management was practiced by 10 respondents. And all of the respondents perceived it to be up to 75.00 per cent effective. Manuring practices were primarily adopted for cultivating vegetable crops in small-scale areas within the village vicinity. However, there has been a gradual shift towards horticultural cash crops, which now dominate most of the cultivation areas. Simultaneously, the practice of rearing pigs near fields has declined over time, which resulted in the reduction of the use of pig manure in agricultural fields.

4.2.3.6 Pest and disease management

Table 4.2.3.6 Distribution of respondents based on extent of adoption and perceived effectiveness towards pest and disease management (Cultural)

Sl. no	Cultural Practices	No. of users		Effectiveness									
				No success		Up to 25 %		Up to 50 %		Up to 75 %		Up to 100 %	
		F	%	F	%	F	%	F	%	F	%	F	%
1	*Neong ksha Totowat / Kalyuõ kabũ goya*	89	40.46	-	-	-	-	14	15.73	58	65.16	17	19.10
2	*Tahmah-sit / Lükap-sik* application	-	-	-	-	-	-	-	-	-	-	-	-
3	*Kasak / Maku* application	-	-	-	-	-	-	-	-	-	-	-	-
4	*Kasak / Maku* application with ash and tobacco	8	3.63	-	-	-	-	-	-	8	100.00	-	-
5	Late sowing of crops	8	3.63	-	-	-	-	3	37.50	5	62.50	-	-
6	Cultivating crops in larger area than required area	-	-	-	-	-	-	-	-	-	-	-	-
7	*Biyomai / Byũme*	173	78.63	-	-	125	72.25	48	27.74	-	-	-	-
8	*Hakap / Kapo*	5	2.27	-	-	-	-	-	-	5	100.00	-	-
9	*Hambrung / Tadap*	47	21.36	-	-	29	61.70	18	38.29	-	-	-	-
10	*Taiphungg / Halyang garã*	-	-	-	-	-	-	-	-	-	-	-	-

Table 4.2.3.6 revealed that *Neong ksha totowat/Kalyuõ kabũ goya* magico-cultural practice was followed by 89 respondents. From which 19.10 per cent of the respondent's perceived it to be up to 100.00 per cent effective while 65.16 per cent of the respondents perceived it to be up to 75.00 per cent effective and 15.73 per cent of the respondents perceived it as up to 50.00 per cent effective respectively. Magico-cultural practices are deeply rooted in the cultural practice of the *Mishmi* community, which have been passed down through generations and hold significant cultural and historical value. This must be the reason that *Neong ksha totowat/Kalyuõ kabũ goya* practice was still maintained by few farmers.

Table 4.2.3.6 indicated that *Tahmah-sit*/*Lükap-sik* application was followed by none of the respondents. The use of *Tahmah-sit*/*Lükap-sik* against locust was reported from Ngi village and Surnung village of Hawai circle. The local insecticide, known as *Tahmah-sit*/*Lükap-sik*, was primarily used to combat pests like hoppers. However, due to a decrease in hopper attacks, the application of *Tahmah-sit*/*Lükap-sik* was no longer followed. In the past, large areas were devoted to agricultural crops such as maize, millets, and rice before the introduction of horticultural crops such as orange. Consequently, the risk of pest attacks, including hoppers, was high. However, with the reduction in the cultivation of agricultural crops, the emergence of hoppers in the study area has been indirectly controlled. This is likely the reason why there have been no reported incidents of hopper damage in the fields. As a result, the traditional practice of dealing with hoppers was no longer in use.

Table 4.2.3.6 revealed that *Kasak*/*Maku* or carbon soot application was followed by none of the respondents as most of the respondents were unaware about such practice. The use of *Kasak*/*Maku* or carbon soot was reported from Manchal village. In the past, agricultural fields were situated far away from the villages and were cultivated on a larger scale. This created a higher risk of pest

and animal attacks from various directions, requiring different preventive and curative measures to be adopted. One such measure was the use of *Kasak*/*Maku* as a repellent against deer's and other wild animals in the fields. However, as the area dedicated to agricultural crops decreased and the fields became closer to settlements and village vicinity, the appearance of wild animals also decreased. Consequently, there has been a significant reduction in the opportunity to practice this traditional method (ITK). Over time, as the practice fell out of use, it became obsolete, and the knowledge about it gradually faded away from society, including the younger generation. This lack of awareness among respondents explains why the practice is no longer being implemented and why many people were unaware of such practice.

Table 4.2.3.6 reported that *Kasak*/*Maku* application with ash and tobacco was followed by 8 respondents. All of the respondents perceived it to be up to 75.00 per cent effective. The use of *Kasak*/*Maku* with tobacco was reported from Metengliang circle and Manchal circle. Due to decrease in the cultivation area of colacasia crops, the occurrence of pest attacks was rarely reported. Colacasia was cultivated on a larger scale as it served as an alternative food source and was also used as animal feed, particularly for pigs. However, over time, there has been a shift in the food system as rice was introduced and was being widely cultivated, leading to a decline in the cultivation of colacasia crops. This decline in cultivation was the primary reason for the decrease in the number of users relying on colacasia as a food source and animal feed.

Table 4.2.3.6 indicated that late sowing of crops was followed by 8 respondents. From which 62.50 per cent of the respondents perceived it to be up to 75.00 per cent effective while 37.50 per cent perceived it to be up to 50.00 per cent effective respectively. The farmers in the village areas were mostly older peoples, and they mostly rely on traditional farming methods and

their agricultural practices are often closely aligned with the local climate and weather pattern. Therefore it was revealed that late sowing may result in crops to escape adverse weather conditions and pest infestations.

Table 4.2.3.6 inferred that cultivating crops in larger area than required area was followed by none of the respondents. The practice was reported from Manchal village and Surnung village. As previously discussed, before the introduction of horticultural crops, larger areas were dedicated to agricultural crops as they served as the primary means of survival. This was necessary to ensure sufficient production to withstand animal attacks and other uncertainties. However, over time, people have shifted away from cultivating agricultural crops on a large scale. This change occurred because the production of these crops was not sufficient to sustain people for extended periods. Instead, more areas were allocated for orange cultivation, which provided tangible monetary returns upon sale. Consequently, farmers began shifting towards horticultural crops, resulting in reduced areas being managed for agricultural crops. This shift limited the opportunities for practicing traditional agricultural methods in the field. Therefore, it is reasonable to assume that the traditional practice is no longer followed.

Table 4.2.3.6 revealed that *Biyomai*/*Byũme* was used by 173 respondents. Among which 27.74 per cent of the respondents perceived it to be up to 50.00 per cent effective while 72.25 per cent of respondents perceived it to be up to 25.00 per cent effective respectively. *Biyomai*/*Byũme* is a scare crow made using straw which resembles human being structure dressed with human cloths.

Table 4.2.3.6 reported that *Hakap*/*Kapo* was used by 5 respondents. All of the respondents perceived it to be up to 75.00 per cent effective. *Hakap*/*Kapo* is prepared using bamboo which acts as clapper device to scare birds away.

Table 4.2.3.6 revealed that 47 respondents used *Hambrung*/*Tadap*. Among the respondents, 38.29 per cent of respondents perceived *Hambrung*/*Tadap* to be up to 50.00 per cent effective, while 61.70 per cent perceived it to be up to 25.00 per cent effective. *Hambrung*/*Tadap* is created by hanging empty tin cans on bamboo sticks. When the wind blows, it produces sound which scares away birds.

Table 4.2.3.6 inferred that *Taiphungg*/*Halyang garã* was used by none of the respondents. Most of the respondents were aware about the *Taiphungg*/*Halyang garã*. *Taiphungg*/*Halyang garã* is a dried wooden log, typically small to medium-sized, made from specific tree species such as *Makaranga sp* and *Tahar-shung*/*Hülyang-ashang*. It was used as an instrument to produce sound when beaten, effectively scaring away birds and animals. Additionally, *Taiphungg*/*Halyang garã* served as a source of entertainment for people staying in fields far away from the village. However, as the time has passed and areas under agricultural crops have decreased, along with the availability of alternative media sources, the traditional use of *Taiphungg*/*Halyang garã* had been replaced by more versatile options.

4.2.3.7 Pest and disease management

Table 4.2.3.7 Distribution of respondents based on extent of adoption and perceived effectiveness towards pest and disease management (Mechanical)

Sl. no	Mechanical methods	No. of users		Effectiveness									
				No success		Up to 25 %		Up to 50 %		Up to 75 %		Up to 100 %	
		F	%	F	%	F	%	F	%	F	%	F	%
1	*Atiphang / Machik kapo*	13	5.90	-	-	-	-	1	7.69	12	92.30	-	-
2	*Handam / Düye*	127	57.73	-	-	5	3.93	82	64.56	40	31.49	-	-
3	*Tawan / Takü*	105	47.73	-	-	-	-	3	2.85	72	68.57	30	28.57
4	*Kaiwoh*	8	3.63	-	-	-	-	-	-	7	87.50	1	12.50
5	*Dhiawoh / Thu*	73	33.18	-	-	-	-	11	15.06	61	83.56	1	1.36
6	*Hakapp / Kapo*	88	40	-	-	-	-	23	26.13	64	72.72	1	1.13
7	*Khyet / Takhrek*	66	30	-	-	-	-	11	16.66	55	83.33	-	-
8	*Bappaih / Talũ*	28	12.73	-	-	-	-	10	35.71	18	64.28	-	-

Table 4.2.3.7 revealed that *Atiphang*/*Machik kapo* was used by 13 respondents. *Atiphang*/*Machik kapo* is a device specifically designed to deter animals that pose a threat to agricultural fields, typically installed near fields with water streams. Among the respondents, 92.30 per cent of respondents perceived it to be up to 75.00 per cent effective while 7.69 per cent of respondents perceived it to be up to 50.00 per cent effective. Since these devices were installed near river streams, a single *Atiphang*/*Machik kapo* can cover a considerable area within its effective range in the vicinity. As a result,

many others also benefit from a single installation. However, not everyone's field is located near a river stream, which limits the application of *Atiphang*/*Machik kapo* in those areas. Furthermore, once the application of *Atiphang*/*Machik kapo* is stopped, it may discourage farmers from future installations. Additionally, the lack of skilled individuals for proper installation in the study area may have discouraged people from using the device. These factors could be the reasons why every farmer in the study area did not adopt the use of *Atiphang*/*Machik kapo*.

Table 4.2.3.7 reported that *Handam*/*Düye* was used by 127 respondents. Among which 31.49 per cent of respondents perceived it to be up to 75.00 per cent effective while 64.56 per cent of respondents perceived it to be up to 50.00 per cent effective and 3.93 per cent of respondents perceived it to be up to 25.00 per cent effective respectively. *Handam*/*Düye* is a simple trap made using easily accessible stones commonly found in the nearby fields. The use of *Handam*/*Düye* was reported in every block of the study area. It was observed that the majority of respondents had utilized this trap at least once in their lifetime because of its ease of use, coupled with its cost-effectiveness.

Table 4.2.3.7 inferred that *Tawan*/*Takü* was used by 105 respondents. *Tawan*/*Takü* is a triangular trap made using fence wires and bamboo. The use of *Tawan*/*Takü* was reported in every block of the study area, indicating its widespread adoption. Among the respondents, 28.57 per cent of respondents perceived it to be up to 100.00 per cent effective while 68.57 per cent of the respondents perceived it to be up to 75.00 per cent effective and 2.85 per cent of the respondents perceived it to be up to 50.00 per cent effective respectively.

Table 4.2.3.7 indicated that *Kaiwoh* was used by 8 respondents. *Kaiwoh* is a trap that utilizes a stone as a weight to entrap rodents while they are feeding on the bait. *Kaiwoh* trap was reported from Walong circle and Manchal circle. Among the respondents, 87.50 per cent of respondents perceived it to be

up to 75.00 per cent effective while 12.50 per cent of respondents perceived it to be up to 100.00 per cent effective respectively. It was learned that the use of this trap was limited to only few villages. This could be attributed to the fact that only a small number of skilled individuals possessed knowledge about preparation and using this trap, and unfortunately, the skill was not effectively disseminated to others in the study area or it may be assumed that those possessing such knowledge had passed away.

Table 4.2.3.7 revealed that *Dhiawoh*/*Thu* was used by 73 respondents. *Dhiawoh*/*Thu* is a snare trap made using a j-shaped stick and wire. Among the respondents, 1.36 per cent of respondents perceived it to be up to 100.00 per cent effective while 83.56 per cent of respondents perceived it to be up to 75.00 per cent effective and 15.06 per cent of the respondents perceived it as up to 50.00 per cent effective respectively.

Table 4.2.3.7 indicated that *Hakapp*/*Kapoh* was used by 88 respondents. *Hakapp*/*Kapoh* is a split bamboo trap, which was reported to be practiced in almost every block in the study area. Among the respondents, 1.13 per cent of respondents perceived it as up to 100.00 per cent effective while 72.72 per cent of respomdents perceived it to be up to 75.00 per cent effective and 26.13 per cent of respondents perceived it to be up to 50.00 per cent effective respectively.

Table 4.2.3.7 revealed that *Khyet*/*Takhrek* was used by 66 respondents. *Khyet*/*Takhrek* is trap made using strong steel wires with a noose made in the wire. The trap is used mainly against large animals. The use of this trap was reported from every block in the study area. Among the respondents, 83.33 per cent of respondents perceived it to be up to 75.00 per cent effective while 16.66 per cent of respondents perceived it to be up to 50.00 per cent effective respectively.

Table 4.2.3.7 inferred that *Bappaih*/*Talũ* was used by 28 respondents. *Bappaih*/*Talũ* is a type of spring pull snare that is strategically placed around fields against rodents and birds. It was reported from every block in the study area. Among the respondents, 64.28 per cent of respondents perceived it to be up to 75.00 per cent effective while 35.71 per cent of respondents perceived it to be up to 50.00 per cent effective respectively

4.2.3.8 Post harvest management

Table 4.2.3.8a Distribution of respondents based on extent of adoption and perceived effectiveness towards post-harvest management

Sl. no	Practices	No. of users		Effectiveness									
				No success		Up to 25 %		Up to 50 %		Up to 75 %		Up to 100 %	
		F	%	F	%	F	%	F	%	F	%	F	%
1	*Boh-hari / Nabũ-lyang*	69	31.37	-	-	-	-	24	34.78	45	65.21	-	-
2	Traditional method of seed preservation	133	60.46	-	-	-	-	35	26.31	85	63.90	13	9.77

Table 4.2.3.8a revealed that *Boh-hari*/*Nabũ-lyang* was used by 69 respondents. *Boh-hari*/*Nabũ-lyang* is a special structure made in the field for storage of maize after harvest in field condition. Among the respondents, 65.21 per cent of respondents perceived it to be up to 75.00 per cent effective while 34.78 per cent of the respondents perceived it to be up to 50.00 per cent effective respectively. *Boh-hari*/*Nabũ-lyang* structures were primarily made in the field to store harvested crops in proper condition. This was necessary because transporting the entire harvest at once was challenging due to the hilly terrain observed in the study area. The traditional baskets used for carrying the harvest were smaller in size and had limited capacity. However, with the

availability of gunny bags and other storage items from outside markets, larger quantities of crops could be transported in a single trip. Additionally, the shift in cultivating crops closer to inhabited areas has discouraged the use of *Boh-hari*/*Nabũ-lyang* structures. These factors were likely responsible for the decreased number of users of *Boh-hari*/*Nabũ-lyang* in the study area.

Table 4.2.3.8a indicated that traditional method of seed preservation was followed by 133 respondents. Among the respondents, 9.77 per cent of respondents perceived it to be up to 100.00 per cent effective while 63.90 per cent of the respondents perceived it to be up to 75.00 per cent effective and 26.31 per cent of respondents perceived it to be up to 50.00 per cent effective respectively. Traditional seed preservation methods are generally low-cost or even cost-free. They rely on locally available materials and techniques, which makes them accessible and affordable for farmers in rural areas who may have limited financial resources. This also makes the farmers self-sufficient and independent in seed production. This must be the reason for still relying on traditional method of seed preservation in the study area.

4.2.3.8b Seed selection method

Table 4.2.3.8b Distribution of respondents based on extent of adoption and perceived effectiveness towards seed selection method

Sl. no	Practices	No. of users		Effectiveness									
				No success		Up to 25 %		Up to 50 %		Up to 75 %		Up to 100 %	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Seed selection	89	40.46	-	-	-	-	7	7.86	52	58.42	30	33.70

Table 4.2.3.8b revealed that traditional method of seed selection was followed by 89 respondents. Among which 33.70 per cent of the respondents

perceived it to be up to 100.00 per cent effective while 58.42 per cent of respondents perceived it to be up to 75.00 per cent effective and 7.86 per cent of the respondents perceived it to be up to 50.00 per cent effective respectively. Farmers select seeds from a small number of plants within their immediate vicinity, leading to a reduced diversity of traits in the resulting crops. This limited diversity makes the crop more vulnerable to diseases, pest and environmental stresses. This traditional method may not involve deliberate selection based on specific desirable traits. As a result, all the selected seeds may not possess the desirable traits. Also, inadequate storage condition can reduce seed viability and lead to disease and pest infestation. This may be the reason for varying response among the respondents.

Table 4.2.3.9 Distribution of respondents based on extent of adoption of ITK

N=220

Sl no.	Category	Frequency	Percentage	Mean	SD
1	Low (Up to 14.04)	38	17.28	24.91	10.87
2	Medium(Between 14.04 to 35.78)	151	68.63		
3	High (35.78 and above)	31	14.09		
Total		220	100		

Table 4.2.3.9 revealed that 68.63 per cent of the respondents were under medium level category based on extent of adoption of ITKs, followed by low level category with 17.28 per cent and high level category with 14.09 per cent. ITKs have been primarily passed down orally from generation to generation. However, as village communities undergo social and economic changes, the traditional knowledge may not be adequately documented or transmitted. This

lack of formal documentation and limited dissemination hinders the preservation and continuity of ITK practices. With change in lifestyle and modernization, traditional agricultural may be often seen as labour-intensive, time consuming and less profitable compared to other alternate livelihood option. This is the reason that younger generations are more attracted to non-agricultural occupations, leading to decline in the transmission of ITK from older generation to younger generation of the community. It was also learned that most farmers have shifted towards cultivation of horticulture cash crops which does not align with the traditional knowledge system that was practiced for *jhum* cultivation.

Table 4.2.3.10 Perceived effectiveness of identified indigenous technical knowledge

N=220

Sl. no	Identified Practices	No of respondents using ITK	Percieved Effectiveness Score	Mean Percieved Effectiveness Score	Overall Mean	SD
1	Field Preparation				2.79	0.49
	i. Site selection.	78	213	2.73 (M)		
	ii. Small to medium sized trees are left half-cut.	67	195	2.91 (M)		
	iii. Method to control spread of fire.	108	264	2.44 (M)		
2	Sowing Season					
	i. Birds as seasonal indicator.	156	536	3.43 (H)		
	ii. Plants as seasonal indicator.	8	23	2.87 (M)		
3	Sowing Time					
	i. Lunar calendar	23	75	3.26 (M)		
	ii. Sowing seed in evening	2	6	3.00 (M)		
4	Sowing Method					
	i. Millet sowing method	116	336	2.89 (M)		
5	Fertility management					
	i. *Changwin* / *Khlow* application	2	6	3.00 (M)		
	ii. Pig manure	10	30	3.00 (M)		

6.	Pest and Disease Management A. Cultural Methods i. *Neong ksha totowat / Kalyuõ kabũ goya* ii. *Tahmah-sit/Lükap-sik* iii. *Kasak* / *Maku* iv. *Kasak* / *Maku* with ash and tobacco v. Late sowing vi. Cultivating crops in larger area than required area vii. *Biyomai* / *Byũme* viii. *Hakap* / *Kapo* ix. *Hambrung* / *Tadap* x. *Taiphungg* / *Halyang garã* B. Mechanical Methods i. *Atiphang* / *Machik kapo* ii. *Handam* / *Düye* iii. *Tawan* / *Takü* iv. *Kaiwoh* v. *Dhiawoh* / *Thu* vi. *Hakapp* / *Kapoh* vii. *Khyet* / *Takhrek* viii. *Bappaih* / *Talũ*	 89 0 0 8 8 0 173 5 47 0 13 127 105 8 73 88 66 28	 270 0 0 24 21 0 221 15 65 0 38 289 342 25 209 242 187 74	 3.03 (M) 0 0 3.00 (M) 2.62 (M) 0 1.27 (L) 3.00 (M) 1.38 (L) 0 2.92 (M) 2.27 (L) 3.25 (M) 3.12 (M) 2.86 (M) 2.75 (M) 2.83 (M) 2.64 (M)		
7.	Post-Harvest management i. *Boh-hari* / *Nabũ-lyang* ii. Seed preservation in smoke condition	 69 133	 183 377	 2.65 (M) 2.83 (M)		
8.	Seed selection and preservation method i. Selection of good quality seeds	89	290	3.25 (M)		

(L = Less effective, M = Moderately effective, H = Highly effective)

Table 4.2.3.10 revealed that 78 numbers of respondents followed the activity of site selection with mean perceived effectiveness score of 2.73(M), activity of medium to small sized trees left half-cut was followed by 67 number of respondents with mean effectiveness score of 2.91(M) and activity of method to control fire was followed by 108 numbers of respondents with mean perceived effectiveness score of 2.44(M).

Table 4.2.3.10 indicated that 156 numbers of respondents followed the observation of birds as seasonal indicator with mean perceived effectiveness score of 3.43(H) and observation of plants as seasonal indicator was followed by 8 numbers of respondents with mean effectiveness score of 2.87(M).

Table 4.2.3.10 revealed that 23 numbers of respondents followed lunar calendar as a method to determine sowing time with mean perceived effectiveness score of 3.26(M) and 2 numbers of respondents followed the method of sowing seed during evening time with mean perceived effectiveness score of 3(M).

Table 4.2.3.10 indicated that 116 numbers of respondents followed different approach of millet sowing for millet cultivation with mean perceived effectiveness score of 2.89(M).

Table 4.2.3.10 stated that 2 numbers of respondents followed the practice of *Changwin* / *Khlow* application for soil fertility management with mean perceived effectiveness score of 3(M) and 10 respondents practiced the application of pig manure as soil fertility management with mean perceived effectiveness score of 3(M).

Table 4.2.3.10 revealed that 89 numbers of respondents followed the practice *Neong ksha totowat / Kalyuõ kabũ goya* for pest and disease management with mean perceived effectiveness score of 3.03(M), while none of the respondents followed the application of *Tahmah-sit/Lükap-sik* for pest

management, none of the respondents followed the application of *Kasak / Maku* for pest management, 8 numbers of respondents followed the application of *Kasak / Maku* with ash & tobacco for pest management with mean perceived effectiveness score of 3(M), late sowing method to escape pest infestation was followed by 8 numbers of respondents with mean perceived effectiveness score of 2.62(M), none of the respondents followed the practice of cultivating crops in larger area than required area to minimize the loss of crops by wild animals, application of *Biyomai / Byũme* to deter birds and animals was followed by 173 numbers of respondents with mean perceived effectiveness score of 1.27(M), application of *Hakap / Kapo* to deter birds and animals away was followed by 5 numbers of respondents with mean perceived effectiveness score of 3(M), application of *Hambrung / Tadap* to deter birds and animals away was followed by 47 numbers of respondents with mean perceived effectiveness score of 1.38(M), and none of the respondents followed the application of *Taiphungg / Halyang garã* to deter wild animals away.

Table 4.2.3.10 indicated that 13 numbers of respondents adopted *Atiphang / Machik kapo* to deter animals away from the field with mean perceived effectiveness score of 3.03(M), 127 numbers of respondents adopted *Handam / Düye* traps for rodent pest management in *jhum* field with mean perceived effectiveness score of 2.27(L), 105 numbers of respondents adopted *Tawan / Takü* traps for rodent pest management in *jhum* field with mean perceived effectiveness score of 3.25(M), 8 numbers of respondents adopted *Kaiwoh* traps for rodent pest management in *jhum* field with mean perceived effectiveness score of 3.12(M), 73 numbers of respondents adopted *Dhiawoh / Thu* traps for birds and rodent pest management in *jhum* field with mean perceived effectiveness score of 2.86(M), 88 numbers of respondents adopted *Hakapp / Kapoh* traps for birds and rodent pest management in *jhum* field with mean perceived effectiveness score of 2.75(M), 66 numbers of respondents

adopted *Khyet / Takhrek* traps for larger animals management in *jhum* field with mean perceived effectiveness score of 2.83(M), 28 numbers of respondents adopted *Bappaih / Talũ* traps for birds and rodent pest management in *jhum* field with mean perceived effectiveness score of 2.64(M),

Table 4.2.3.10 revealed that 69 numbers of respondents followed the practice of *Boh-hari / Nabũ-lyang*, a traditional method of post-harvest management in field condition with mean perceived effectiveness score of 2.65(M) and seed preservation in smoke condition was followed by 133 numbers of respondents with mean effectiveness score of 2.83(M).

Table 4.2.3.10 stated that 89 numbers of respondents followed the traditional method for selection of good quality seeds with mean perceived effectiveness score of 3.25(M).

4.2.4 Traditional food as a source of nutrition

Nyuq / *Malũ* (*Arenga obtusifolia* Griff.)

The sugar palm tree, scientifically known as *Arenga obtusifolia* Griff., is referred locally as *Nyuq*/*Malũ* among the *Mishmi* community. It is predominantly found in various parts of Arunachal Pradesh, thriving in subtropical climates with abundant rainfall and high humidity. These trees flourish in hilly terrains near water streams in mountainous regions. They are characterized by their medium height, typically ranging from 3 to 3.5 meters when fully matured, with trunk circumferences varying from 30 to 60 centimeters (Nanda *et al*., 2018).

Nyuq/*Malũ* is a processed food product obtained from the stem of *Arenga obtusifolia* Griff and holds a significant place in the local population's traditional practices, particularly during periods of natural disasters. It is an off-white mixture powder, which is consumed in various culinary forms. The consumption of sugar palm tree as a traditional food has also been reported by Nanda *et al*. (2018) and Singh *et al*. (2013) among other tribes of Arunachal Pradesh.

Nyuq/*Malũ* is prepared by utilizing the stems of mature sugar palm trees. The outer layer of the stem is carefully peeled off and discarded. The outer layer of the stem is carefully peeled away and discarded. The remaining inner part, soft in texture, is carefully chosen and then scraped using small size wooden hammer or wooden knife into fibrous or thread-like particles. These fibrous particles are gathered and placed in a container filled with water, subsequently filtered to separate the fibers, resulting in an off-white liquid mixture. The mixture is then left undisturbed for a day to allow sedimentation. On the following day, the water is drained, leaving behind a powdery off-white substance that settles at the bottom of the container. This collected off-white powdery substance is referred to as Nyuq/Malũ, which is then placed in a cloth

bag to remove excess water and hung up for drying. Nyuq/Malũ is prepared in various culinary styles, either by cooking over an open fire as roti or bread or by boiling directly in water. Traditionally, Nyuq/Malũ was consumed during those periods, especially in times when rice was scarce. Nowadays, it is enjoyed occasionally during traditional events as traditional delicacy.

Tupah / *Tüpa* (*Angiopteris evecta*)

Angiopteris evecta (G. Forst) Hoffm. commonly referred as the giant fern or the king fern, known locally as *Tupah*/*Tüpa* among *Mishmi* tribe, is a species of fern belonging to the family Marattiaceae. They are commonly found in moist, shady environments such as rain forest, wetlands and along stream banks (Srivastava, 2008).

The upper swollen rhizome of the fern is collected, cleaned, and placed in a basket. Ash is then applied to the entire surface of the rhizome, which is then covered with a gunny bag and left undisturbed for ripening. The presence of a strong pungent odor resulting from fermentation indicates that the rhizome has ripened. After ripening, it is thoroughly cleaned with water and is ready for cooking. Typically, it is placed near fire for cooking. This food was traditionally prepared and consumed during times of natural calamities when staple diets were not readily available. Lungphi *et al*., (2018) also reported the consumption of the rhizome of *Angiopteris evecta* by the *Tangsa* community of Arunachal Pradesh. Additionally, this plant is known for its ethno-medicinal use in treatment of dysentery and other skin diseases (Benniamin, 2011).

Bou / *Khüna* (*Chenopodium album*)

Chenopodium album, which belongs to the Amaranthaceae family, is known locally as *Bou*/*Khüna* among the *Mishmi* community. It is cultivated as an additional crop around the edges of the main field or in small patches adjacent to the main crop in homestead gardens, as observed in villages. This

plant typically reaches a height of 2 meters and is an upright, often branched annual herb. Its inflorescence starts off green in color but transitions to a dark pinkish hue as it matures. The flowers grow in small cymes on a densely branched inflorescence that measures 10-40 cm in length (Naveen *et al*., 2021).

Chenopodium album is primarily consumed as a leafy vegetable, and its seeds are used as food and food additives. Due to limited production, *Chenopodium* seeds are highly valued as food additives, particularly among village elders. In traditional cuisine, a staple food called "*Boh shayt*/*Nabũ tapë*" is prepared by mixing rice with crushed corn, which can be rough to consume. To overcome the rough texture, *Chenopodium* seeds are added before cooking. This not only softens the food but also enhances its stickiness and taste, thereby improving the overall eating experience.

Additionally, the seeds of *Chenopodium* were utilized in the preparation of a fermented product called "*Thengi*/*Tasang*." *Thengi*/*Tasang* is produced by adding yeast to the seeds for the production of local wine. This fermented product is soft and easily consumable beverage which is mostly preferred by older individuals in the village. In rare cases of natural uncertainties, such as food scarcity, *Chenopodium* seeds were also employed as a primary food.

Chenopodium album, an underutilized vegetable, offers substantial functional potential beyond its fundamental nutritional advantages. Apart from providing minerals, fiber, vitamins, and essential fatty acids, this plant is incorporated into diets to enhance the sensory and functional aspects of food. Throughout history, it has been traditionally recognized for its medicinal properties, serving as a blood purifier, diuretic, sedative, hepatoprotective agent, antiscorbutic laxative, and anthelmintic against roundworms and hookworms (Poonia and Upadhayay, 2015).

Phurung / *Khünaza* (*Amaranthus hypochondriacus*)

Amaranthus hypochondriacus belongs to the family Amaranthaceae, which is commonly called as cocks comb and is known locally as *Phurung*/ *Khünaza* among the *Mishmi* community. Amaranthus are half-hardy annual plants, growing up to height of 1.2 meters. They are frost tender. Inflorescences are yellow and red in colour, much branched and grains are white to creamish yellow in colour (Naveen *et al*., 2021).

Amaranthus belongs to the pseudocereal category due to its starchy grains. The leaves of Amaranthus are utilized as leafy vegetables, while the seeds serve as a source of food. After harvesting, the seeds are dried and lightly heated in a pan to cook them. These cooked seeds are then crushed into a powdered form. This powdered form is called '*Maiphin*/*Mayap*'. To enhance the taste, sugar is added to this starchy powder before consumption. This convenient and nutritious food has proven to be immensely beneficial for farmers working in fields located far away from villages, as well as for individuals venturing into deep jungles for hunting. The older generation in the villages particularly cherished this ready-to-eat food, as they have been consuming it since their early years.

Arik-sit / *Pya-sik* (*Nephrolepis cordifolia*)

Nephrolepis cordifolia belongs to the family Oleandraceae and is known locally as *Arik-sit*/*Pya-sik* among the *Mishmi* community. *Nephrolepis cordifolia*, a land-dwelling fern, exhibits robust growth by establishing colonies through its short rhizomes and small scaly tubers at the root level. This fern displays adaptability to various environments, thriving as both an epiphytic and epilithic plant. Its fronds, typically measuring 16-32 inches in length and 4 inches in width, exhibit a vibrant shade of green. The *Nephrolepis cordifolia*, also known as the erect sword fern, has multiple methods of

propagation, including spores, stolons, tubers, and rhizomes. These mechanisms enable its spread and colonization (Chettri *et al*., 2020).

The scaly tubers of *Nephrolepis cordifolia* contain a high amount of moisture, which helps to get rid of individuals' thirst when no nearby water stream is available, especially during long walks to reach other nearby villages or fields. The fresh harvested scaly tubers are collected, scales are removed and cleaned, and are ready for consumption. Furthermore, these tubers possess numerous health benefits. The rhizome exhibits antibacterial properties and is utilized for alleviating symptoms such as cough, rheumatism, chest congestion, nasal blockage, and loss of appetite (Benniamin, 2011). Traditional medicinal practices also employ these ferns for the treatment of liver disorders (Chettri *et al*., 2020).

Maiki / *Umkhalai* (*Houttuynia cordata* Thumb)

Houttuynia cordata is a medicinal herb which belongs to the family Saururaceae. *Houttuynia cordata* is known locally as *Maiki*/*Umkhalai* among the *Mishmi* community. It is characterized by its creeping root stock and attains a height of approximately 20-50 cm, while its leaves, which are broad and ovate-cordate in shape, measure around 4-8 cm in length and 3-6 cm in width (Kumar *et al*., 2014).

In the *Mishmi* community of Anjaw district, the entire plant of *H. cordata* was traditionally consumed. The leaves were utilized as a green leafy vegetable and for the preparation of chutney. The rhizome, in particular, served as a significant source of food for people residing in remote areas during that time. Fresh rhizomes are harvested, cleaned, and cooked in boiling water, serving as a primary food item. However, with the passage of time, this particular food item is no longer consumed.

Among the six identified plants that serve as a source of food and nutrition, *Chenopodium album* (*Bou*/*Khüna*) and *Amaranthus hypochondriacus* (*Phurung*/*Khünaza*) were reported to have been traditionally consumed in processed form by older generations in a few villages. However, *Arenga obtusifolia* (*Nyuq*/*Malũ*) and *Angiopteris evecta* (*Tupah*/*Tüpa*) are no longer consumed by the local community. The respondents were aware of these plants and could identify them but the processing required considerable time. Furthermore, the taste of *Nyuq*/*Malũ* and *Tupah*/*Tüpa* (plants' processed forms) were not favored by the younger generation. Moreover, rice and other ready-to-eat foods are readily available in the market, which has reduced the demand for these traditional plant-based sources of nutrition. The rhizome of *Houttuynia cordata* (*Maiki*/*Umkhalai*) is no longer consumed as a primary food as it was done in the past, but rather used as a leafy vegetable. The scaly tubers of *Nephrolepis cordifolia* (*Arik-sit*/*Pya-sik*) are seldom ingested to get rid of thirst, given the convenience of readily available beverages in compact packaging, making them easy to carry.

4.2.5 Ethno-veterinary practices

Ethno-veterinary practices refer to traditional veterinary knowledge and techniques that have been developed and used by various cultures and indigenous communities around the world. These practices often involve the use of medicinal plants, local remedies, and specific treatment methods to diagnose, prevent, and treat ailments and diseases in animals. They have been passed down through generations and play a vital role in the healthcare of livestock and working animals in many parts of the world, especially in rural areas where access to modern veterinary services may be limited.

Table 4.2.5.1 Identified ethno-veterinary medicinal plants

Sl. no	Botanical name	Local name	Therapeutic uses	Plant parts used	Indigenous knowledge
1	*Zanthoxylum oxyphyllum* / Rutaceae	*Mazang /Mathã*	Anti-ticks	Leaf and seeds	Small amount of crushed seed powder or one to two leafs are mixed with common salt and fed to animals like mithun.
2	*Gynocordia odorata* / Achariaceae	*Tahmah-shung* / *Lükap-ashang*	Anti-maggot	Bark	Barks are crushed and applied over the wounds.
3	*Datura stramonium*/ Solanaceae	*Mokya* / *Bru phala*	Anti-maggot	Leaf	Leafs are crushed and applied over the wounds to kill the maggots.
4	*Prunus persica*/ Rosaceae	*Aman-sit* / *Haqum-sik*	Anti-maggot	Leaf	Leafs are crushed and applied over the wounds to kill the maggots.
5	*Camellia sinensis*/ Theaceae	*Phalap* / *Phalam*	cuts	Leaf	Fresh leaf is crushed and applied over fresh wound after castration for healing.
6		*Mahlong* / *Malong*	cuts	Whole plant	Whole plant is crushed and applied over fresh wound to stop bleeding.
7	*Bambusa sp* / Poaceae	*Wah-maiwal* / *Hwü-takeh*	cuts	Bamboo skin	Using sharp object outer layer skin is peeled and powdered. This powder is applied over fresh cut to stop bleeding.
8	*Bryophyta*	*Maiwan* / *Mepüng*	cuts	Whole plant	Mosses are collected and crushed. This is applied over wounds to stop bleeding.

9	*Tinospora cordifolia*/ Menispermaceae	*Amuk-bran* / *Tamyam tatshüy*	cuts	Stem	Sap from freshly harvested stem is applied over fresh wound to heal.
10	*Nicotiana sp* / Solanaceae	*Tumbyah* / *Duwã*	Insect repellent	Leaf	Fresh leaf is plucked and exposed to fire for few minutes. This leaf is placed near the chicken nest which act as repellent against the fleas.
11	*Stephania japonica* / Menispermaceae	*Chapukk* / *Chikãpum*	Insect repellent	Tuber	Tuber is chopped and placed near the chicken nest. This act as repellent against the fleas.
12	*Syzygium sp* / Myrtaceae	*Chann*	Skin infection	Leaf	Leaf is crushed and applied over the infected skin or leaves are spread over the pig shed. This helps in healing the skin infection in pigs.
13	*Ricinus communis* /Euphorbiaceae	*Changkoh* / *Tyu tha*	Fever	Leaf	During fever, leaves are placed near the chicken nest, and a few of them are crushed and fed to the chickens.
14	*Coptis teeta* /Ranunculaceae	*Pawah* / *Ruchek*	Eye sore, infection	Root	The root extract is mixed with water and utilized as eye drops in animals such as mithun.

4.2.5.2 Description about ethno-veterinary medicinal plants

Zanthoxylum oxyphyllum

Zanthoxylum oxyphyllum is known locally as *Mazang*/*Matha* belonging to the Rutaceae family, is a highly versatile and extensively distributed plant species. It is primarily utilized as a leafy vegetable and condiment by the *Mishmi* community, adding flavor and enhancing the taste of various dishes. In addition to being consumed as food condiments, *Zanthoxylum oxyphyllum* is also utilized as an ethno-veterinary medicine. It is employed as an anti-tick treatment for animals such as mithun. The method involves feeding mithun with one to two tender leaves or half a teaspoon of dried seed powder mixed with common salt. The *Zanthoxylum* plant is highly valued for its aromatic and medicinal properties, and it also demonstrates insect repellent and insecticidal/larvicidal properties against many pests (Kaleeswaran*et al*., 2019).

Gynocordia odorata

Gynocordia odorata is known locally as *Tahmah-shung*/*Lükap-ashang*, belongs to the Achariaceae family and holds significant medicinal value for the *Mishmi* community. This plant has been utilized as traditional medicine for the treatment of diverse ailments. In Anjaw district, many residents perceive the plant as poisonous and employ it as an insecticide, vermifuge, and piscicide, as well as to repel bees. The tree's bark is collected and crushed, and then applied to wounds as a remedy against maggots.

Datura stramonium

Datura stramonium commonly reffered to as jimsonweed is known locally as *Mokya*/*Bru phala* among the *Mishmi* community in the Anjaw district. This Solanaceae plant is known for its medicinal as well as poisonous properties and has been proven to have great pharmacological potential with a great usage and utility in folklore medicine (Soni*et al*., 2012). To combat

maggots, the crushed leaves of *Datura stramonium* are applied directly into the wounds.

Prunus persica

Prunus persica is known locally as *Aman-sit*/*Haqum-sik* among the *Mishmi* community which belongs to the family Rosaceae and is widely consumed worldwide under the popular name peach. This plant holds significance as an important medicinal plant, exhibiting a range of medicinal activity. The leaves of the peach plants were also used as an anthelmintic, insecticidal, laxative, sedative and vermicidal (Haleema *et al*., 2020). Fresh leaves of peach plants are crushed, and are utilized as a remedy against maggots by applying them directly to wounds.

Camellia sinensis

Camellia sinensis is known locally as *Phalap*/*Phalam*, which means tea. *Phalap*/*Phalam* is an evergreen shrub or medium-sized tree belonging to the Theaceae family. This plant is recognized for its various health benefits, including anti-cancer, antioxidant, and antimicrobial properties. Mishmi community members crush the leaves of this plant and apply them to fresh cut wounds after castration of piglets to facilitate the healing process. Hajiaghaalipour *et al*. (2013) studied the effect of C. *sinensis* on wound healing potential and reported that C. *sinensis* showed high potential in wound healing.

Mahlong / *Malong*

Mahlong/*Malong* plant used by the *Mishmi* community for medicinal purpose is a woody climber having tendrils, trifoliate leaf pattern, parallel type of venation, serrated leaf margin, acuminate or aristate type of leaf. The sap extracted from the plant is sticky in nature. The plant's sap, when extracted, is employed for the healing of larger wounds as it rapidly aids in the fusion of the

injured tissues. Additionally, this plant holds significant sacred value within the community and is utilized for local religious rituals.

Bambusa sp

Bambusa sp are diverse group of evergreen perennial plant of the grass family. *Bambusa sp* are known locally as *Wah*/*Hwü* among the *Mishmi* community. Here *maiwal*/*takeh* means outer skin of the bamboo. In order to make powder, thin outer layer of bamboo skin is carefully scraped using a sharp object, and the peeled outer skin is collected and crushed. This powder is then applied to fresh cuts in order to effectively stop bleeding.

Bryophyta

Mosses are small, non-vascular flowerless plants in the taxonomic division bryophyte, known locally as *Maiwan*/*Mepüng* among the *Mishmi* community in the Anjaw district. Following collection, mosses are crushed and employed to halt bleeding by direct application into wounds.

Tinospora cordifolia

Tinospora cordifolia belonging to family Menispermaceae is a herbaceous vine that grows over other trees. *T. cordifolia* called as *guduchi* in Sanskrit is known locally as *Amuk-bran*/*Tamyam tatshüy* among the *Mishmi* tribe in the Anjaw district of Arunachal Pradesh. This plant is known to have been used in Ayurveda for treatment of various diseases (Saha and Gosh, 2012). The *Mishmi* tribe residing in the Anjaw district utilizes the sap extracted from freshly harvested stems to effectively halt bleeding by directly applying it to wounds.

Nicotiana sp

Nicotiana sp belonging to family Solanaceae are herbaceous plants, which are used as local source of tobacco by the *Mishmi* tribe of Anjaw

district. This wild tobacco plant is known locally as *Tumbyah*/*Duwã*. The freshly harvested leaves of *Tumbyah*/*Duwã* are briefly exposed to fire before being placed in the chicken nests, effectively acting as a natural flea repellent. Tobacco (*Nicotiana sp*) is frequently mentioned in traditional medicine as a potent pesticide and possesses notable antiparasitic properties (Schorderet *et al.*, 2019).

Stephania japonica

Stephania japonica belonging to family Menispermaceae is an herbaceous perennial vine with peltate & membranous leaves and a large underground tuber. *Stephania japonica* is known locally as *Chapukk*/*Chikãpum* among the *Mishmi* community of Anjaw district. *Stephania japonica* is reported to have medicinal properties and has been used as a traditional folk medicine for treatment of various medical ailments such as asthma, tuberculosis, dysentery, hyperglycemia, malaria, cancer and fever (Semwal *et al*., 2010). Islam *et al*. (2019) reported that S. *japonica* possess antimicrobial and insecticidal properties as well. Traditionally, the tubers of *Stephania japonica* are gathered and cut into smaller pieces, which are then scattered in proximity to the chicken nests or around the house. This practice effectively serves as a natural flea repellent.

Syzygium sp

Syzygium sp belonging to Myrtaceae family and known locally as *chann* is a tree with dense bushy crown, with medium height and young leaves emerge as reddish in colour, which later changes to green colour. *Syzygium sp* is often cultivated as ornamental plant. It was also reported that plants belonging to the genus *Syzygium* are being used in the traditional system of medicine in Asian countries like India, China and Bangladesh (Uddin *et al*., 2022). The leaves of *Syzygium* are harvested from their natural habitat, crushed, and subsequently applied to the affected area of the animal. On occasion, the leaves are also

dispersed over the animal shed. This practice proves beneficial in the treatment of skin infections in pigs, aiding in the healing process.

Ricinus communis

Ricinus communis, known as the castor oil plant which belongs to the Euphorbiaceae family is known locally as *Changkoh*/*Tyu tha* among the *Mishmi* community. This soft-wooded small tree is cultivated worldwide in tropical, sub-tropical, and warm temperate regions (Ramanjaneyulu and Gopal, 2015).

Traditionally, during fever symptoms in poultry animals, leaves of the *Ricinus communis* plant are placed near the chicken nest, and a few leaves are crushed and mixed with feed to be fed to the chickens. This practice is believed to aid in the recovery of chicken health. Elkousy *et al*. (2021) reported that *Ricinus communis* leaves possess antiviral activity.

Coptis teeta

Coptis teeta is a stemless herbaceous plant belonging to the family Ranunculaceae which is popularly known as *Mishmi teeta*. It is also referred to as *Pawah*/*Ruchek* among the *Mishmi* community of Anjaw district. This plant is a perennial herb with a rhizomatous growth habit and densely fibrous roots. It features long petioles and ovate-lanceolate leaves. The flowers, which are whitish yellow in color, bloom from February to April. The rhizome of the plant has a golden color and possesses a bitter taste (Payum, 2017).

The roots of the *Coptis teeta* plant are placed in a bowl of water and left to soak for a few hours until the water changes to a yellowish color. This resulting solution is then used as eye drops for animals such as mithuns to treat eye infections.

Table 4.2.5.2 Distribution of respondents based on perceived effectiveness towards ethno-veterinary medicinal plants

Sl. no	Ethno-veterinary Practices	No. of users		Effectiveness									
				No success		Up to 25 %		Up to 50 %		Up to 75 %		Up to 100 %	
		F	%	F	%	F	%	F	%	F	%	F	%
1	Use of *Mazang*/*Mathã* as anti-tick	3	1.35	-	-	-	-	-	-	-	-	3	1.35
2	Use of *Tahmah-shung*/*Lükap-ashang* as anti-maggot	-	-	-	-	-	-	-	-	-	-	-	-
3	Use of *Mokya*/*Bruphala* as anti-maggot	1	0.45	-	-	-	-	-	-	-	-	1	0.45
4	Use of *Aman-sit*/*Haqum-sik* as anti-maggot	1	0.45	-	-	-	-	-	-	-	-	1	0.45
5	Use of *Phalap*/*Phalam* for healing cut wounds	-	-	-	-	-	-	-	-	-	-	-	-
6	Use of *Mahlong*/*Malong* for healing cut wounds	2	0.90	-	-	-	-	-	-	-	-	2	0.90
7	Use of *Wah-maiwal*/*Hwü-Takeh* for healing cut wounds	-	-	-	-	-	-	-	-	-	-	-	-
8	Use of *Maiwan/Mepüng* for healing cut wounds	4	1.80	-	-	-	-	3	1.35	1	0.45	-	-
9	Use of *Amuk-bran*/*Tamyam Tatshüy* for healing cut wounds	3	1.35	-	-	-	-	-	-	-	-	3	1.35
10	Use of *Tumbyah*/*Duwã* as insect repellant	1	0.45	-	-	-	-	-	-	1	0.45	-	-
11	Use of *Chapukk*/*Chikãpum* as insect repellant	-	-	-	-	-	-	-	-	-	-	-	-
12	Use of *Changkoh*/*Tyu Tha* during fever	1	0.45	-	-	-	-	-	-	-	-	1	0.45
13	Use of *Chann* for skin treatment	1	0.45	-	-	-	-	-	-	-	-	1	0.45
14	Use of *Pawah*/*Ruchek* as eye drops	1	0.45	-	-	-	-	-	-	-	-	1	0.45

Table 4.2.5.2 inferred that use of *Mazang*/*Mathã* (*Zanthoxylum oxyphyllum*) as an anti-tick was found to be practiced by three respondents from the village of Kanning, Manchal, and Surnung. The effectiveness of this ethno-veterinary practice was perceived to be up to 100.00 per cent by the respondents. The majority of the respondents were aware of such practice or had learned about it through others but never applied it.

Table 4.2.5.2 reported that use of *Tahmah-shung*/*Lükap-ashang* (*Gynocordia odorata*) as an anti-maggot was found to be practiced by none of the respondents. This ethno-veterinary practice was reported from Manchal circle and Hawai circle. Many respondents were found to be unaware of this practice, possibly because it was not transmitted across generations. When a traditional knowledge and practice is not actively used in the present, it tends to discourage its continuation in the future, leading to a gradual fading away of associated knowledge and skills. Local residents may have faced challenges in accessing this essential plant when it was most needed, potentially discouraging the utilization of this ethno-veterinary medicinal plant.

Table 4.2.5.2 reported that use of *Mokya*/*Bru phala* (*Datura stramonium*) as an anti-maggot was found to be practiced by a single respondent from Manchal village. This ethno-veterinary practice was rarely adopted, only when necessary, due to its poisonous nature. The respondent perceived the practice to be up to 100.00 per cent effective. Most of the respondents were found to be aware of such practice but did not apply it. This decline in users about such practice may also be due to the influence of modern medicine from market.

Table 4.2.5.2 revealed that use of *Aman-sit*/*Haqum-sik* (*Prunus persica*) as an anti-maggot was found to be practiced by a single respondent from Amliang village. The practice was perceived as 100.00 per cent effective by the respondent. While most of the respondents were aware of other ethno-

medicinal practices involving this plant, they were not aware of its specific application as an ethno-veterinary practice.

Table 4.2.5.2 states that none of the respondents were found to adopt the use of *Phalap*/*Phalam* (*Camellia sinensis*) for wound healing after piglet castration. It was learned that the practice of piglet castration was rarely performed due to the lack of locally skilled individuals capable of carrying out such operations. In the past, when connectivity was poor, people in remote villages had to handle every problem themselves. Consequently, skilled personnel were present within the community who could perform these operations and utilize traditional medicinal plants. However, as time passed and people with such expertise were lost, the associated knowledge and skills gradually diminished. Furthermore, the availability of modern medications from nearby towns has led people to rely more on conventional medicine rather than traditional remedies.

Table 4.2.5.2 revealed that use of *Mahlong*/*Malong*, a traditional medicinal plant for healing cut wounds was found to be practiced by single respondent from both Manchal and Naraliang village. The perceived effectiveness of this practice was reported to be up to 100 per cent effective by both respondents. Many respondents were aware of the plant due to its sacred value in the community. However, there was lack of awareness about its medicinal uses among most of them. This knowledge gap could be attributed to a generation gap or insufficient documentation/transmission of traditional practices. Additionally, the limited availability of the plant posed a challenge as individuals had to travel long distances to gather it. Moreover, the identification of the plant could only be done by a few individuals, further discouraging its applicability. These factors contribute to the limited adoption of the plant for medicinal purposes.

Table 4.2.5.2 inferred that none of the respondents practice the use of *Wah-maiwal*/*Hwü-takeh* (*Bambusa sp*) for healing cut wounds. The application of *Wah-maiwal*/*Hwü-takeh* to control minor bleeding from cuts was primarily adopted as an emergency measure for both humans and animals. Using sharp objects the outer bamboo skin is peeled and powdered, which is applied to wounds to stop bleeding. However, it was discovered that the use of other ethno-veterinary medicinal plants, such as *Maiwan*/*Mepüng*, was easier to apply, as reported. This difficulty of application may be a contributing factor for the lower adoption of this practice.

Table 4.2.5.2 inferred that use of *Maiwan*/*Mepüng* (*Bryophyta*) to heal cut wounds was found to be practiced by four respondents from the villages of Kaning, Roiliang, and Kamlat. Among them, two respondents from Roiliang and one from Kaning perceived the effectiveness of this practice to be up to 50.00 per cent, while another respondent from Kamlat village perceived it to be up to 75.00 per cent effective. This plant is easily available in the rocks surface and in trees. As time has passed, the younger generation has become more exposed to mainstream media and modern medicine, which can influence their attitudes towards traditional medicine and contribute to its lesser adoption. This shift in exposure shapes their perception of traditional medicine as less effective. However, it is worth noting that the applicability of this medicinal plant was still observed in a few villages. The varying responses among users may be attributed to their individual experiences and skills while using these remedies to treat ailments, influenced by their personal situations.

Table 4.2.5.2 revealed that the use of *Amuk-bran*/*Tamyam tatshüy* (*Tinospora cordifolia*) was found to be practiced by three respondents, with two from Kaning village and one from Chipro village. All the respondents perceived this practice to be up to 100.00 per cent effective. Although most of the respondents were aware of this plant, but they did not actively apply it. It

was learned that the availability of this plant was limited to specific locations, making it difficult to obtain. Furthermore, due to its limited availability, only a few individuals were able to correctly identify this plant, which restricts its widespread usage. These factors contribute to the lower adoption of the plant among users.

Table 4.2.5.2 reported that use of *Tumbyah*/*Duwã* (*Nicotiana sp*) as an insect repellent was reported by a single respondent from Hutong village. The practice was perceived as being up to 75.00 per cent effective by the respondent. It was discovered that the effectiveness of this practice depends on the use of cured tobacco leaves, which helps control fleas to some extent. However, most of the other respondents were not aware of such a practice. The limited adoption of the plant for insect repellant purposes could be attributed to the lack of knowledge transfer from those who possess the understanding of such practices to younger generations. This knowledge gap has led to a generational divide, resulting in the younger generation being unaware of these traditional practices.

Table 4.2.5.2 reported that none of the respondents were found to practice the use of *Chapukk*/*Chikãpum* (*Stephania japonica*) as an insect repellent. The information about the use of this plant as insect repellant was reported from Manchal circle and Hawai circle. Most of the younger generations were unaware of such practice. As previously mentioned, the limited adoption of the plant for insect-repellant purpose could be attributed to the lack of knowledge transfer from previous generations to the younger ones. Additionally, changes in the housing style of the *Mishmi* community may contribute to the plant's decreased applicability. In the past, chicken nests were placed within the house's front portion to protect them from animal attacks, creating a favorable environment for flea breeding. To control fleas, chopped *Chapukk*/*Chikãpum* was placed in the house. However, over time, the practice

shifted, and chicken nests are now placed separately, greatly reducing the incidence of fleas inside the house. This change in housing style resulted in a decreased need for the plant's use and subsequently led to less awareness among others about its insecticidal properties.

Table 4.2.5.2 revealed that use of *Changkoh*/*Tyu tha* (*Ricinus communis*) for fever treatment of chicken was reported to be practiced by single respondent from Kamlat village. The effectiveness perceived was up to 100.00 per cent by the respondent. Most of the respondents were unaware about such practice. The limited adoption of this practice could be due to the reason that people with knowledge about such practice did not transmit to others.

Table 4.2.5.2 reported use of *Chann* (*Syzygium sp*) as a remedial for treatment of skin infection of pig was reported by single respondent from Kamlat village. The perceived effectiveness for the practice was up to 100.00 per cent by the respondent. Most of the respondents were unaware about such practice. Due to the reason that knowledge about such practice was not passed on to others. This must be the reason for less awareness about such practices.

Table 4.2.5.2 revealed use of *Pawah*/*Ruchek* (Coptis teeta) as an eye drop by sole respondent from Chipro village, attributing its effectiveness to be up to 100.00 percent. Nonetheless, other individuals were not acquainted with this specific application, despite being familiar with the plant's other medicinal properties. Traditionally, *Pawah/Ruchek* has been used for various treatments in humans. The limited availability of *Pawah/Ruchek* during times of need may restrict its usage in this context.

4.3 Constraints faced by the ITK users in practice of indigenous technical knowledge

Under this objective, the major constraints faced by the ITK users in practice of indigenous technical knowledge in agriculture were identified based on the available literature, opinion of the respondents, and expert suggestions. In this study a total seven major constraints were selected and ranking was done following the Garett ranking method.

Table 4.3.1 Distribution of constraints based on ranking given by respondents

N=220

Constraints	Ranks given by the respondents						
	I	II	III	IV	V	VI	VII
Traditional agriculture is labour intensive	15	16	26	37	20	25	81
Traditional agriculture gives lower production and lower income	28	31	16	48	31	43	23
Shift from agricultural to horticultural crops	48	47	40	10	49	10	16
No proper strides taken to preserve and document ITKs	14	16	5	46	35	61	43
Ignorance of youths towards practice of ITKs	40	53	33	26	35	28	5
Availability of items and resources as substitute for tools & implements and farm produce from market	72	27	67	23	17	14	0
Youths engaged in education related activities	3	30	33	30	33	39	52

Table 4.3.2 Per cent positions and Garret values

Sl no.	100 (R_{ij} – 0.5)/N_j	Calculated value	Garret value
1	100 (1-0.5)/ 7	7.14	78
2	100 (2-0.5)/ 7	21.42	66
3	100 (3-0.5)/ 7	35.71	58
4	100 (4-0.5)/ 7	50	50
5	100 (5-0.5)/ 7	64.28	43
6	100 (6-0.5)/ 7	78.57	35
7	100 (7-0.5)/ 7	92.85	22

Table 4.3.3 Distribution of constraints based on Garret values

N=220

Constraints	Ranks given by the respondents							Total	Percentage	Rank
	I	II	III	IV	V	VI	VII			
Traditional agriculture is labour intensive	1170	1056	1508	1850	860	875	1782	9101	41.36	**VII**
Traditional agriculture gives lower production and lower income	2184	2046	928	2400	1333	1505	506	10902	49.55	**IV**
Shift from agricultural to horticultural crops	3744	3102	2320	500	2107	350	352	12475	56.70	**II**
No proper strides taken to preserve and document ITKs	1092	1056	290	2300	1505	2135	946	9324	42.38	**VI**
Ignorance of youths towards practice of ITKs	3120	3498	1914	1300	1505	980	110	12427	56.48	**III**
Availability of items and resources as substitute for tools & implements and farm produce from market	5616	1782	3886	1150	731	490	0	13655	62.06	**I**
Youths engaged in educational related activities	234	1980	1914	1500	1419	1365	1144	9556	43.43	**V**

As shown in Table 4.3.3

1. Availability of items and resources as substitute for tools & implements and farm produce from market scored highest total Garret score of 13655 and a percentage of 62.06, thus making it rank first among all the constraints identified. It was learned that intensive subsistence type of agriculture was mainly practiced by the Mishmi tribe of Anjaw district. The typical practice of agriculture can be observed like this- individuals farming small patches of land for self-consumption with production insufficient to feed the whole family. The availability of processed product from market and subsidized rice through the public distribution system's fair price shops can also be attributed as a key reason for the decline of land-under-agricultural-crops in the study area. It was also reported that easy availability of modern items and resources lead to shift away from traditional practices, including the use of ITK. This occur because they may be perceived as easier to use and more efficient than traditional ones. With gradual changes due to passage of time and modernization many traditional customs and practices which hold cultural and traditional value as repositories of ancestral knowledge are being ignored and forgotten.

2. Shift from agriculture to horticulture crops was ranked as the second most important constraint as reported in the study area. It scored a total Garret score of 12475 and percentage of 56.70. As discussed earlier, traditional agricultural practices sufficed to sustain a family only for few months which often led people to engage in other activities for sustenance, be it food or income. The introduction of horticultural cash crops such as orange and large cardamom have, as a result, gained a great momentum and became one major source of income for the farmers in the study area. With the shift in focus from agriculture to

horticulture crops, we find large areas have taken over by these crops which naturally led to the reduction of cultivable land set aside for cultivation of rice, maize, millets and other grain crops. With the gradual decrease in area under traditional agricultural practices much untold indigenous knowledge systems associated with and employed in cultivation enrooted to the culture is on the verge of decline if not completely lost.

3. Ignorance of youths towards practice of indigenous technical knowledge was ranked the third most important constraint with total Garret score of 12427 and a percentage of 56.48. The decline in the interest of youths towards traditional knowledge systems has become a great concern for the elders of the society. Due to globalization, younger generations are less accustomed or tied to their ancestral cultural roots and tradition than those of their age were in the past. This has impacted the way of thinking, and youths are aligned more towards adopting and imitating new cultures with the perspective that their own traditions are outdated and irrelevant. As reported by the respondents, this cultural shift leads to a decrease in the transmission of ITK from one generation to the next.
4. Traditional agriculture gives lower production and lower income was ranked as fourth major constraint as reported by the respondents in the study area. The total Garret score for the statement is 10902 and percentage of 49.55. Lower production and income in traditional agriculture is one of the major constraints faced by the traditional farmers. Lack of knowledge about improved practices and access to modern inputs such as improved seeds, fertilizers or pesticides limits their production. In the study area, majority of the respondents where illiterate and middle aged groups, they place a high value on preserving cultural and social traditions, which include traditional agricultural practices. Therefore, they prioritize maintaining their cultural identity

and way of living over increasing productivity or income. They also place a high value on self-sufficiency and are able to meet their basic needs with the production and income they generate. This must be the reasons that lower production and income was not perceived as the most important constraints among the respondents.

5. Youths engaged in education related activities was ranked as fifth major constraint with total Garret score of 9556 and a percentage of 43.43. Most of the respondents perceive that youths engaged in education-related activities may not have enough time to devote to farming and learning about ITK since they are preoccupied with their studies. As younger generations engage more with activities related to education and allied livelihood components, they become detached from traditional methods of learning such as the transmission of traditional knowledge orally through story telling by elders, folklore, songs, indigenous knowledge about the village ecosystem, thus, creating a gap for learning. Since they are not exposed to the traditional practices and may not understand their value and significance. Also, younger generations with the aim of pursuing higher education leave the villages, resulting in decrease of family members engaged with agriculture and related activities. As youth become more educated, they will be more exposed to modern cultural values and may view traditional practice as out dated or less important. However, it is important to note that education and ITK can coexist and complement each other to improve farming and practices and livelihoods of the farmer.

6. No proper strides taken to preserve and document indigenous technical knowledge was ranked as sixth major constraint with total Garret score of 9324 and percentage of 42.38. It was learned that traditional practices have been passed down orally from generation to generation and farmers familiarity with ITK, that they have been using these practices for many

years, and therefore the need to document the practices was perceived as secondary motive. As most of the respondents were illiterate, they may not have access to the technology or resources necessary to document ITK in written format, also lack of incentives and recognition for farmers to document ITK would discourage them from doing so. With the dissonance between urban spaces occupied by the youth in their pursuit of livelihood sources and the rural agricultural population becoming larger with each passing year there is an urgent need to actively transfer the oral based traditional knowledge systems to credible legitimate databases or loses it permanently.

7. Traditional agriculture is labour intensive was ranked as seventh major constraint with total Garret score of 9101 and percentage of 41.36. It was learned that many traditional farmers are aging, and the labour intensive nature of traditional agriculture can be physically demanding, making it difficult for older farmers to continue farming practices. Traditional agriculture being labour intensive in nature requires significant amount of time and effort which gives limited productivity, making it difficult for the farmers to meet the demands, which limits the adoption of ITK. In the modern economy time equals money and the philosophy of the greatest returns with least efforts does not coincide with the labor intensive requirements of agriculture. This perhaps was the key reason to the traditional economic practices losing its allure to the 21st century youth. But, it was also observed that traditional farmers place high value on hard work and manual labour, and familiarity with labour intensive nature of traditional agriculture, as it has been a part of their farming practices for many years, could be the reason for least important among all the constraints.

4.4 Association and influence of independent variables with dependent variable

4.4.1 Association and influence of independent variables with extent of adoption and perceived effectiveness of ITK

Table 4.4.1a Relationship between independent variables and extent of adoption of ITK

N=220

Sl. no	Independent Variables	Coefficient of correlation(r)	P value
1.	Age	0.163*	0.016
2.	Education	-0.172*	0.011
3.	Farming experience	0.189**	0.005
4.	Operational land holding	0.135*	0.045
5.	Occupation	0.141*	0.037
6.	Farm income	0.092 NS	0.172
7.	Total income	-0.112 NS	0.097
8.	Social participation	0.09 NS	0.185
9.	Extension contact	0.002 NS	0.982
10.	Scientific orientation	-0.142*	0.036
11.	Mass media exposure	0.003 NS	0.962
12.	Training attended	-0.062 NS	0.362

*Correlation is significant at the 0.05 level (2 tailed) NS – Non Significant
**Correlation is significant at the 0.01 level (2-tailed)

The findings present in Table 4.4.1a reveals the correlation analysis between various socio-economic factors and the extent of adoption of ITK.

The correlation value between the age and the extent of adoption of ITK by the users was 0.163* with p value 0.016. Thus, it can be concluded that the extent of ITK adoption by users tends to increase with the respondent's age,

suggesting a positive correlation between older age and greater adoption of ITK.

The correlation value between the education and the extent of adoption of ITK by the users is -0.172* with p value 0.011. Based on the findings, it can be inferred that there was an inverse relationship between the education level of the respondents and the extent of ITK adoption among ITK users in the study area. In other words, higher levels of education are associated with lower levels of ITK adoption.

The correlation value between the farming experience and the extent of adoption of ITK by the users was 0.189** with p value 0.005. Based on the analysis, it can be inferred that there was a positive correlation between the farming experience of the respondents and the extent of ITK adoption among ITK users in the study area. In other words, as the farming experience of the respondent's increases, there is a greater tendency for them to adopt ITK.

The correlation value between the operational land holding and the extent of adoption of ITK by the users was 0.135* with p value 0.045. Based on the analysis, it can be inferred that there was a positive relationship between the operational land holding of the respondents and the extent of ITK adoption among ITK users in the study area. In other words, as the operational land holding of the respondent's increases, there is a greater likelihood for them to adopt ITK.

The correlation value between the occupation and the extent of adoption of ITK by the users was 0.141* with p value 0.037. Based on the findings, it can be inferred that there was a positive association between the occupation of being a farmer among the respondents and the extent of ITK adoption among ITK users in the study area. In other words, individuals with a higher likelihood of being farmers as their occupation tend to exhibit a greater extent of ITK adoption.

The correlation value between the farm income and the extent of adoption of ITK by the users was 0.092 with p value 0.172. The result was statistically non-significant. Thus, it can be concluded that farm income of the respondents has no relationship with the extent of adoption of ITK by the ITK users in the study area.

The correlation value between the total income and the extent of adoption of ITK by the users was -0.112 with p value 0.097. The result was statistically non-significant. Thus, it can be concluded that total income of the respondents has no relationship with the extent of adoption of ITK by the ITK users in the study area.

The correlation value between the social participation and the extent of adoption of ITK by the users was 0.09 with p value 0.185. The result was statistically non-significant. Thus, it can be concluded that social participation of the respondents has no relationship with the extent of adoption of ITK by the ITK users in the study area.

The correlation value between the extension contact and the extent of adoption of ITK by the users was 0.002 with p value 0.982. The result was statistically non-significant. Thus, it can be concluded that extension contact of the respondents has no relationship with the extent of adoption of ITK by the ITK users in the study area.

The correlation value between the scientific orientation and the extent of adoption of ITK by the users was -0.142* with p value 0.036. Based on the analysis, it can be inferred that there was an inverse relationship between the scientific orientation of the respondents and the extent of ITK adoption among ITK users in the study area. In other words, individuals with a higher scientific orientation tend to exhibit lower levels of ITK adoption.

The correlation value between the mass media exposure and the extent of adoption of ITK by the users was 0.003 with p value 0.962. The result was statistically non-significant. Thus, it can be concluded that mass media exposure of the respondents has no relationship with the extent of adoption of ITK by the ITK users in the study area.

The correlation value between the training attended and the extent of adoption of ITK by the users was -0.062 with p value 0.362. The result was statistically non-significant. Thus, it can be concluded that training attended of the respondents has no relationship with the extent of adoption of ITK by the ITK users in the study area.

Table 4.4.1b Relationship between independent variables and perceived effectiveness of ITK

N=220

Sl. no	Independent Variables	Coefficient of correlation(r)	P value
1.	Age	0.220**	0.001
2.	Education	-0.179**	0.008
3.	Farming experience	0.231**	0.001
4.	Operational land holding	0.115 NS	0.09
5.	Occupation	0.13 NS	0.054
6.	Farm income	0.076 NS	0.259
7.	Total income	-0.094 NS	0.165
8.	Social participation	0.082 NS	0.227
9.	Extension contact	-0.035 NS	0.601
10.	Scientific orientation	-0.182**	0.007
11.	Mass media exposure	0.002 NS	0.981
12.	Training attended	-0.06 NS	0.378

*Correlation is significant at the 0.05 level (2 tailed) NS – Non Significant
**Correlation is significant at the 0.01 level (2-tailed)

The findings present in Table 4.4.1b reveals the correlation analysis between various socio-economic factors and the effectiveness of ITK as perceived by the users.

The correlation value between the age and the effectiveness of ITK as perceived by the users was 0.220** with p value 0.001. Based on the findings, it can be inferred that there is a positive association between the age of the respondents and their perceived effectiveness of ITK in the study area. In other words, older individuals are more likely to perceive ITK as effective compared to younger respondents.

The correlation value between the education and the effectiveness of ITK as perceived by the users was -0.179** with p value 0.008. Based on the analysis, it can be inferred that there was a negative relationship between the

lower education level of the respondents and their perceived effectiveness of ITK in the study area. In other words, individuals with lower levels of education are more likely to perceive ITK as effective compared to those with higher levels of education.

The correlation value between the farming experience and the effectiveness of ITK as perceived by the users was 0.231** with p value 0.001. Based on the findings, it can be inferred that there is a positive correlation between the farming experience of the respondents and their perceived effectiveness of ITK (Indigenous Traditional Knowledge) in the study area. In other words, individuals with greater farming experience are more likely to perceive ITK as highly effective compared to those with less farming experience.

The correlation value between the operational land holding and the effectiveness of ITK as perceived by the users is 0.115 with p value 0.09. The result was statistically non-significant. Thus, it can be concluded that operational land holding of the respondents has no relationship with the effectiveness of ITK as perceived by the ITK users in the study area.

The correlation value between the occupation and the effectiveness of ITK as perceived by the users was 0.13 with p value 0.054. The result was statistically non-significant. Thus, it can be concluded that occupation of the respondents has no relationship with the effectiveness of ITK as perceived by the ITK users in the study area.

The correlation value between the farm income and the effectiveness of ITK as perceived by the users is 0.076 with p value 0.259. The result was statistically non-significant. Thus, it can be concluded that farm income of the respondents has no relationship with the effectiveness of ITK as perceived by the ITK users in the study area.

The correlation value between the total income and the effectiveness of ITK as perceived by the users is -0.094 with p value 0.165. The result was statistically non-significant. Thus, it can be concluded that total income of the respondents has no relationship with the effectiveness of ITK as perceived by the ITK users in the study area.

The correlation value between the social participation and the effectiveness of ITK as perceived by the users was 0.082 with p value 0.227. The result was statistically non-significant. Thus, it can be concluded that social participation of the respondents has no relationship with the effectiveness of ITK as perceived by the ITK users in the study area.

The correlation value between the extension contact and the effectiveness of ITK as perceived by the users was -0.035 with p value 0.601. The result was statistically non-significant. Thus, it can be concluded that extension contact of the respondents has no relationship with the effectiveness of ITK as perceived by the ITK users in the study area.

The correlation value between the scientific orientation and the effectiveness of ITK as perceived by the users was -0.182** with p value 0.007. Based on the analysis, it can be inferred that there is an inverse relationship between the scientific orientation of the respondents and their perceived effectiveness of ITK in the study area. In other words, individuals with a higher scientific orientation tend to perceive ITK as less effective compared to those with a lower scientific orientation.

The correlation value between the mass media exposure and the effectiveness of ITK as perceived by the users was 0.002 with p value 0.981. The result was statistically non-significant. Thus, it can be concluded that mass media exposure of the respondents has no relationship with the effectiveness of ITK as perceived by the ITK users in the study area.

The correlation value between the training attended and the effectiveness of ITK as perceived by the users was -0.06with P value 0.378. The result was statistically non-significant. Thus, it can be concluded that training attended by the respondents has no relationship with the effectiveness of ITK as perceived by the ITK users in the study area.

4.4.2 Influence of independent variables with extent of adoption and perceived effectiveness of ITK

Table 4.4.2a Influence of independent variables and extent of adoption of ITK

N=220

Sl. no	Independent Variables	Regression Coefficient
1.	Education	-0.167**
2.	Land holding	0.368*
3.	Total income	-0.222*
4.	Scientific orientation	-0.188*

*Significant at the 0.05 level of probability F = 9.681** ; R2 = .184
** Significant at the 0.01 level of probability

Table 4.4.2a let us to infer that four variables *viz*., education, land holding, total income and scientific orientation were the important variables in influencing the extent of adoption of ITK by the users to an extent of 18.40 per cent and the 'f' value (9.681) was also found to be significant.

Therefore, it could be concluded that four variables indicated in the Table 4.4.2a were alone the important variables in influencing the extent of adoption of ITKs by the respondents.

It could be observed that one unit increase in education would decrease the extent of adoption of ITKs by the users by 0.167 units.

It could be observed that one unit increase in operational land holding would increase the extent of adoption of ITKs by the users by 0.368 units.

It could be observed that one unit increase in total income would decrease the extent of adoption of ITKs by the users by 0.222 units.

It could be observed that one unit increase in scientific orientation would decrease the extent of adoption of ITKs by the users by 0.188 units.

Table 4.4.2b Influence of independent variables and perceived effectiveness of ITK

N=220

Sl. no	Independent Variables	Regression Coefficient
1.	Education	-0.232**
2.	Land holding	0.253**
3.	Scientific orientation	-0.244**

*Significant at the 0.05 level of probability F = 12.026** ; R2 = .183
** Significant at the 0.01 level of probability

Table 4.4.2b let us to infer that three variables *viz*., education, land holding and scientific orientation were the important variables in influencing the perceived effectiveness of ITK by the users to an extent of 18.30 per cent and the 'f' value (12.026) was also found to be significant.

Therefore, it could be concluded that three variables indicated in the Table 4.4.2b were alone the important variables in influencing the perceived effectiveness of the respondents.

It could be observed that one unit increase in education would decrease the perceived effectiveness of the users by 0.232 units.

It could be observed that one unit increase in operational land holding would increase the perceived effectiveness of the users by 0.253 units.

It could be observed that one unit increase in scientific orientation would decrease the perceived effectiveness of the users by 0.244 units.

CHAPTER V

SUMMARY AND CONCLUSIONS

SUMMARY AND CONCLUSIONS

Indigenous Technical Knowledge (ITK) is local knowledge, knowledge that is unique to a given culture or society. It is an integral part of the culture and history of a local community. It is the knowledge that a community has cultivated through experiences, often validated over an extended period, adapted to local culture and environment. This knowledge is dynamic, evolving, and prioritizes risk minimization rather than profit maximization.

Indigenous in this context suggests that the knowledge is generated by the local people. However, it is probable that it continues to evolve due to exposure to external factors, agencies, and individual innovations. 'Technical' in this context refers to the particular knowledge that individuals possess due to their own experiences in a specific subject area. Recognizing people's knowledge implies a more detailed understanding than that of others who lack the same experiences or skills in observing similar situations.

Ever since the beginning of the human civilization, man has always been using indigenous ways for survival. Indigenous technological knowledge is native local knowledge which is transferred from generation to generation that is unique to a given culture or society. Indigenous knowledge resides within the memories and activities of individuals, finding expression in stories, songs, folklore, proverbs, dances, myths, cultural values, beliefs, rituals, community laws, local language, agricultural practices, materials, and more. Such indigenous practices were practical, environment friendly and culturally acceptable. However over time due to rapid modernization such indigenous practices are being lost at an unprecedented rate. The indigenous practices and knowledge which had been transmitted from one generation to the next through the oral tradition is also in danger of dying out. Therefore it was felt

necessary to undertake the present study entitled, **"Indigenous technical knowledge in agriculture of Mishmi tribe of Anjaw district, Arunachal Pradesh"** with the following objectives:

1. To study the profile of indigenous technical knowledge users of Mishmi tribe of Arunachal Pradesh.
2. To identify and document the indigenous technical knowledge in agriculture used by Mishmi tribe of Arunachal Pradesh.
3. To study the constraints faced by the indigenous technical knowledge users in practice of indigenous practices in agriculture.

Research methodology

The research design was descriptive and multistage purposive cum random sampling design was followed for the study. The study was conducted in the Anjaw district of Arunachal Pradesh, focusing on two sub-tribes, Kaman Mishmi and Tawrah/Taraon Mishmi, residing in different blocks. All blocks within the district were included in the study, namely Hayuliang-Goiliang CD Block, Manchal CD Block, Chaglagam-Metailiang CD Block, and Hawai-Walong CD Block. Eleven villages were randomly selected from each block for the study, namely Naraliang, Amliang, Kongra, Paya, Hayugham, Nenuliang, Glotonglat, Goiliang, Gemliang, Duiliang, and Challang from Hayuliang-Goiliang CD Block; Khalega-Metengliang, Tarampa, Chipra, Tegamna, Abohagam, Metengliang, Bomna, Methumna, Chipro, Teapani, and Roiliang from Chaglagam-Metailiang CD Block; Mepoglat, Qunboo, Khoiliang, Dhanbari, Greliang, Phonglonglat, Kanning, Hutong, Randam, Quibang, and Manchal from Manchal CD Block; and Watong, Chengung, Marbo, Kamlat, Ngi, Surnung, Sarti, Khamti, Yasong, and Warti from Hawai-Walong CD Block. A total of 220 respondents were selected for the study, with

5 respondents chosen from each village. The selection of respondents was conducted randomly. Data collection was carried out through individual interviews and group discussions, utilizing a structured interview schedule.

Findings of the study

Profile characteristic of the respondents

It is evident from the study that 57.72 per cent of the respondents were middle aged, 60.91 per cent were male respondents and 68.64 per cent of the respondents were illiterate. It was found that 61.81 per cent of the respondents had 12 to 28 years of farming experience and 74.54 per cent of the respondents had medium sized operational land holding. Majority of the respondents were engaged in agriculture as main occupation, while only 0.45 per cent of the respondents were engaged in agriculture along with livestock activities. It was also found that 88.63 per cent of the respondents were under medium level income category. Income from farm activities revealed that 77.73 per cent of the respondents were under medium level income category. Study also revealed that mass media exposure, extension contact and social participation were low in the study area. It was observed that 59.55 per cent of the respondents were in the medium level category of scientific orientation. Additionally, it was found that only 5.00 per cent of the respondents reported having attended agriculture related training in the last 5 years.

Identification and documentation of indigenous technical knowledge

Indigenous technical knowledge in agriculture

A total of 32 indigenous practices related to agriculture were identified. Most of the identified ITKs are mainly related to *jhum* cultivation practices. Three indigenous practices related to field preparation were identified. Areas that were less inclined and covered by dense canopy of large trees were selected for new cultivation due to their high soil fertility and easier weed

management. Small to medium-sized standing trees were left half-cut during vegetation clearance to preserve soil integrity and prevent erosion. These trees also served as support for growing crops such as legumes. Buffer zones, cleared up to two-meter width or more around the field edges, were established to prevent the spread of fire.

The sowing season was determined through the observation of seasonal birds like the common cuckoo and plant indicators such as peach blossoms and the emergence of bamboo shoots. Sowing time was further guided by following and observing lunar phases, with seeds sown during evening hours. Millet seeds were broadcasted before the weeding process. Soil fertility management involved the use of *Changwin*/*Khlow (Artemisia sp)*, which also helped to soften hard soil. Pig manure, along with crop residues was utilized as organic fertilizer.

A magico-cultural practice known as *Neong ksha totowat/Kalyuõ kabũ goya* was reported to control pest and disease infestations in *jhum* paddy fields. Botanicals were also used for pest control, although the efficacy of this practice in the current situation remains questionable. *Tahmah-shung/Lükap-ashang* (*Gynocardia odorata*) and the root of *Chapukk/Chikãpum* (*Stephania japonica*) were reported to be used against locusts. The utilization of *Kasak/Maku* or carbon soot was also reported. However, it was also noted that the local communities of the *Mishmi* tribe strictly prohibited carrying freshly harvested *Shukrah/Taraw hagrã* (*Bauhinia vahlii*) in the paddy field during the flowering stage.

Other cultural practices included late sowing of crops and cultivating crops in larger areas than required. Maize was stored in structures called *Boh-hari/Nabũ-lyang*, mainly for seed material storage. Traditional methods of seed preservation for cereal crops involved hanging the harvest in the traditional

kitchen. Selection of seed material was done through observation and physical examination of the seeds.

Seven traps for rodents and other animals were identified: *Handam/Düye*, *Tawan/Takü*, *Kaiwoh*, *Dhiawoh/Thu*, *Hakapp/Kapoh*, *Khyet/Takhrek*, and *Bappaih/Talũ*. Additionally, five different types of scarecrows and other devices were also used to deter birds and animals: *Biyomai/Byũme*, *Hakap/Kapo*, *Hambrung/Tadap*, *Taiphungg/Halyang garã*, and *Atiphang/Machik kapo*.

Perceived effectiveness of identified indigenous technical knowledge in agriculture

The practice of site selection was followed by 78 respondents, from which 26.92 per cent of respondents perceived the practice as 50.00 per cent effective, while 73.07 per cent of respondents perceived the practice as 75.00 per cent effective. The mean perceived effectiveness index was 2.73 with moderate effectiveness.

The practice of leaving behind small to medium sized half-cut trees was followed by 67 respondents, from which 14.92 per cent of respondents perceived the practice as 50.00 per cent effective, while 79.10 per cent of respondents perceived the practice as 75.00 per cent effective and 5.97 per cent of the respondents perceived the practice as 100.00 per cent effective. The mean perceived effectiveness index was 2.91 with moderate effectiveness.

To prevent the spread of fire, buffer zones of firebreaks were usually made called '*Tangkat/Khri tyoya*'. The practice *Tangkat/Khri tyoya* was followed by 108 respondents, from which 55.55 per cent of respondents perceived the practice as 50.00 per cent effective, while 44.44 per cent of respondents perceived the practice as 75.00 per cent effective. The mean perceived effectiveness index was 2.44 with moderate effectiveness.

Observing birds as season indicator was followed by 156 respondents. Among which 47.43 per cent of the respondents perceived it to be up to 100.00 per cent effective, 48.71 per cent of the respondents perceived it to be up to 75.00 per cent effective while 3.84 per cent perceived it to be up to 50.00 per cent effective respectively. The mean perceived effectiveness index was 3.43 with high effectiveness.

Observing plants as season indicator was followed by 8 respondents. Among which 87.50 per cent of the respondents perceived it to be up to 75.00 per cent effective while 12.50 per cent of the respondents perceived it to be up to 50.00 per cent effective respectively. The mean perceived effectiveness index was 2.87 with moderate effectiveness.

Lunar calendar for seed sowing was followed by 23 respondents. Among which 26.08 per cent of the respondents perceived it to be up to 100.00 per cent effective while 73.91 per cent of the respondents perceived it to be up to 75.00 per cent effective respectively. The mean perceived effectiveness index was 3.26 with moderate effectiveness.

Sowing seeds during evening hours was followed by 2 respondents. All of the respondents perceived it to be up to 75.00 per cent effective. The mean perceived effectiveness index was 3 with moderate effectiveness.

Millet sowing method was followed by 116 respondents. Among which 8.62 per cent of the respondents perceived it to be up to 100.00 per cent effective while 72.41 per cent of the respondents perceived it to be up to 75.00 per cent effective and 18.96 per cent of the respondents perceived it to be up to 50.00 per cent effective respectively. The mean perceived effectiveness index was 2.89 with moderate effectiveness.

Artemisia sp locally known as *Changwin*/*Khlow*, is a green and tender plant that was previously utilized as green manure by the villagers.

Changwin/Khlow (*Artemisia sp*) application as fertility management was followed by 2 respondents. All of the respondents perceived it to be up to 75.00 per cent effective. The mean perceived effectiveness index was 3.00 with moderate effectiveness.

Pig manure along with crop residues application for fertility management was followed by 10 respondents. All of the respondents perceived it to be up to 75.00 per cent effective. The mean perceived effectiveness index was 3.00 with moderate effectiveness.

Neong ksha totowat/Kalyuõ kabũ goya was primarily carried out to control pests and diseases in rice crops and promote the healthy growth of plants. *Neong ksha totowat/Kalyuõ kabũ goya* magico-cultural practice was followed by 89 respondents. Among which 19.10 per cent of the respondents perceived it to be up to 100.00 per cent effective while 65.16 per cent of the respondents perceived it to be up to 75.00 per cent effective and 15.73 per cent of the respondents perceived it to be up to 50.00 per cent effective respectively. The mean perceived effectiveness index was 3.03 with moderate effectiveness.

Tahmah-sit/Lükap-sik is a paste prepared by decaying process using plant parts of *Tahmah-shung/Lükap-ashang* (*Gynocardia odorata*) and root of *Chapukk/Chikãpum* (*Stephania japonica*), which was once used as an insecticide mainly to control the locust (*Khumb/Tükã*). *Tahmah-sit/Lükap-sik* application was followed by none of the respondents.

Kasak/Maku is carbon soot found in the traditional kitchen where firewood is burnt. *Kasak/Maku* application was found to be followed by none of the respondents.

Kasak/Maku application with ash and tobacco was followed by 8 respondents. All of the respondents perceived it to be up to 75.00 per cent

effective. The mean perceived effectiveness index was 3.00 with moderate effectiveness.

Late sowing of crops was followed by 8 respondents. From which 62.50 per cent of the respondents perceived it to be up to 75.00 per cent effective while 37.50 per cent of the respondents perceived it to be up to 50.00 per cent effective respectively. The mean perceived effectiveness index was 2.62 with moderate effectiveness.

Cultivating crops in larger area than required area was followed by none of the respondents.

Biyomai/Byũme is a scarecrow made of straw designed to resemble a human figure, dressed in human clothes. *Biyomai/Byũme* was used by 173 respondents. Among which 27.74 per cent of the respondents perceived it to be up to 50.00 per cent effective while 72.25 per cent of the respondents perceived it to be up to 25.00 per cent effective respectively. The mean perceived effectiveness index was 1.27 with less effectiveness.

Hakap/Kapo is a bamboo clapper device, a tool crafted from bamboo to deter birds and animals from the field. *Hakap/Kapo* was used by 5 respondents. All of the respondents perceived it to be up to 75.00 per cent effective. The mean perceived effectiveness index was 3.00 with moderate effectiveness.

Hambrung/Tadap is a device created by using empty and available tins. These tins are tied together and suspended from a bamboo stick in the field. *Hambrung/Tadap* was used by 47 respondents. Among which 38.29 per cent of the respondents perceived it to be up to 50.00 per cent effective while 61.70 per cent of the respondents perceived it to be up to 25.00 per cent effective respectively. The mean perceived effectiveness index was 1.38 with less effectiveness.

Taiphungg/Halyang garã is a dried wooden log of medium to large sized, which is used as an instrument to produce sound to scare away animals and birds. *Taiphungg/Halyang garã* was found to be used by none of the respondents.

Atiphang/Machik kapo is a device specifically designed to deter animals that pose a threat to agricultural fields was used by 13 respondents. Among which 92.30 per cent of the respondents perceived it to be up to 75.00 per cent effective while 7.69 per cent of the respondents perceived it to be up to 50.00 per cent effective respectively. The mean perceived effectiveness index was 2.92 with moderate effectiveness.

Handam/Düye is a stone crush trap, used by 127 respondents. Among which 31.49 per cent of the respondents perceived it to be up to 75.00 per cent effective while 64.56 per cent of the respondents perceived it to be up to 50.00 per cent effective and 3.93 per cent of the respondents perceived it to be up to 25.00 per cent effective respectively. The mean perceived effectiveness index was 2.27 with less effectiveness.

Tawan/Takü is a triangular trap made using fence wires and bamboo was used by 105 respondents. From which 28.57 per cent of the respondents perceived it to be up to 100.00 per cent effective while 68.57 per cent of the respondents perceived it to be up to 75.00 per cent effective and 2.85 per cent of the respondents perceived it to be up to 50.00 per cent effective respectively. The mean perceived effectiveness index was 3.25 with moderate effectiveness.

Kaiwoh is a trap that utilizes a stone as a weight to entrap rodents while they are feeding on the bait was found to be used by 8 respondents. Among which 87.50 per cent of the respondents perceived it to be up to 75.00 per cent effective while 12.50 per cent of the respondents perceived it to be up to 100.00 per cent effective respectively. The mean perceived effectiveness index was 3.12 with moderate effectiveness.

Dhiawoh/Thu is a snare trap constructed using a j-shaped stick and wire was found to be used by 73 respondents. Among which 1.36 per cent of the respondents perceived it to be up to 100.00 per cent effective while 83.56 per cent of the respondents perceived it to be up to 75.00 per cent effective and 15.06 per cent of the respondents perceived it to be up to 50.00 per cent effective respectively. The mean perceived effectiveness index was 2.86 with moderate effectiveness.

Hakapp/Kapoh is a split bamboo trap, which was found to be used by 88 respondents. Among which 1.13 per cent of the respondents perceived it to be up to 100.00 per cent effective while 72.72 per cent of the respondents perceived it to be up to 75.00 per cent effective and 26.13 per cent of the respondents perceived it to be up to 50.00 per cent effective respectively. The mean perceived effectiveness index was 2.75 with moderate effectiveness.

Khyet/Takhrek is a trap, made using strong steel wires with a noose fashioned in the wire was found to be used by 66 respondents. From which 83.33 per cent of the respondents perceived it to be up to 75.00 per cent effective while 16.66 per cent of the respondents perceived it to be up to 50.00 per cent effective respectively. The mean perceived effectiveness index was 2.83 with moderate effectiveness.

Bappaih/Talũ is a type of spring pull snare that is strategically placed around fields which is constructed using wire and bamboo was found to be used by 28 respondents. Among the respondents 64.28 per cent of the respondents perceived it to be up to 75.00 per cent effective while 35.71 per cent perceived it to be up to 50.00 per cent effective respectively. The mean perceived effectiveness index was 2.64 with moderate effectiveness.

Boh-hari/Nabũ-lyang is a structure prepared in field condition was found to be used by 69 respondents. Among which 65.21 per cent of the respondents perceived it to be up to 75.00 per cent effective while 34.78 per

cent of the respondents perceived it to be up to 50.00 per cent effective respectively. The mean perceived effectiveness index was 2.65 with moderate effectiveness.

Traditional method of seed preservation was found to be practiced by 133 respondents. From which 9.77 per cent of the respondents perceived it to be up to 100.00 per cent effective while 63.90 per cent of the respondents perceived it to be up to 75.00 per cent effective and 26.31 per cent of the respondents perceived it to be up to 50.00 per cent effective respectively. The mean perceived effectiveness index was 2.83 with moderate effectiveness.

Traditional method of seed selection was found to be followed by 89 respondents. From which 33.70 per cent of the respondents perceived it to be up to 100.00 per cent effective while 58.42 per cent of the respondents perceived it to be up to 75.00 per cent effective and 7.86 per cent of the respondents perceived it to be up to 50.00 per cent effective respectively. The mean perceived effectiveness index was 3.25 with moderate effectiveness.

The extent of adoption of ITKs was calculated by using adoption index. It was found that 68.63 per cent of the respondents were in medium level category in adoption index. The effectiveness of the identified ITKs were calculated by using mean per effectiveness index, the identified ITKs were categorized as less, medium and high respectively.

Traditional food as a source of nutrition

Six number of plants were identified which were important source of food and nutrition for people during uncertainties. They are *Nyuq/Malũ* (*Arenga obtusifolia* Griff.) is a sugar palm tree, starchy powder extracted from stem fibre was consumed after coking, *Tupah/Tüpa* (*Angiopteris evecta*) is a giant ferm, swollen rhizome consumed after cooking, *Bou/Khüna* (*Chenopodium album*) from Amaranthaceae family, seeds used as food

additives due to limited production, *Phurung/Khünaza* (*Amaranthus hypochondriacus*) from Amaranthaceae family, used as ready to eat food, *Arik-sit/Pya-sik* (*Nephrolepis cordifolia*) scaly tubers rich in moisture content serves as source of water, *Maiki/Umkhalai* (*Houttuynia cordata* Thumb) the rhizome, in particular, served as a significant source of food for people residing in remote areas.

Ethno-veterinary practices

Fourteen number of ethno-veterinary medicinal plants were identified, namely *Zanthoxylum oxyphyllum*, *Gynocordia odorata*, *Datura stramonium*, Prunus persica, *Camellia sinensis*, *Bambusa sp*, Bryophyta, Tinospora *cordifolia*, *Nicotiana sp*, *Stephania japonica*, *Syzygium sp*, *Ricinus communis*, *Coptis teeta* and Mahlong. These plants were used for treatment of various ailments such as wounds, eye infection, cuts, skin infection, anti-ticks and anti-maggots.

Constraints faced by the ITK users in practice of indigenous technical knowledge

1. Availability of items and resources as substitute for tools & implements and farm produce from market scored highest total Garret score of 13655 and a percentage of 62.06, thus making it rank first among all the constraints identified.

2. Shift from agriculture to horticulture crops was ranked as the second most important constraint as reported in the study area. It scored a total Garret score of 12475 and percentage of 56.70.
3. Ignorance of youths towards practice of indigenous technical knowledge was ranked as third most important constraint with total Garret score of 12427 and a percentage of 56.48.

4. Traditional agriculture gives lower production and lower income was ranked as fourth major constraint as reported by the respondents in the study area. The total Garret score for the statement is 10902 and percentage of 49.55.
5. Youths engaged in education related activities was ranked as fifth major constraint with total Garret score of 9556 and a percentage of 43.43.
6. No proper strides taken to preserve and document indigenous technical knowledge was ranked as sixth major constraint with total Garret score of 9324 and percentage of 42.38.
7. Traditional agriculture is labour intensive was ranked as seventh major constraint with total Garret score of 9101 and percentage of 41.36.

Association and influence of independent variables with dependent variable

Association of independent variables with extent of adoption and perceived effectiveness of ITK

The correlation value between the age and the extent of adoption of ITK by the users was 0.163* with p value 0.016. The correlation value between the education and the extent of adoption of ITK by the users is -0.172* with p value 0.011. The correlation value between the farming experience and the extent of adoption of ITK by the users was 0.189** with p value 0.005. The correlation value between the operational land holding and the extent of adoption of ITK by the users was 0.135* with p value 0.045. The correlation value between the occupation and the extent of adoption of ITK by the users was 0.141* with p value 0.037. The correlation value between the farm income and the extent of adoption of ITK by the users was 0.092 with p value 0.172. The result was statistically non-significant. The correlation value between the total income and the extent of adoption of ITK by the users was -0.112 with p

value 0.097. The result was statistically non-significant. The correlation value between the social participation and the extent of adoption of ITK by the users was 0.09 with p value 0.185. The result was statistically non-significant. The correlation value between the extension contact and the extent of adoption of ITK by the users was 0.002 with p value 0.982. The result was statistically non-significant. The correlation value between the scientific orientation and the extent of adoption of ITK by the users was -0.142* with p value 0.036. The correlation value between the mass media exposure and the extent of adoption of ITK by the users was 0.003 with p value 0.962. The result was statistically non-significant. The correlation value between the training attended and the extent of adoption of ITK by the users was -0.062 with p value 0.362. The result was statistically non-significant.

The correlation value between the age and the effectiveness of ITK as perceived by the users was 0.220** with p value 0.001. The correlation value between the education and the effectiveness of ITK as perceived by the users was -0.179** with p value 0.008. The correlation value between the farming experience and the effectiveness of ITK as perceived by the users was 0.231** with p value 0.001. The correlation value between the operational land holding and the effectiveness of ITK as perceived by the users is 0.115 with p value 0.09. The result was statistically non-significant. The correlation value between the occupation and the effectiveness of ITK as perceived by the users was 0.13 with p value 0.054. The result was statistically non-significant. The correlation value between the farm income and the effectiveness of ITK as perceived by the users is 0.076 with p value 0.259. The correlation value between the total income and the effectiveness of ITK as perceived by the users is -0.094 with p value 0.165. The result was statistically non-significant. The correlation value between the social participation and the effectiveness of ITK as perceived by the users was 0.082 with p value 0.227. The result was statistically non-significant. The correlation value between the extension contact and the

effectiveness of ITK as perceived by the users was -0.035 with p value 0.601. The result was statistically non-significant. The correlation value between the scientific orientation and the effectiveness of ITK as perceived by the users was -0.182** with p value 0.007. The correlation value between the mass media exposure and the effectiveness of ITK as perceived by the users was 0.002 with p value 0.981. The correlation value between the training attended and the effectiveness of ITK as perceived by the users was -0.06 with P value 0.378. The result was statistically non-significant.

Influence of independent variables with extent of adoption and perceived effectiveness of ITK

Four variables *viz*. education, land holding, total income and scientific orientation were the important variables in influencing the extent of adoption of ITK by the users to an extent of 18.40 per cent and the 'f' value (9.681) was also found to be significantIt could be observed that one unit increase in education would decrease the extent of adoption of ITKs by the users by 0.167 units. It could be observed that one unit increase in operational land holding would increase the extent of adoption of ITKs by the users by 0.368 units. It could be observed that one unit increase in total income would decrease the extent of adoption of ITKs by the users by 0.222 units. It could be observed that one unit increase in scientific orientation would decrease the extent of adoption of ITKs by the users by 0.188 units.

Three variables *viz*. education, land holding and scientific orientation were the important variables in influencing the perceived effectiveness of ITK by the users to an extent of 18.30 per cent and the 'f' value (12.026) was also found to be significant. Therefore, it could be concluded that three variables were alone the important variables in influencing the perceived effectiveness of the respondents. It could be observed that one unit increase in education would decrease the perceived effectiveness of the users by 0.232 units. It could be

observed that one unit increase in operational land holding would increase the perceived effectiveness of the users by 0.253 units. It could be observed that one unit increase in scientific orientation would decrease the perceived effectiveness of the users by 0.244 units.

Conclusion and Implications of the Study

The importance of documentation of such Indigenous Technical Knowledge lies in the fact that such knowledge is fast disappearing and it is imperative that before it becomes extinct it must be acknowledged and recorded as it is a valuable knowledge bank. The findings show that very few people apply these ITK because it has not been passed down to them or it has faded from memory. Thus the significance of such studies comes to the fore.

From the major findings of the present study regarding the indigenous technical knowledge in agriculture the following is highlighted:

1. Indigenous technical knowledge has been found to have strong roots in rural culture which offers a unique perspective and alternative approach to solving practical problems, often based on resourcefulness, adaptability, and a deep understanding of local ecosystems. One significant advantage of ITK is its focus on low-cost technologies, which are often suitable for resource-constrained communities and have minimal environmental impact. This can serve as an alternative to contemporary technologies.

3. The study findings revealing a majority of illiterate respondents highlight the necessity for adult education programs in the farming community. Adult education plays a crucial role in the holistic development of farmers by addressing the challenges posed by illiteracy and empowering individuals with vital knowledge and skills. Adult education programs tailored to the needs of illiterate farmers can

significantly contribute to their overall development. By improving literacy skills, providing agricultural knowledge, promoting financial literacy, fostering market awareness, encouraging sustainable practices, and empowering individuals, adult education programs empower farmers to enhance their livelihoods, make informed decisions, and contribute to sustainable agricultural development.

4. The identified indigenous technical knowledge should be scientifically validated, field-tested, and integrated into packages of indigenous practices suitable for specific areas to ensure that the indigenous practices are not only based on traditional wisdom but are also supported by scientific evidence and practical application to promote the recognition and utilization of indigenous knowledge systems, leading to sustainable agricultural development, cultural preservation, and improved livelihoods for farming communities.

5. Publishing leaflets and other media sources in the local language can address the low mass-media exposure in areas with low education levels, poor connectivity, and language barriers. By doing so, it improves accessibility, captures attention, and fosters engagement within the community. It is essential to tailor the content to the local context, utilize visual communication, and ensure the materials are tangible and shareable. By complementing existing channels, this approach can effectively bridge the information gap and empower villagers with valuable knowledge and resources.

6. Scientific orientation may bring benefits such as evidence-based approaches and technological advancements; it should not automatically dismiss or devalue the rich traditional knowledge systems developed by indigenous communities. Emphasizing dialogue, respect, and collaboration between scientific and indigenous perspectives can lead to

a more comprehensive and inclusive understanding of medicinal plants and their uses.

Recommendation

1. A concentrated effort is required to document Indigenous Technical Knowledge (ITK) in all districts before it is lost. Indigenous Technical Knowledge poses a greater risk of losing valuable knowledge and practices unique to indigenous communities. Currently, documentation efforts were limited to only one district. Therefore, it is essential to expand these initiatives to encompass all districts and ensure the preservation of ITK.
2. It is recommended that concerned agencies should undertake extensive scientific validation and field trials to integrate the valuable insights from both the scientific world and Indigenous Technical Knowledge (ITK). This should be done through thorough research and consideration of specific agro-ecological conditions. The aim is to ensure that the resulting recommendations are robust, sustainable, and tailored to the needs of local communities and environments.
3. Integrating the documented ITK in the education curriculum is highly recommended as it raises awareness among students about this valuable knowledge. It will encourage them to investigate further and may even inspire them to develop innovative approaches.
4. In the state, the department of agriculture should explore the feasibility and viability of incorporating ITK related to agriculture. Through collaborative efforts with scientists, ITK practitioners, and the community, a remarkable amalgamation of traditional and modern practices can be achieved. This approach should aim to harness the strengths of both knowledge systems and promote innovative, sustainable agricultural practices in the state.

5. The state government should work closely with local bodies and societies to build trust and collaboration, ensuring that the practices of ITK are duly recognized and incentivized. Efforts should be made to encourage the teaching and promotion of ITK among the youth, while creating awareness about its value. By involving and empowering local communities and organizations, the government can foster a sense of ownership and pride in ITK, contributing to its preservation and transmission to future generations.

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APPENDICES

PhD Research on Indigenous Technical Knowledge in Agriculture of Mishmi tribe of Anjaw District, Arunachal Pradesh

INTERVIEW SCHEDULE

Schedule no:
Respondent no:

Part – I

General Information

1. **Name of the respondent:**
2. **Name of the CD-Block:**
3. **Name of the village:**
4. **Name of the district:**

Part – II

Socio-Economic Profile of the Respondent

1. **Age (in years):**
2. **Sex:**
3. **Educational status: Please select ('√') the appropriate option.**
   i). Illiterate. ( ) ii). Can read only. ( ) iii). Can read and write. ( )
   iv). Primary education v). Middle education. ( ) vi). Secondary education. ( ) vi). Higher secondary education.( ) vii). Graduate and Above. ( ).
4. **Family size:**

Sl. No.	Name	Age	Sex	
			M	F

5. **Farming experience (in years):**
6. **Operational land holding:**
   i) Cultivable land owned:
   ii) Cultivable land (leased in):
   iii) Cultivable land (leased out):
7. **Occupation: Please select ('√') the appropriate option.**
   i) Farming alone ( )
   ii) Farming + Agricultural labour ( )
   iii) Farming + Livestock ( )
   iv) Farming + Independent profession ( )
   v) Farming + Service ( )

8. **Annual income:**
9. **Social participation: Please select ('√') the appropriate option.**
    i) Member in one organization ( )
    ii) Member in more than one organization ( )
    iii) Office bearer in one organization ( )
    iv) Office bearer in more than one organization ( )

10. **Extension contact: Please select ('√') the appropriate option.**

Sl. No.	Extension Contact	Response Category				
		Weekly	Monthly	6 monthly	Yearly	Never
i.	Agricultural scientists					
ii.	Agricultural development officers					
iii.	AFA					
iv.	Block Extension Personnel					
v.	Input dealers					
vi.	NGO members					
vii.	Progressive farmers					

11. **Scientific orientation: Please select ('√') the appropriate option.**

Sl. No.	Statements	Response Category				
		SA	A	UD	D	SD
i.	New methods of farming give better results to farmer than the older methods.					
ii.	Even a farmer with lots of experience should use new method of farming.					
iii.	Though it takes time for a farmer to learn new method in farming, it is worth the effect.					
iv.	A good farmer experiments with the new ideas in farming.					
v.	Traditional methods of farming have to be changed in order to raise the economic and social level of the farmer.					
vi.	The way the farmers' forefathers farmed is still the best way to farm today.					

12. Mass media exposure: Please select ('√') the appropriate option.

Sl. No.	Statements	Responses		
		Regularly	Rarely	Never
1.	Listening to agricultural programmes in radio.			
2.	Reading or listening to reading of agricultural news in newspaper.			
3.	Reading or listening to reading of agricultural news in magazines, leaflets, folders and bulletins.			
4.	Viewing of agricultural programmes in television.			
5.	Seeing of agricultural films.			
6.	Participation in agricultural demonstrations and field days.			

13. Training exposure:

Sl. No.	Name of the training	Subject covered	Duration (Days)	Year
1.				
2.				
3.				
4.				
5.				

Part – III

Identification of ITKs with rationale behind their use in agriculture.

Sl. No.	Identification of ITK	Description of ITKs known	Whether used? (Yes/ No)	If used, please specify the stage at which used.	Effectiveness					Rationale behind the use of ITK	Other benefits
					No success	Up to 25 %	Up to 50 %	Up to 75 %	Up to 100 % success		
1	Field preparation										
2	Sowing season										
3	Sowing time										
4	Sowing method										
5	Fertility management										

6	Pest & Disease management										
7	Post-Harvest Management										
8	Seed preservation & selection										

Identification of Traditional food.

Si. No.	Name of the plant	Description of the plant	Rationale behind the use	Other benefits

Identification of ethno-veterinary practices.

Sl. No.	Identification of plant	please specify the purpose	Whether used? (Y/N)	Description of the practice	Effectiveness				
					No success	Up to 25%	Up to 50%	Up to 75%	Up to 100% success

PART-IV

Constraints

Sl. No.	Constraints	Ranking (I to VII)
1.	Traditional agriculture is labour intensive	
2.	Traditional agriculture gives lower production and lower income	
3.	Shift from agricultural to horticultural crops	
4.	No proper strides taken to preserve and document ITKs	
5.	Ignorance of youths towards practice of ITKs	
6.	Availability of items and resources as substitute for tools & implements and farm produce from market	
7.	Youth engaged in education related activities	

PHOTO GALLERY

Clearing of vegetation

Drying of vegetation

Tangkhat/Khri tyoya

Burning of vegetation

Plate 1 Field Preparation

Small to medium sized trees left half-cut

Plate 2 Field preparation

Flowering of *Prunus persica*

Emergence of bamboo shoot

Plate 3 Sowing season indicator

Changwin/Khlow

Pig sty near field

Plate 4 Traditional method of soil fertility management

Neong ksha totowat/Kalyuõ kabũ goya **practice**

Kambong/Kabũ **practice**

Plate 5 Traditional method of crop protection (Cultural method)

Bauhinia vahlii ***Gynocordia odorata***

Carbon soot

Plate 6 Traditional method of crop protection (Cultural method)

Biyomai/Byũme

Hakap/Kapo

Hambrun/Tadap

Taiphung/Halyang garã

Plate 7 Traditional method of crop protection (Cultural method)


Atiphang/Machik kapo


Tawan/Takũ

Plate 8 Traditional method of crop protection (Mechanical method)

Kaiwoh

Handam/Düye

Khyet/Takhrek

Bappaih/Talũ

Plate 9 Traditional method of crop protection (Mechanical method)

Hakapp/Kapoh

Dhiawoh/Thu

Plate 10 Traditional method of crop protection (Mechanical method)


Boh-hari / Nabũ-lyang




Traditional seed preservation method

Plate 11 Traditional seed storage and preservation method

Nyuq/Malũ

Tupah/Tüpa

Maiki/Umkhalai

Phurung/Khünaza

Bou/Khüna

Arik-sit/Pya-sik

Plate 12 Identified plants as source of traditional food & nutrition

Amuk-bran/Tamyam tatshüy

Changkoh/Tyu tha

Chapukk/Chikãpum

Tumbyah/Duwã

Maiwann/Mepüng

Wah/Hwü

Plate 13 Identified ethno-veterinary medicinal plants

Pawah/Ruchek

Chann

Manzang/Mathã

Phalap/Phalam

Tahmah shung/Lükap ashang

Mokya/Bru phala

Plate 14 Identified ethno-veterinary medicinal plants


Mahlong/Malong

Aman-sit/Haqum-sik

Plate 15 Identified ethno-veterinary medicinal plants