GROWING AND UTILIZATION STATUS OF TRADITIONAL VEGETABLES IN PYINMANA AREA

THAW NI NI ZAW

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GROWING AND UTILIZATION STATUS OF TRADITIONAL VEGETABLES IN PYINMANA AREA

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Department of Horticulture and Plant Biotechnology
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The thesis attached here to, entitled **"Growing and Utilization Status of Traditional Vegetables in Pyinmana Area"** was prepared and submitted by Thaw Ni Ni Zaw under the direction of chairperson of the candidate's supervisory committee and has been approved by all members of that committee and board of examiners as a partial fulfillment of the requirements for the degree of **MASTER OF AGRICULTURAL SCIENCE (HORTICULTURE).**

U San Shwe Myint
Chairman of Supervisory Committee
Lecturer
Department of Horticulture and
Agricultural Biotechnology
Yezin Agricultural University

Dr. Nyo Nyo
External Examiner
Professor and Head (Retd.)
Department of Horticulture and
Agricultural Biotechnology
Yezin Agricultural University

Dr. Nang Hseng Hom
Member of Supervisory Committee
Pro-Rector (Administration)
Yezin Agricultural University

Daw Tin May Yu Aung
Member of Supervisory Committee
Lecturer
Department of Horticulture and
Agricultural Biotechnology
Yezin Agricultural University

Dr. Khin Thida Myint
Professor and Head
Department of Horticulture and Agricultural Biotechnology
Yezin Agricultural University

Date…………………………

This thesis was submitted to the Rector of Yezin Agricultural University and was accepted as a partial fulfillment of the requirements for the degree of **MASTER OF AGRICULTURAL SCIENCE (HORTICUTURE).**

Dr. Myo Kywe

Rector

Yezin Agricultural University

Date ------------------------- Yezin, Nay Pyi Taw

DECLARATION OF ORIGINALITY

This thesis represents the original work of the author, except where otherwise stated. It has not been submitted previously for a degree at any other University.

Date -------------------------

Thaw Ni Ni Zaw

DEDICATED TO MY BELOVED PARENTS,

U ZAW WIN AND DAW NYO NYO AYE

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ABSTRACT

Local, indigenous vegetables undoubtedly have the greatest potential to improve nutrition with the least cost. This study was conducted to observe the growing and consumption status of traditional vegetables and to document species distribution of traditional vegetables (TVs) in Pyinmana area during February 2013 to January 2014. A total of 136 households were selected through stratified random sampling from 18 villages which were organized into four different strata of altitudes (G I: 0-500 ft, G II: 501-1500 ft, G III: 1501-2500 ft, G IV: 2501- 3500 ft). Interviews using structured questionnaires, field observation and documentation were performed in surveys. In gender ratio, male respondents comprised nearly three times of the female respondents. Most of the respondents (90.4%) were farmers with the education of primary school level. Most of respondents (58.86%) were growing TVs mainly for home consumption using their own produced seeds. Regarding consumption, The householders (89.82%) from group I were mainly relied on buying and the householders (nearly 40 %) from higher altitude groups of III and IV bought vegetables. In the study area, 13 species observed as the least frequent vegetable species (<15% of study villages) and these species were recorded as localized species. Regarding species diversity, a total of 173 species were recorded in study area with 122 known species, belonging to 60 families and 35 orders. Among the species, 18 species belonging to 10 families were hosted by over 80% of villages, while 13 species were identified to be localized in 15% of villages. The families Cucurbitaceae, Zingiberaceae, Fabaceae, and Lamiaceae revealed the highest in species richness comprising over five species. The villages from 1501-2500 ft altitude occupied the highest numbers of species. Up to 2500 ft, altitude and species number were positively related. And also there was strong positive relationship between upland area and crop species.

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LIST OF ABBREVIATIONS

TVs	= Traditional Vegetables
FAO	= Food and Agriculture Organization
WHO	= World Health Organization
NUS	= Neglected and Underutilized Species
IVs	= Indigenous Vegetables
IK	= Indigenous Knowledge
ITK	= Indigenous Technical Knowledge
RPK	= Rural People’s Knowledge
LK	= Local Knowledge
IPGRI	= International Plant Genetic Resources Institute
DoA	= Department of Agriculture
MOAI	= Ministry of Agriculture and Irrigation
RH	= Relative Humidity
ft	= Feet
ac	= Acre

CHAPTER I
INTRODUCTION

A well-balanced diet is essential to good health and human development, and malnutrition occurs when this is not the case. Malnutrition is primarily a "hidden hunger" that severely stunts human potential due to a lack of vital protein and micronutrients such as vitamins or minerals, affecting and estimated one in three people world wide (WHO 2001).

Vegetables are the main inexpensive natural source of minerals, vitamins, fiber, and in many cases, proteins (WHO 2003). Fiber content in vegetables adds bulk to the food, thereby minimizing the feeling of hunger in addition to enhancing movement of food through the digestive system. Therefore, micronutrient deficiency can be corrected by increasing uptake of vegetables (Ali and Tosu 1997). Especially, consumption of dark green leafy vegetables can partially alleviate malnutrition (Swai 1989).

Traditional vegetables (TVs) are nutritionally higher in vitamin A and C, folic acid and minerals than many exotic vegetables. Moreover, they are adapted to local agro-ecological conditions, require a minimum of cultivation, can be grown in home gardens, give high yields within a short period, and are easy to harvest and preserve. Therefore traditional vegetables undoubtedly have the greatest potential to improve nutrition with the least cost (Manyafu 1971; Reuben and Minjas 1991; Manzava 1993). However, the use of indigenous vegetables declined especially among children in the rural areas resulting in nutritional deficiencies, (Okigbo 1990).

In Myanmar, there are variety of diverse landscapes with continuous geographic variation from the delta and costal areas in the southern part to the area of mountains in the northern part. Vegetable genetic diversity of Myanmar represents one of the hot spots in the world due to diversity in the ecological system.

More than a hundred kinds of vegetables are growing in different agro-ecological regions of Myanmar (Theingi Swe 2008). However, many are cultivated in small patches in home gardens or found growing as weeds in marginal area within farms or growing wild in forest area. The aggregated value of their contribution to rural diets and food security often has been underappreciated and majority of the traditional vegetables still remains as underutilized (Manyafu 1971, Reuben and Minjas 1991, and Mnzava 1993).

In rural areas of Myanmar, farmers used to collect wild varieties of vegetables from their farm and nearby forests so that they may be able to use them for home consumption and get extra income by selling out in local markets (Maung Maung Yi 2008).

In Nay Pyi Taw Pyinmana area, the availability of wild vegetables is decreasing mainly due to increasing population and rapid urbanization (Zin Mar Lwin 2007). Ignorance of values and mismanagement on maintenance of local vegetables can contribute this pitfall.

Therefore, the need to document the local knowledge about the use and management of these valuable resources is becoming a pressing task. Moreover, it is interesting that there should be a relationship between the socio economic status and existing and utilization of traditional vegetables.

But, there is rare academic study regarding traditional vegetables (TVs) especially in Pyinmana area. This study was therefore designed as an initial effort to observe and identify the existing species of traditional vegetable occurred in different ecological conditions especially altitude zones. The subjectives of this study are;

- To observe the existing growing and consumption status of traditional vegetables in Pyinmana area and
- To document species distribution of TVs at varying topography in Pyinmana area.

CHAPTER II
LITERATURE REVIEW

2.1 Traditional Vegetables (TVs)

Cultivated plants have been essential for human existence for millennia. They are sources of food in the form of leaves, seed, berries, fruit, roots, tubers, stems rhizomes and to a lesser degree gums. Plants also provide for the other needs of mankind in the form of shelter, fuel, medicine and fiber, to name but a few (Maundu et al. 1999).

According to FAO (1988), traditional vegetables are all categories of plants whose leaves, fruits or roots are acceptable and used as vegetables by rural and urban communities through custom, habit and tradition. They are crucial to food security, particularly during famines or natural disasters. The plants grow as weeds in the wild and/ or cultivated areas, are semi- cultivated or cultivated. If domesticated, they are crops that require few inputs. Most of the vegetables are gathered when in season, or are grown in home gardens or intercropped with stables.

2.1.1 Growing of traditional vegetables

Traditional vegetables might not be indigenous to a country, but they can be associated with traditional production systems, local knowledge and usually have a long history of local selection and usage (Keller et al 2004) and are described as indigenized foods (Phillips- Howards 1999).

In Africa, traditional leafy vegetables are mostly grown as minor crops in association with major food crops. This system prevails mostly during the rainy season. During the dry season they are grown mostly in swamps and along the borders of streams and on streambeds. At this time they are generally grown as monocrops but can be mixed with other vegetables on field crops.

Traditional leafy vegetables are a major part of the daily diets for both rural and urban households not only because they are relatively cheap to produce and available all year round, but because they are an integral part of the traditional farming systems and dishes of the different ethnic groups. Therefore, traditional leafy vegetables are commonly found in home gardens where they are readily available for daily home use. But the production, consumption, marketing and preservation/storage of leafy vegetables are certain problems. Some of the most pressing problems highlighted by farmers include: pests and diseases, lack of seeds, lack of pure varieties, and lack of improved storage and preservation technologies (Gockowski and Ndumbe 1996)

2.1.2 What are neglected and underutilized species?

Neglected and underutilized species are often considered 'minor crops' because they are less important than staple crops and agricultural commodities in terms of global production and market value. However, from the standpoint of the rural poor who depend on many of these species for their food security, nutrition and incomes, they are hardly minor. These species are neglected by science and development; some therefore call them 'orphan crops'. They may also be underutilized in terms of their potential to contribute to the incomes and well-being of the poor and to global food security in general (IPGRI 2002).

By definition, **neglected crops** are those grown primarily in their centres of origin by traditional farmers, where they are still important for the subsistence of local communities. Some species may be widely distributed around the world but tend to occupy special niches in the local ecology and in local production and consumption systems. While these crops continue to be maintained by sociocultural preferences and the ways they are used, they remain inadequately documented and neglected by formal research and conservation (IPGRI 2002).

In the case of **underutilized crops,** they were once grown more widely or intensively but are falling into disuse for a variety of agronomic, genetic, economic and cultural reasons. Farmers and consumers are using these crops less because they are in some way not competitive with other species in the same agricultural environment. The decline of these crops may erode the genetic base and prevent distinctive and valuable traits being used in crop adaptation and improvement (Padulosi and Frison 2000).

Common features of neglected and underutilized species are local importance in consumption and production systems, highly adapted to agro-ecological niches/marginal areas, receive scarce attention by national agricultural and biodiversity conservation policies, research and development, represented by ecotypes/landraces, cultivated and utilized relying on indigenous knowledge and scarcely represented in ex situ collections (Guarino 1997; Schipper and Buddl 1997; Abukutsa et al. 2005)

2.1.3 The importance of traditional vegetables

Traditional leafy vegetables (TVs) have several advantages over the exotic crops that are promoted extensively by research and extension. TVs have a short growing period as they can be harvested within 3-4 weeks, they can tolerate abiotic and biotic stress and they respond well to organic fertilizers (Maundu 1997). Many traditional crops grow in marginal areas, where exotic crops struggle to survive (Abukutsa 2007). However, the bulk of this production never reaches the market as they are mainly used for household consumption, leading to an underestimation of the importance of these crops to household food security (Hart and Vorster 2006, Shackleton and Mathabela et al. 1998). These crops are growing under rainfed conditions as intercrops with local staples in home gardens or fields, and management therefore is relatively low (Hart and Vorster 2006; Mnzava 1997).

Kordylas (1990) reported that traditional leafy vegetables are mainly consumed when fresh, but are preserved by using their traditional drying methods or using a solar method. TLVs are often used and made up a large percentage of the food intake, leads to an increase of diversity of the diet (Hart and Vorster 2006; Shackleton et al. 1998).

Traditional foods contribute to household food supplies on a seasonal emergency and supplemental basis (Rubaihayo 1997; Shackleton et al. 2000). Use of wild food during drought or in marginal areas increases and represents a part of the rural safety net against poverty and disaster (Shackleton 2003). Communities often face a shortage of vegetables during the dry season. Preservation of edible leaves is one of the strategies developed to help face these times of shortage (Mnzava 2005). During periods of unemployment (between jobs, after retirement) these plants become very important for the affected families (Dovie et al. 2002).

According to Mnzava (1997) improving the cultural practices, processing and status of the plants can improve the cash income and status of the plants. In an effort to develop a holistic perspective on food, the nutritional culture of a society needs to be connected to a scientific study of nutrients to the same society (Khare 1980). Fleuret and Fluret (1980) suggested that traditional food systems are rational, well-balanced adaptations to the limitations that technology and the environment place on them and that the indigenous food systems provide the appropriate nutrients needed by the population by using a wide range of non-staple foods, especially edible greens. Several studies report on the vulnerability of women and young children (especially female children) due to the marginalization of their nutritional needs through indigenous food distribution practices (Berg 1981; Fleuret & Fleuret 1980).

2.1.4 Positive and negative qualities of TVs

Some of the positive qualities of traditional vegetables are long harvesting period, easily available, good taste, high yield, early maturing, resistance to drought and resistance to pests and diseases.

Some of negative qualities of TLVs are stinging hairs, bitter, low yield, weedy, low market value, long preparation process, smell/odour and poisonous (IPGRI 1997).

2.1.5 Utilization of TVs and food security

Many neglected and underutilized species are nutritionally rich and are adapted to low-input agriculture. The erosion of these species, whether wild, managed or cultivated, can have immediate consequences on the food security and well-being of the poor. Their enhanced use can bring about better nutrition. For example, many underutilized fruits and vegetables contain more vitamin C and pro-vitamin A than widely available commercial species and varieties. Neglected grains such as quinoa (*Chenopodium quinoa*) or fonio (*Digitaria exilis*), have better protein quality than most major cereals. Focusing attention on neglected and underutilized species is an effective way to help maintain a diverse and healthy diet and to combat micronutrient deficiencies, the so-called ‘hidden hunger’, and other dietary deficiencies particularly among the rural poor and the more vulnerable social groups in developing countries (IPGRI 2002).

Traditional vegetables have a considerable demand and directly replace meat in diets. Their high protein and vitamin contents indicated the outstanding potential of these plant species to eliminate nutritional deficiencies amongst groups such as young students, children, expected mothers, destitute, urban and semi-urban unemployed migrants as well as low-income workers. Concerns have been raised that the decline in utilization of TVs has resulted in nutritional deficiencies, especially among children in the rural areas. Most of the rural people do not earn a regular income to enable them to purchase the exotic vegetables. Leafy vegetables directly replace meat (FAO 1998).

In the Sahelian, semi-arid and other parts of the dry savanna areas of Africa, the deficiency of vegetables in the diets is a major course of vitamin A deficiency (Okigbo 1990). This causes blindness and even death in young children. Vegetables contain fibre which adds to the bulk of the food consumed. This minimizes the feeling of hunger in addition to enhancing movement of food through the alimentary canal.

2.1.6 Nutritional value of Traditional Vegetables

Moore and Raymond (2006) found that modern crops that are commonly less nutritious and poorly adapted to the marginal growing conditions TVs are adapted to, replaced TVs. The higher nutritional value of the traditional crops when compared to cash crops lead to greater nutritional vulnerability in rural areas than in urban areas where other crops can be more easily purchased (Labadarios 2000, Labadarios and Van Middelkoop 1995). Increasing the availability and consumption of, and access to nutritional plants should be an important strategy in resource poor areas. Various traditional food plants have been analysed for nutrients, and have shown high nutritional contents for especially iron, zinc, vitamin A, C and E (Mnzava 1997; Kruger et al. 1998), as well as folic acid (Tucker 1986). They are excellent sources of proteins, carbohydrates, minerals and vitamins for poor people. Based on the high nutritional content, availability and affordability of these traditional plants, crop production systems should increase the use of underutilized crops such as traditional food crops (Modi, et al. 2006; Nesamvuni et al 2001; FAO 1997). Labadarios and Steyn (2001) suggested that one should guard against the exclusive promotion of exotic fruits and vegetables, which could result in indigenous plants and their products being regarded as inferior, even when many are nutritionally superior.

As regards their nutritive value, leafy vegetables have been noted to contain important dietary elements. Oomen and Grubben (1978) reported that leafy vegetables like amaranthus, colocasia, cassava and the leaves of sweet potatoes contain amounts of nutritive elements similar to grain legumes (groundnut, soyabean and cowpea) and that the iron, calcium, vitamin C and carotene contents were twice as high. Leafy vegetables contain a high amount of fibre, which in Africa is necessary to reduce the absorption of toxic substances in the intestines and also reduces problems of constipation.

2.1.7 Increased incomes for the rural poor

The growing demand from consumers in developed and developing countries for diversity and novelty in foods is creating new market niches for neglected and underutilized species. These market opportunities can generate additional income for poor farmers in less-favoured environments where these crops have comparative advantages over major staples or commercial crops. In addition, the ability of modern technologies to transform crops and other plants into diverse products and to extend their shelf-life has created new opportunities to develop new uses and thus to market these species and their products. For example, bread fruit (*Artocarpus altilis*), a multipurpose tree popular across the Pacific and Caribbean regions, is a starchy food species whose many food, fodder and non-food uses as timber, traditional medicine and insect repellent, have scarcely been tapped (IPGRI 2002).

2.1.8 Ecosystem stability

Climate change and the degradation of land and water resources have led to a growing interest in crops and species that are adapted to difficult environments such as desert margins, those with poor soil or degraded vegetation, or subject to drought. Lathyrus, quinoa, fonio, bambara groundnut and Andean roots and tubers are examples of neglected or underutilized species that are adapted to difficult conditions. NUS can also occupy specialized micro-environments within farming systems. Examples include several species of squash and gourd, edible aroids such as taro and tannia, and many herbs. Because they can tolerate stresses and occupy specialized niches, neglected and underutilized species (NUS) often increase the overall productivity and stability of agro-ecosystems. A good example is the sago palm (*Metroxylon sagu*). This is found across South East Asia and Oceania and has been described as humankind’s oldest food plant. Its advocates praise it as an economically acceptable plant that is environmentally sustainable and uniquely versatile (IPGRI 1997).

2.1.9 Cultural diversity

The use of plants has long been an intimate part of local cultures and traditions. Many neglected and underutilized species play a role in keeping alive cultural diversity associated with food habits, health practices, religious rituals and social exchanges. The vast diversity of neglected and underutilized food crops should not be seen solely as a source of nutrition. Their unique array of diversity in taste, colour, texture, modes of preparation and so on represents a rich component of the cultural food-based social language and an important instrument in the organization and maintenance of local systems of communication. Many neglected and underutilized species have their greatest cultural value at the local level, which makes greater attention to NUS an important way of supporting cultural diversity in a world of increasing globalization. Food culture which encompasses taste preferences, cooking, presentation and ritual uses - is an integral part of IPGRI's work to maintain and promote NUS, making our lives more interesting and enjoyable (IPGRI 2002).

2.1.10 Maintaining diversity

Little is known of the eco-geographic distribution of many neglected and underutilized species and even less of the extent and distribution of their genetic diversity. Their poor conservation and high level of genetic erosion call for coordinated efforts to safeguard these resources. Surveys, taxonomic identification and analysis of the extent and distribution of genetic diversity, together with work on local and traditional knowledge, remain priorities for many NUS. Tools to assess genetic erosion will have to be developed and applied to facilitate these processes. From this information, complementary conservation strategies will need to be developed that give priority to maintenance in production systems (*in situ* conservation), with *ex situ* conservation providing back-up systems and material for access by other users. Characterization and evaluation can, in many cases, be carried out in the production systems with the communities growing and using NUS. There may also be a need for specific studies on topics such as reproductive biology, *in vitro* conservation and ways of eliminating viruses from vegetatively propagated species (IPGRI 1998).

2.2 Indigenous Knowledge (IK)

2.2.1 Understanding indigenous knowledge

Indigenous knowledge (IK) is also known as local knowledge, indigenous technical knowledge (ITK), sustainable knowledge, traditional knowledge, people's knowledge, folk science, farmers' knowledge, cultural knowledge, ethnoscience, experiential knowledge, rural people's knowledge (RPK), folk agricultural knowledge, metis and traditional environmental knowledge to name but a few

(Waters-Bayer 1994; Ellen & Harris 2000; Sillitoe 2000; Antweiler 2004). The use of these diverse terms and abbreviations reflect the different viewpoints and political agendas that come with these different uses (Ellen & Harris 2000; Antweiler 2004). Many authors are now starting to use the term indigenous knowledge (IK) and local knowledge (LK) interchangeably. ITK is a term used by many researchers and extension personnel, with it being used in the broad sense meaning indigenous knowledge, while many refer to it as the agricultural technical knowledge farmers have (Chambers et al 1989; Mettrick 1997), thus a very narrow knowledge system.

Several organizations working with IK have defined indigenous knowledge in different ways. There are several interrelated aspects that seem to be specific to IK. It is locally bound and indigenous to a specific area and closely related to subsistence and survival for many. IK is orally transmitted, or transmitted through imitation and demonstration, usually not documented. Moreover, it is non-formal knowledge, culture and context specific. Besides, it is holistic, integrative, dynamic and adaptive. And also, it does not believe in individualist values.

2.2.2 Variation of indigenous knowledge

These aspects highlight the fact that indigenous knowledge is not equally spread (Swift 1979; Howes & Chambers 1980; Ellen & Harris 2000). Other factors such as age, kinship, religion, wealth and ethnicity also contribute to the difference in knowledge (Grenier 1998; Howes & Chambers 1980). The majority perception reflects the community's knowledge, with the deviation showing the individual's experiences that have modified their own perception. These individuals might be the people in the community who have expertise in certain areas (Quek 1997). Cultivating specific food and cash crops, collecting wild fruits and leaves, processing, preparing processing and preservation food and caring for livestock are activities assigned to different age and gender groups (Friis-Hansen & Sthapit 2000; Haverkort 1993). It is generally recognized that women often play a key role in domesticating wild species, selecting, processing, storing and exchanging seed. They commonly dominate the management of food crops that are primarily grown for household food consumption (Davidson 1993; Friis-Hansen and Sthapit 2000).

Environmental, cultural, population and historical changes are challenging the flexibility and dynamic character of IK that enables it to change from within. In areas where the strong social organization has broken down, some IK may survive but might not be relevant to the new organizational form that has usually been formed with outside help (Farrington & Martin 1988). Communities manipulate their social and natural environment to achieve a successful livelihood (Alcorn 1995), but IK can also internalize, adapt and use external knowledge (Richards 1985; Grenier 1998; Sillitoe 2000).

2.2.3 Ethnobotany of traditional vegetables

Indigenous knowledge regarding utilization, processing, distribution, conservation, sustainable harvesting methods, preservation and preparation of TLVs is possessed by the old rural area dwellers. This knowledge is not documented anywhere for use by researchers eager to develop and promote the TLVs resources. However, it is not too late to document it. The knowledge differs from area to area, from tribe to tribe and according to gender. (Padulosi and Frison 2000)

2.2.4 Traditional crops and indigenous knowledge

Biodiversity is the source of food, shelter, medicine and industry. It is increasingly recognized that farmers play a crucial role in the conservation and management of genetic and other natural resources. Maintaining genetic diversity and species in fields is one of the best ways to create stable systems for rural farmers in marginal areas where they use low-input agriculture (Montecinos & Altieri 1992). If cultural recognition and continuous propagation favor the maintenance of that diversity, it would protect that variability (Nazarea 1998; Abukutsa 2007). This will ensure that the local varieties continue to evolve, thus retaining their value (Mooney 1992). The value of these plants lies in their genes as they have the potential to address agricultural, technological and medical problems (Natarajan 2002; Kiambi & Opole 1992).

Erosion of genetic diversity brings about loss of plant or animal species and leads to loss of associated knowledge of those species (Grain 1992). It also undermines food security and contributes to the powerlessness of farmers throughout the developing world (Salazar 1992). There is an accompanying loss of landraces and other genetic diversity (sometimes species are lost), leading to a loss in associated knowledge (names, uses, etc.). Protection of indigenous knowledge, just as crop genetic resources, cannot be done without protecting the agroecosystem and the socio-cultural organization of the local people (Agrawal 1995; Nazarea 1998).

2.2.5 Good quality seed for conservation

Farmers are often losing control over their most important link in sustainable agriculture-their seeds. An important requirement for efficient crop production is good quality seed. Seed quality is affected by the agronomic practices used, the time of harvest and how the seeds are processed (Mazava 1997). Farmers need to ensure that their seeds are well preserved to ensure their viability over time (David 2004; Adebooye et al. 2005). The relatively poor farm-level storage conditions on farms cause rapid seed deterioration, causing low germination rates and poor vigour (Schippers 2000). Losses at farmer level often lead to permanent losses as the strong regional preferences for indigenous vegetables make it uneconomical for seed companies to invest in seed production (David 2004), thus farmers are the only custodians of this seed.

2.2.6 Causes for erosion of conservation systems

Traditional conservation systems have eroded due to (Grain 1992; Keller et al. 2004) the following causes: (1) Loss of IK associated with seed systems (2) Rural population growth leading to less land needing to produce more food, (3) Increasingly lower soil fertility or soil degradation, (4) Forces outside the small-scale farmers' control (These include political, economic and climatic aspects of the environment in which the farmer has to operate.), (5) Growing urban populations taking over agricultural land (Natarajan 2002)

2.2.7 Conservation through the use of TVs

Despite their many benefits, the diversity and uses of traditional vegetables are under threat in the world. Also, many traditional vegetables are associated with poor rural lifestyles and low status. Cultural change and urbanization have led to further neglect of these plants. Governments tend not to include these species in agricultural or food security. They are seldom counted in agricultural statistics (Abukutsa et al. 2005).

The formal-sector agricultural research and development organizations have tended to neglect these plant genetic resources. The number of species involved is large and not readily amenable to conventional agronomic study. The ones that are cultivated are grown in small, isolated patches, in home gardens along field margins and between the rows of tuber crops. The primary producers, transformers and sellers of these plants are most often women. Women are also the key custodians of the knowledge and genetic resources of these vegetable species. Neglect by the development process is leading to a decline in the use of traditional vegetables, increasingly seen as low-status foods. Traditional species are not competing well with more costly introduced vegetables, largely because of the greater attention the latter have received. Decline in the production, consumption and diversity of traditional leafy green vegetables will have significant impacts on the incomes of women farmers and the nutritional status of their households (IPGRI 1998)

2.3 Constraints to Optimal Production and Utilization of TVs

2.3.1 Negligence and stigmatization

Changed food habits in favour of introduced temperate vegetables lowered the demand of indigenous vegetables, due to the fact that the former fetched higher prices in local markets. Indigenous vegetables were considered out of fashion, poor man's food that could only be used as a last resort. Thus they enjoyed less social prestige, being associated with the low-income group. As the poor sought to imitate the eating habits of the affluent and were exposed to more fashionable exotic species, the indigenous species became neglected. The neglect and stigmatization was perpetuated by stakeholders like the policy makers, agricultural training institutions, traders, researchers, consumers and the traders (Mnzava 1997). Having been branded and denoted by the agriculturalists and researchers as weeds, the tendency was to eradicate them and not conserve them as it were. This trend started changing gradually after the promotion and sensitization workshops that were held in Nairobi, Limbe and Maseno in 1995, 1997 and 2003 respectively (Guarino 1997; Schippers & Budd 1997; Abukutsa et al. 2005).

2.3.2 Inadequate awareness of the value and potential of TVs

Lack of awareness of the merits and opportunities of traditional vegetables was due to negative attitudes developed by all stakeholders. Although there were indications that traditional vegetables had some great attributes many stakeholders did not take the facts seriously. This therefore called for deliberate awareness campaigns to promote these traditional vegetables (Padulosi and Frison 2000).

2.3.3 Lack of quality seed

Lack of quality seed has been a major hindrance to sustainable production and utilization of indigenous vegetables. Some of the vegetables perpetuate themselves untended, they were harvested whenever they occurred and this system of seed procurement heavily depended on the soil borne seed pool and the ability of these species to reseed themselves. Seed production has for a long time virtually remained in the hands of farmers, although seed sale in markets was common. For a very long time these vegetables were harvested from the wild, but as the pressure on land increased, they were domesticated and the need for quality seed set in. Normally indigenous vegetables are grown as a subsistence crop and most farmers save their own seed from season to season, and sell surplus to other growers. The quality of such seeds is poor in terms of purity, viability and seed dormancy issues. There is need for production and supply of quality seed to increase yields and quantities produced to meet the unsatisfied market demands of priority indigenous vegetables especially in urban centers (Onyango 2010).

2.3.4 Lack of agronomic and utilization technical packages

Indigenous vegetables have often been grown as intercrops with other vegetables or staples; however there has been hardly any technical information on optimal production and appropriate cropping systems. There has been lack of agronomic and preparation packages and access to technical information has been very limited, therefore extension workers have limited knowledge to advise indigenous vegetable growers. This necessitated researches on development of optimal production packages for indigenous vegetables and recipe development (Onyango 2010).

2.3.5 Poor marketing strategies

Marketing of indigenous vegetables has been poor dis- organized leading to great losses of the produce in transit or in markets. The major constraints of marketing include: abundance of vegetables during the rainy season leading to low prices and scarcity during the dry season; exploitation of traders due to lack of market information; lack of inadequate market and transport infrastructure. This calls for identification and creation of markets for indigenous vegetables and possibly linking farmers/farmer groups to appropriate markets (IPGRI 2002; Onyango 2010)

2.4 Consequences of the constraints

The consequences of the constraints were low production and poor distribution of indigenous vegetables. Farmers achieved very low yields of 1–3 tonnes per hectare, far below the optimal levels that range from 20 to 40 tonnes per hectare (Abukutsa-Onyango 2003) leading to low consumption and utilization resulting in loss of biodiversity. Increased and sustainable production and utilization of indigenous vegetables can be attained by ensuring supply of quality seed and development of environment-friendly production and utilization technologies. Improved production technologies like spacing, fertilizer rates and use of organic sources of manure will lead to increased yields and improved nutrition and economic empowerment of the rural communities (Onyango 2010).

2.5 Marketing System

Strengthened market systems are crucial to the promotion of neglected or underutilized species. Better commercialization translates into greater opportunities for income generation by the poor farmers who cultivate these species. The cultural value of non-underutilized species (NUS) is also an important element that can support the markets for these species. IPGRI will seek strategic alliances with agencies or organizations that have experiences in marketing, processing and product development of neglected species. Efforts which will be directed at: (i) identifying opportunities to add value through improved preparation or processing methods and the development of low cost technologies; (ii) marketing activities including user and market-niche definition and improving price, distribution and presentation; (iii) creating and identifying opportunities to develop new products and markets; (iv) identifying ways to ensure that the nutritional contributions of selected NUS are recognized and integrated into national nutritional programmes; and (v) developing public awareness activities for crops and products at local and national levels and integrating such work in development-related activities, for example *in situ* and on-farm conservation and home gardens (IPGRI 2002; Onyango 2010).

CHAPTER III
RESEARCH METHODOLOGY

3.1 Description of Study Area

Pyinmana Township was chosen as a study area as it falls into Transitional Zone of Myanmar. Pyinmana is located on the Yangon–Mandalay railroad in a mountainous, forested region. It is included in 8 townships of Nay Pyi Taw region.

Pyinmana is located within 19˚ 18΄ - 20˚ 20΄ N latitude and 95˚ 45΄- 96˚ 46΄ E longitude, and it covers a total area of 1145.9 square kilometers (442.43 square miles) and 320 feet above sea level (MAI 2011). The current population of Pyinmana Township is estimated as 187,415 and it is situated in the southern part of NayPyi Taw region. Rainfall in the region, however, is generally scantly and the average annual rainfall is about 1397 mm and enjoys a mean annual temperature of 33.5˚C (93˚F). The average relative humidity (RH) of this region is about 71% (MNPED 2006). In terms of size, Pyinmana constitutes 0.19 percent of the total area of Myanmar. Soil types prevailing in the rice-base home garden systems include lateritic soil, red earth and yellow earth soil (Myanmar Atlas 2002).

Map and characteristic of study area are described in figure 3.1, table 3.1 and 3.2 respectively. The study area comprised of 18 villages namely Hnantaw, Thitlaylone, Ngakaungkan, Yanaung, SanthitLwin, Seikphutaung, Thonekhwataw, Phalaung, Mepauk, Aungbeiktheik, Myathar, Thandaungboma, Salu, Gamonetaung, Wetharli, Phonesoe, Saungtaunggyi and Yepu. The average altitude of the whole study area was 1644 feet.

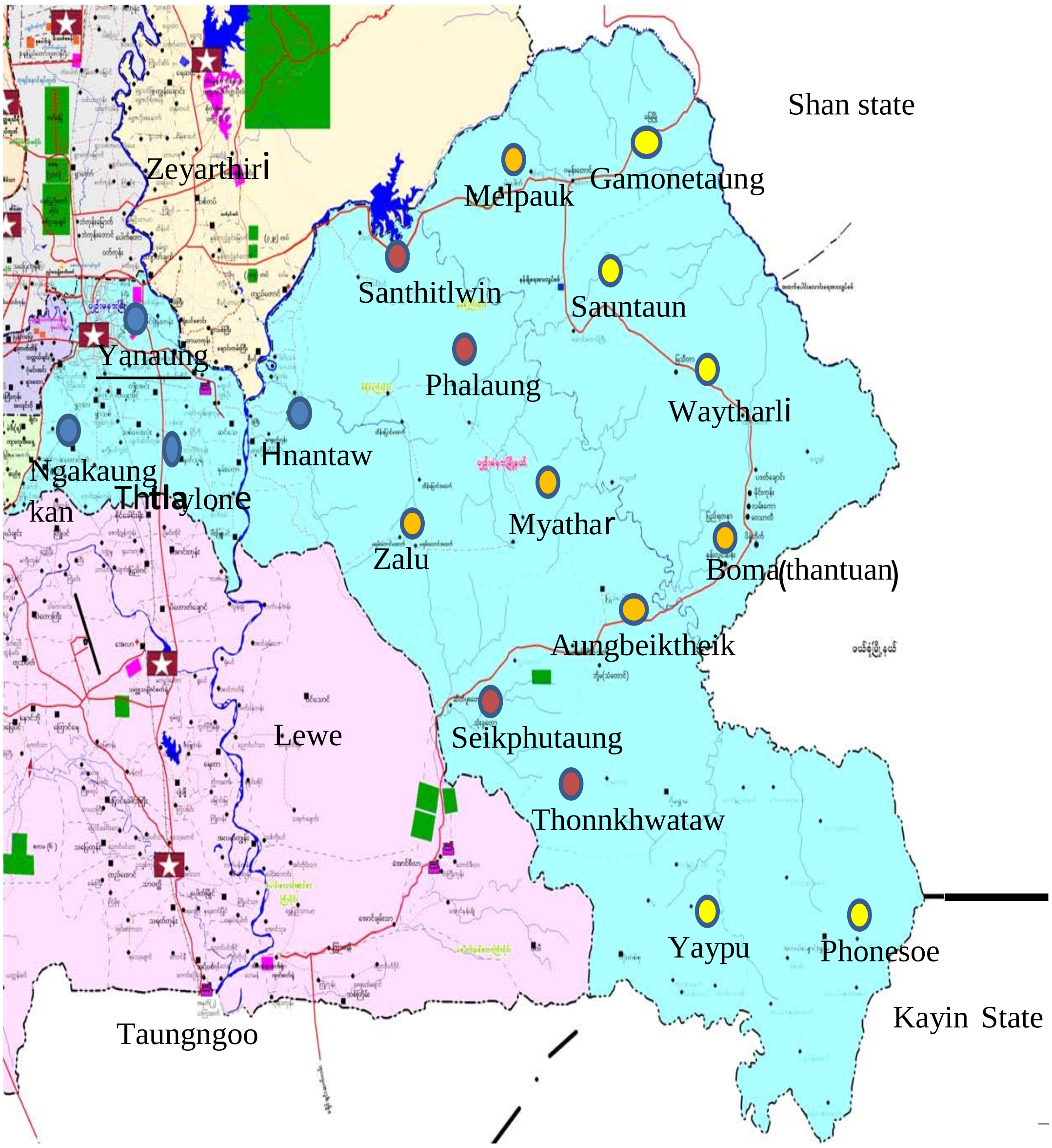

Figure 3.1 Map of study sites comprising 18 selected villages in Pyinmana area

Table 3.1 Characteristics of sample villages grouped into four altitude groups

Altitude group	Village	Altitude (ft)	Total HH	Total Pop^{n}	% of Male Pop^{n}	% of Female Pop^{n}
G I	Hnantaw	273	206	1001	47.25	52.75
	Thitlaylone	298	1137	4690	47.51	52.49
	Ngakaungkan	317	100	450	44.44	55.56
	Yanaung	362	2885	14007	47.90	52.10
	Mean	**313**	**481**	**2047**	**46.78**	**53.22**
GII	SanthitLwin	519	80	370	51.62	48.38
	Seikphutaung	722	100	468	50.21	49.79
	Thonekhwataw	833	10	28	46.43	53.57
	Phalaung	1035	129	721	49.93	50.07
	Mean	**777**	**80**	**397**	**49.55**	**50.45**
G III	Mepauk	2028	59	256	49.61	50.39
	Aungbeiktheik	2034	73	313	49.20	50.80
	Myathar	2120	50	248	51.21	48.79
	Thandaungboma	2197	41	184	56.52	43.48
	Salu	2206	39	164	50.00	50.00
	Mean	**2117**	**52.4**	**233**	**51.31**	**48.69**
G IV	Gamonetaung	2687	142	688	52.33	47.67
	Wetharli	2930	63	304	51.97	48.03
	Phonesoe	2932	7	49	42.86	57.14
	Saungtaunggyi	3017	30	165	48.48	51.52
	Yepu	3076	9	60	36.67	63.33
	Mean	**2928**	**50**	**253**	**46.46**	**53.54**
	Grand mean	**1534**	**166**	**732**	**48.52**	**51.48**

Pop^{n}= Population

Table 3.2 Characteristics of sample respondents in study areas

Altitude group	Village	Sample HH			
		Total No.	% of population	Male %	Female %
G I	Hnantaw	8	3.88	75.00	33.33
	Thitlaylone	6	0.53	100.00	0.00
	Ngakaungkan	7	7.00	100.00	0.00
	Yanaung	7	0.24	28.57	250.00
	Mean	**7.00**	**2.91**	**75.89**	**70.83**
G II	SanthitLwin	12	15.00	91.67	9.09
	Seikphutaung	4	4.00	75.00	33.33
	Thonekhwataw	2	20.00	100.00	0.00
	Phalaung	6	4.65	50.00	50.00
	Mean	**6.00**	**10.91**	**79.17**	**23.11**
G III	Mepauk	11	18.64	90.91	9.09
	Aungbeiktheik	8	10.96	50.00	50.00
	Myathar	5	10.00	100.00	0.00
	Thandaungboma	8	19.51	62.50	37.50
	Salu	10	25.64	70.00	30.00
	Mean	**8.40**	**16.95**	**74.68**	**25.32**
G IV	Gamonetaung	10	7.04	0.00	100.00
	Wetharli	9	14.29	0.00	100.00
	Phonesoe	4	57.14	100.00	0.00
	Saungtaunggyi	13	43.33	69.23	30.77
	Yepu	6	66.67	66.67	33.33
	Mean	**8.40**	**37.69**	**47.18**	**52.82**

3.2 Sampling Method and Data Collection

Before conducting the main survey, the preliminary survey was performed to determine the study sites and target TVs from November to December 2012 in Yezin, Pyinmana and Arhayathuka markets. In this survey, twenty villages were selected to localize study sites and specify the respondents, and to determine the vegetable species available locally, which can thereby contribute to the preparation of suitable questionnaires. Main survey was done from February 2013 to January 2014 by using Stratified random sampling method. The survey zones in Pyinmana are demarcated by four groups (strata) according to different altitudes using the predetermined GPS data. These four main altitude groups consisting of four to five villages (replication) each were categorized into G I (1 - 500 ft), G II (501 - 1500 ft), G III (1501 – 2500 ft), and G IV (2501 to 3500 ft).

Data were collected through observations and interviews. Prior to the interviews, the farms were visited together with the owner to make observations on the overall conditions of the farms. The data were collected for both types of farms homestead and field, which were under the management of family members. Surveys were done by interviewing average 7 respondents each from 18 selected villages, with the total of 136 sample householders which represented about 21% of total population. Heads of the household, usually men, whenever possible with their wives, were involved in the interviews.

The primary data included in the questionnaires are –

(1) the socio-economic and demographic characteristics of each farm household such as age, education level, household’s experience, profession, farm size, family labour;
(2) growing status of TVs such as seed sources, cultural practices, cropping patterns;
(3) utilization of TVs such as consumption of TVs, knowledge and opinion on food and health values of TVs.

The secondary data such as climatic data, total crop growing areas and total population etc. were obtained from the Township Administration Office, Department of Agriculture (DoA), Ministry of Agriculture and Irrigation (MOAI), and other official institution.

Species observation was made by visiting forests near studied villages and also each farm together with the owner of the farm. The interviews were done, and species of cultivated crops and trees were enumerated and documented. Some of rare traditional vegetables were made as herbarium for further classification, apart from on farm classification.

3.3 Data Analysis

Stratified random sampling method was used with four strata (altitude groups) each consisting of four or five replications (villages). Statistical Package for Social Science (SPSS) programme (version 16.0) and Microsoft excel program were used for the data analysis. Concerning with socio-economic and demographic characters that linked to the different altitudes, and growing and utilization status of TVs, crosstab of descriptive statistics, mean comparison and one way ANOVA were performed. Pearson correlation analysis was also employed in order to observe the relationship between topography, species richness, and local farming systems. Botanical classifications of sampled vegetable species were done with the help of text books and websites on taxonomic classification.

CHAPTER IV
RESULTS AND DISCUSSION

4.1 Socioeconomic and Demographic Characteristics of Respondents

4.1.1 Demographic figure

Gender ratio and ethnic group of sample respondents from four different altitude ranges were showed in Table 4.1. In terms of gender ratio, male respondents occupied nearly three times the female respondents, which was more visible in group I and II. The average proportion of male respondents was 71.3% and that of female was 28.7%. There was no significant difference in gender issue of household heads among the altitude groups. In the study, main respondents surveyed were householders and they were found to be more responsive than female counterparts. The F-test showed that there is no significant difference in the gender ratio of different altitude groups.

The study area was diverse in terms of ethnicity as three groups come together in this area. The majority of respondents in group I (< 500 ft) were Bamar ethnic group, while the majority of respondents in higher altitude ranges Kayin ethnic group. The respondents of Kayan origin were only observed in the highest altitude (> 2500 ft). Regardless of altitude, the majority of respondents were constituted by the Kayin (68.4%) followed by Bamar (24.3%) and Kayan (7.4%). Among them, the Kayin ethnic was more than others as the study area was near by Kayin State. The F-test showed that the average ethnic groups of household's head were highly significantly different among different types of respondent groups.

The socio- demographic characteristics, such as age, work experience, family size and family worker of sample respondents in study areas are presented in Table 4.2. The average age of the total household head was 46.24 years. Among the respondent groups, group I was the oldest (average 54.64 years old) and group IV was the youngest (average 40.69 years old). The average age of household head who resided in higher altitude was relatively lower than that of household head in lower altitude. They might be nomads and temporally settled from place to place. The F-test showed there was highly significant difference in the average age of household's head among different types of respondent groups.

Table 4.1 Gender ratio and ethnic group of sample respondents from four different altitude ranges (n=136)

Altitude Group	Gender (%)		Ethnic group (%)		
	Male	**Female**	**Bamar**	**Kayin**	**Kayan**
I (n=28)	75.0	25.0	96.4	3.6	0.0
II (n=24)	79.2	20.8	4.2	95.8	0.0
III(n=42)	73.8	26.2	7.2	92.9	0.0
IV(n=42)	61.9	38.1	4.8	71.4	23.8
Mean	**71.3**	**28.7**	**24.3**	**68.4**	**7.4**
F-test	**0.414**		**<0.001**		

I (<500); II (501-1500); III (1501-2500); IV (>2500)

Table 4.2 Some socio-demographic characters of respondents in study areas

Item	Unit	Altitude Group				Mean	F-test
		G I (n=28)	**G II (n=24)**	**G III (n=42)**	**G IV (n=42)**		
Age	(year)	54.64	48.96	44.64	40.69	46.26	**<0.001**
Work experience	(year)	26.68	26.29	25.57	19.10	23.93	**0.022**
Family size	(number)	5.14	5.62	4.98	4.90	5.10	**0.294**
Family worker	(number)	1.76	3.08	2.65	2.87	2.59	**0.001**

I (<500); II (501-1500); III (1501-2500); IV (>2500)

For all sampled householders, the working experience of respondents was an average of 23.93 years in working experience. Among the groups, respondents residing in highest altitude (group IV) revealed the lowest work experience (19.10 years) in the study area. When their working experience was compared with their corresponding age, there was narrow gap between them. They have been in working places since their childhood instead of enrollment in school. The F-test showed that there was no significant difference among these four groups of respondents for years of working experience.

The average family size of households was 5.10 in the study area. The F-test showed that family size was not significantly different among the respondents from four altitude groups. The average number of family worker was 2.59 while the average number of family worker in less than 500 ft altitude was 1.76. The F-test showed that there was highly significant difference in the average numbers of farm workers between these four groups.

To measure the education level of householders, 6 categories were used, namely illiterate level, monastery level, primary level, secondary level, high school level and university level (Table 4.3). The highest number of householder was at primary level (34.60%) and the second was monastery level (31.60%). The graduated 17.90 percent of householders in the study area were found in group 1, and this group was shown the highest education level. The graduated and high school level householders were not found in group IV because of higher altitude as well as poor in road infrastructure. The F-test showed that there was a significant difference in the education level of the study area.

The occupation status of sample respondents in the study area was showed in Table 4.4. Among all altitude groups, retired (7.10%) and staff (10.70%) were only found in group I. The highest percentage of casual (87.50%) was found in group II because there were more plentiful job opportunities than other altitude groups. Comparing the all altitude groups, the majority of respondents have worked as farmers 90.40% for their livelihoods. Among them, all of the respondents from group IV are farmers (100%). The higher the altitude, the more proportion of farmer was. The F-test shows that the average profession of sample respondents from varying altitudes was highly significantly different among the different types of respondent groups.

Table 4.3 Educational status of respondents in study areas

Education	% of sample HH				Mean
	G I (n=28)	G II (n=24)	G III (n=42)	G IV (n=42)	
Schooling period					
Illiterate level	0.00	12.50	4.80	11.90	7.40
Monastery level	3.60	50.00	21.40	50.00	31.60
Primary level	25.00	16.70	52.40	33.30	34.60
Secondary level	28.60	12.50	11.90	4.80	13.20
High school level	25.00	8.30	4.80	0.00	8.10
University level	17.90	0.00	4.80	0.00	5.10
Total	100.00	100.00	100.00	100.00	
F-test	**<0.001**				

I (<500); II (501-1500); III (1501-2500); IV (>2500)

Table 4.4 Occupation of sample respondents from varying altitudes representing 18 villages

Altitude Group	Respondent (%)					
	Retired	Casual	Farmer	Staff	Merchant	Total
I (n=28)	7.10	3.60	75.00	10.70	3.60	100.00
II (n=24)	0.00	12.50	87.50	0.00	0.00	100.00
III(n=42)	0.00	4.80	92.90	0.00	2.40	100.00
IV(n=42)	0.00	0.00	100.00	0.00	0.00	100.00
Mean	**1.50**	**4.40**	**90.40**	**2.20**	**1.50**	**100.00**
F-test	**0.006**					

I (<500); II (501-1500); III (1501-2500); IV (>2500)

4.1.2 Socio-economic figure

Household incomes and expenditures are important factors in the production decisions that households take. Table 4.5 demonstrates that the average income of all householders from different altitudes was 183,750 kyats per month and the average per capital income was 35,620 kyats. Among the sample households, respondents from group I got the highest income (233,000 kyats per month) and those from group IV generated the lowest income (145,000 kyats per month). The F-test presents that the average income was not significantly different among the different groups of sample households.

As depicted in Table 4.5, the total expenditure of the sample households was 140,500 kyats per month (77.56% of income) in different altitudes. The householders from group I showed the lowest total expense, 142,000 kyats per month, (60.94% of income) and the householders from group III had the highest expense, 173,000 kyats per month (97.74% of income). According to F-test, the total expenditure was not significantly different among the different types of sample households.

The average expenditure for buying vegetables of the sample households was 13,160 kyats per month (9.42%). In this study, the householders in altitude of 1 to 500 ft (group I) and who live in 501 to 1500 (group II) showed the highest vegetable expense. This may be due to the opportunity of respondents from higher groups of III and IV to get more traditional vegetables from their home gardens and also wind type. And there are poor in road infrastructure in higher altitude groups. The F-test revealed that the average expenditure for buying of vegetable was significantly different among the different types of sample household.

Table 4.5 Monthly income and expenditure of respondents from varying altitudes (Ks. x10^3)

Altitude Group	Total Income (Ks. x10^3)	Per capital income (Ks. x10^3)	Total expense		Veg. expense	
			Ks. x10^3	% of total income	Ks. x10^3	% of total expense
I (n=28)	233.00	45.33	142.00	60.94	17.10	12.04
II (n=24)	180.00	32.03	140.00	77.78	19.10	13.64
III(n=42)	177.00	35.54	173.00	97.74	9.43	5.45
IV(n=42)	145.00	29.59	107.00	73.79	7.01	6.55
Mean	**183.75**	**35.62**	**140.50**	**77.56**	**13.16**	**9.42**
F-test	**0.057**		**0.352**		**<0.001**	

I (<500); II (501-1500); III (1501-2500); IV (>2500)

4.2 Natural Existence and Growing Condition of Traditional Vegetables

4.2.1 Tenure of upland and lowland holding cultivated area

The tenure of sampled respondents for upland and lowland is described in Table 4.6. The average tenure holding per household was 9.94 ac, 7.03 ac (71.01%) for upland and 2.92 ac (28.99%) for lowland. Comparing the different altitudes, the highest proportion of upland holding was observed in group III and that of lowland was in group I zone. Except group I, all altitude groups possessed the higher portion of upland for they have used shifting cultivation and more possess estates of betel, cardamom. The F- test showed that there was significantly difference in upland holding area and lowland holding cultivated area among these groups.

4.2.2 Cropping patterns and cultural practices of sample growers

According to data shown in Table 4.7, the cropping systems observed in study area can be categorized into 2 kinds, mono and mixed system. Among them, mono system was the lowest used in group IV (40.48%) and the highest in group I (55.00%). Maximum number of respondents from group I (59.52%) also practiced mixed cropping system while those from group I (45.00%) did the minimum rate of mixed system. Interestingly, high proportion of mixed cropping prevailed in higher altitudes of group III and IV (> 1500 ft) can reflect the potential of crop diversification and soil fertility which revealed to be a good situation for nutritional security of the localities.

Table 4.6 Tenure of sample respondents from varying altitudes representing 18 villages

Altitude group	Total tenure	upland		lowland	
	area (ac)	area (ac)	Percent (%)	area (ac)	Percent (%)
I (n=21)	**10.55**	**1.48**	**14.03**	**9.07**	**85.97**
II (n=24)	8.25	7.98	96.73	0.27	3.27
III (n=41)	15.23	13.95	91.60	1.28	8.40
IV (n=42)	5.74	4.69	81.71	1.05	18.29
Mean	9.94	**7.03**	**71.01**	**2.92**	**28.99**
F-test	**0.394**	**0.01**		**0.00**	

I (<500); II (501-1500); III (1501-2500); IV (>2500)

Table 4.7 Cropping system by sample growers in the study areas

Item	Respondents (%)			
	G I (n=21)	G II (n=24)	G III (n=41)	G IV (n=42)
Cropping system				
Mono	55.00	54.17	47.50	40.48
Mixed	45.00	45.83	52.50	59.52
Total	**100.00**	**100.00**	**100.00**	**100.00**

I (<500); II (501-1500); III (1501-2500); IV (>2500)

Note: The total (n) number may be smaller than 136 due to counting of only sample growers.

4.2.3 Purposes of growing and seed sources of traditional vegetables

Seed sources of traditional vegetables in study area were showed in Table 4.8. Regarding seed sources, most of the respondents (62.61%) produced their seeds themselves for growing. Only 3.57% of respondents in group I bought the seed. The F-test shows that there is highly significant difference among four altitude groups on the source of seeds for growing. The grower from group II, III and IV did not need to buy any seeds as they received seeds mainly through sharing and own production. Thiele (1999) stated that local seed system in which farmers themselves produce, disseminate, and access seed directly from their own harvest, through exchange and barter among friends, neighbors and relatives, and through local grain markets.

According to data described in Table 4.9, the traditional vegetables were mainly grown by 58.86% of sample grower for home consumption and this trend was the same for. Also in Africa, most people are growing traditional vegetables for selling and consumption (Maundu et al. 1999). In South Africa, all households (100%) incorporate traditional vegetables into their food security strategies (Vorster et al. 2007). Therefore, it can be said that these crops represented to be part of any agricultural or food security plan for an area.

Table 4.8 Seed sources of traditional vegetables in study area

Item	Respondents (%)					
Reasons	**G I (n=21)**	**G II (n=24)**	**G III (n=41)**	**G IV (n=42)**	**Mean**	**F-test**
No response	19.05	0.00	4.88	14.29	9.56	
Buying	14.29	0.00	0.00	0.00	3.57	
Sharing	4.76	12.50	17.07	7.14	10.37	<0.001
Self-producing	52.38	75.00	68.29	54.76	62.61	
Collection	9.52	12.50	9.76	23.81	13.90	
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	

I (<500); II (501-1500); III (1501-2500); IV (>2500)

Note: The total n number may be smaller than 136 due to counting of only sample growers.

Table 4.9 Purposes of growing of traditional vegetables in study area

Item	Respondents (%)					
	G I (n=21)	**G II (n=24)**	**G III (n=41)**	**G IV (n=42)**	**Mean**	**F-test**
No response	19.05	0.00	4.88	14.29	9.56	
To consume	47.62	62.50	63.41	61.90	58.86	
To sell	0.00	0.00	0.00	2.38	0.60	<0.001
To consume & sell	33.33	33.33	29.27	19.05	28.75	
To share	0.00	4.17	2.44	2.38	2.25	
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	

I (<500); II (501-1500); III (1501-2500); IV (>2500)

4.2.4 Cultural clarification of species occurred in household compound

Table 4.10 shows the occurrence of the crop species per household compound (0.3 ac) in different study groups of villages. Among all crop types, vegetables (27.25 %), fruits (33.45 %) and ornamental plants (21.81 %) were more abundant in all altitude groups. By this result, vegetables, fruit and ornamental plants are current useful crops in the study area. In group II, the occurrence of vegetable (33.30 %) and fruit (43.23 %) were more than in other altitude groups. The data showed different types of crop species occurred in different altitude zones. Among others, vegetables were observed 29.01%, 33.3% (the maximum number), 27.3 % and 19.39% in group I, II, III and IV respectively. In 2007, Nguni et al. found that many farmers grow as volunteer plants in the farms, fallow and the forest. In the rainy season, vegetables are grown mostly in associated with other food crops and generally on very fertile spots in the farm.

4.2.5 Vegetables produced in home garden

Occurrence of home produced vegetables in study area is stated in table 4.11. Less than 20 numbers of species were produced by 50% of respondents residing in low altitude (0-500 ft). The highest proportion of respondents (58.33%) from group II answered that they produced over 60 species of vegetables. Over 40% of the people living in higher altitude group III and IV produced vegetable species at the range of 21- 60 by their own efforts. For the ranges of 21-60 species, it can be said that the higher the altitude, the higher the species richness. The highest account of home produced vegetables was not observed in the respondents living in the highest altitude (> 2500 ft). It means that the highest altitude has the steeper slope and the lower growing surface area. Further more, there has low soil fertility because of soil erosion. Over 60 number of species were produced by more than half (58.33%) of respondents living in 501-1500 ft.

Table 4.10 Kinds of crop per household compound in different study groups of villages

No.	Kinds of crop	Occurrence (%)				
		G I	G II	G III	G IV	Mean
1	Vegetables	29.01	33.30	27.30	19.38	27.25
2	Fruits	28.78	43.23	27.61	34.17	33.45
3	Ornamental plants	23.84	15.38	32.99	15.02	21.81
4	Medicinal plants	10.55	4.39	3.21	5.50	5.91
5	Shade plants/ trees	5.39	2.20	3.21	6.54	4.33
6	Others	2.43	1.49	5.69	19.38	7.25
	Total	**100**	**100**	**100**	**100**	**100**

I (<500); II (501-1500); III (1501-2500); IV (>2500)

Table 4.11 Occurrence of home produced vegetables in the study areas

Home produced veg	HH %				Mean
Range	G I (n=28)	G II (n=24)	G III (n=42)	G IV (n=42)	
0.00	17.86	0.00	0.00	9.52	6.62
1-20	32.14	8.33	11.90	11.90	15.44
21-60	21.43	33.33	40.48	42.86	36.03
>60	28.57	58.33	47.62	35.71	41.91

I (<500); II (501-1500); III (1501-2500); IV (>2500)

4.2.6 Distribution based on plant type and life span of traditional vegetables

Table 4.12 demonstrates plant type and life span of traditional vegetables observed in different study groups of villages. Regarding the plant type, vegetables in herb group occupied the highest number, 122 out of 173 species, representing 70.52%, which was followed by tree type (19.65%) and shrub (9.83%). In terms of life span, annual (49.13%) was mostly found, followed by perennial (36.99%) and biennial (13.87 %) without considering the altitude differences. The predominant nature of annual herbs implies the seasonal availability of traditional vegetables, which demands the systematic preharvest and postharvest practices for sustainability of production and accessibility.

Table 4.12 Plant type and life span of traditional vegetables observed in different study groups of villages

Item	Attribute	Occurrence	
		Number	**(%)**
Plant type	herb	122.00	70.52
	shrub	17.00	9.83
	tree	34.00	19.65
	Total	**174.00**	**100.00**
Life span	annual	85.00	49.13
	biennial	24.00	13.87
	perennial	64.00	36.99
	Total	**173.00**	**100.00**

4.2.7 Seasonal availability of traditional vegetables

The seasonal availability of traditional vegetables in the study area showed in Table 4.13. The ranges of 1-10 traditional vegetables species were available for 39.29%, 76.39%, 79.78% and 62.70% of householders in group I, II, III and IV respectively. In the four main altitude groups, maximum number of respondents in group III (77.78%) were available the ranges of 1-10 traditional vegetables in three seasons.

Most of the householders from low altitude group were available none of vegetable species number, and the householders from other higher altitude groups exhibited the higher availability of 1-10 traditional species. The highest species number 11-20 of traditional vegetables was received by group III (19.84%).

In the lowest altitude group, although the maximum proportion of respondents (53.57 %) used to grow up to 10 species in summer, no vegetable species was available in majority of respondents (42.86 %) in rainy season and winter season (60.71%). In the altitude range between 501 and 1500 ft (G II), up to 10 numbers of species were abundantly observed all three seasons and the high numbers of 11-20 species were mainly received by a total of 50% of householders in rainy season. In higher altitude ranges of group III (1501-2500 ft) and IV ((>2500 ft), 1-10 number of vegetable species were highly concentrated in summer and winter seasons. In fact, these vegetables found in summer and rainy season could be assumed as traditional vegetables. It implies that most of these vegetables are Fabaceae family, tropical type and shorter life span and could not see in winter season. Over 80% of respondents resided in group I, II and IV were available traditional vegetables in rainy season. This result was in line with the finding in Botswana where most of the species are only available locally during the rainy season (Maundu et al. 1999). In Zimbabwe, TVs were assumed to be important during the rainy season when it is difficult to produce exotic vegetables because of high temperature and the high incidence of diseases (Phillips 1999).

Table 4.13 Seasonal availability of traditional vegetables in studied areas

Altitude group	No. of available vegetables	Respondent (%)			
		Summer	Rainy	Winter	Mean
G I (n=28)	Non	46.43	42.86	60.71	50.00
	(1-10)	53.57	25.00	39.29	39.29
	(11-20)	0.00	32.14	0.00	10.71
	Total	**100.00**	**100.00**	**100.00**	
G II (n=24)	Non	8.33	0.00	4.17	4.17
	(1-10)	87.50	50.00	91.67	76.39
	(11-20)	4.17	50.00	4.16	19.44
	Total	**100.00**	**100.00**	**100.00**	
G III (n=42)	Non	0.00	2.38	4.76	2.38
	(1-10)	100.00	38.09	95.24	77.78
	(11-20)	0.00	59.53	0.00	19.84
	Total	**100.00**	**100.00**	**100.00**	
G IV (n=42)	Non	**19.05**	16.67	26.19	20.64
	(1-10)	**76.20**	38.09	73.81	62.70
	(11-20)	**4.75**	45.24	0.00	16.66
	Total	**100.00**	**100.00**	**100.00**	

I (<500); II (501-1500); III (1501-2500); IV (>2500)

4.2.8 Constraints experienced by respondents in growing traditional vegetables

The constraints experienced by respondents regarding the growing of traditional vegetables were demonstrated in Table 4.14 and 4.15. Among the respondents surveyed, 42.65% encountered a number of constraints. Common constraints that occurred in study area were low soil fertility, poor irrigation supply, destruction by wild animals, pests and disease incidence, weeds problem, seed availability, poor market access and price and labour difficulty. Comparing the all altitude groups, minimum constraints was encountered by respondents in group I (21.43%) and maximum constraints (75%) by the respondents in group II.

In the case of low soil fertility, group II, III and IV were found as a problem because they have used only shifting cultivation for 5 to 6 years and did not used other inorganic fertilizers in their fields. Although the fields of respondents in group I are not good in soil fertility, they did not accept as a problem. And also they are used to fertilizer application in their fields to overcome this constraint. Poor irrigation supply was found in all altitude groups but especially found in group II and III. Except Group I, the respondents in other groups relied on rain and can not irrigate due to the poor water situation and high altitude. Lack of rainfall is seen as the major problem that results in the reduction of the availability of TVs. In higher altitude groups, II, III and IV, many respondents stated that many fields were destroyed by wild animals. Pests and disease problem was occurred in all groups but mostly in group I and IV. Weed problem was mostly appeared in group I than other altitude groups. The rest constraints, seed availability, market access and price and labour difficulty were mostly found in the higher regions of group III and IV (Rubaihayo 1997).

Other factors mentioned that threaten the existence of the vegetables include destructive harvesting methods, harvesting plants too early and lack of knowledge or ignorance about the plants. Constraints impeding sustainable production, utilization and conservation of TVs in this area include, among other factors, seasonality of suppy, short shelf- life of the vegetables, lack of cultivation techniques, lack of processing technology, lack of promotional strategies, lack of promotion techniques, low productivity due to poor soils and low erratic rainfall (Chweya & Eyzaguirre 1999).

Table 4.14 Constraints experienced by respondents regarding the growing of traditional vegetables in study area

	Respondents(%)				
Constraints	**G I**	**G II**	**G III**	**G IV**	**Mean**
Constraint	21.43	75.00	50.00	30.95	42.65
Non constraint	78.57	25.00	50.00	69.05	57.35
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

I (<500); II (501-1500); III (1501-2500); IV (>2500)

Table 4.15 General constraints of traditional vegetables encountered by respondents in the study area

No.	Descriptions	Respondents (%)			
		G I (n=4)	**G II (n=13)**	**G III (n=18)**	**G IV (n=19)**
1	Low soil fertility	0.00	23.10	16.70	15.80
2	Poor irrigation supply	27.50	40.40	27.90	10.60
	Destruction by wild animals	0.00	38.50	33.40	26.40
3	Diseases/ Pests	50.00	7.70	22.30	36.90
4	Weeds	25.00	7.70	11.20	10.50
5	Seeds availability	0.00	15.40	5.60	5.30
6	Market access and price	0.00	0.00	5.60	5.30
7	Labor difficulty	0.00	0.00	1.90	0.00
	Total	**102.50**	**132.80**	**124.60**	**110.80**

I (<500); II (501-1500); III (1501-2500); IV (>2500)

Note: The total may be more than 100 due to each respondent have more than one constraint by sample growers.

4.3 Postharvest storage system of Traditional Vegetables

Adoption of respondents to postharvest storage of traditional vegetables was shown in Table 4.16. Over 60% of respondents from different altitude groups in studied area adopted postharvest storage system of traditional vegetables. Regarding of four main altitude groups, the adoption rate of respondents from group III was lower than others as they suddenly consumed after harvesting traditional vegetables from their fields.

Table 4.17 showed the different methods of storage used by the respondent groups. It can be seen that the majority of respondents applied air dried, sun dried and preserved for their postharvest storage system of traditional vegetables. Among the three known storage methods, air dried or spreading on trays method was practiced by (83.32%) of respondents while sun dried (7.29%) and preserved method (9.39%) were rarely used. According to result, most of the respondents consumed as air dried vegetables. Comparing the altitude groups, maximum number (95.45%) of respondents in group III used trays to store their produces through spreading on trays and did not use sun dried method. For all altitude groups, the maximum number of respondents (20.00%) form group II stored vegetables as preserved form. According to the results, the majority of respondents in the study area applied inefficient postharvest storage method that needed to be improved through proper extension plan.

Table 4.16 Adoption of respondents to postharvest storage of traditional vegetables

Item	Respondents (%)				
	G I (n=28)	G II (n=24)	G III (n=42)	G IV (n=42)	Mean
Adopted	60.71	62.50	52.38	66.67	60.29
Non adopted	39.29	37.50	47.62	33.33	39.71
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

I (<500); II (501-1500); III (1501-2500); IV (>2500

Table 4.17 Postharvest storage system of traditional vegetables in different altitude groups in studied area

Item	Respondents (%)				
	G I (n=15)	G II (n=18)	G III (n=27)	G IV (n=26)	Mean
Air dried	82.36	73.33	95.45	82.15	83.32
Sun dried	11.76	6.67	0.00	10.71	7.29
Preserved	5.88	20.00	4.54	7.14	9.39
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

I (<500); II (501-1500); III (1501-2500); IV (>2500

4.4 Seasonal consumption of traditional vegetables

Seasonal consumption of traditional vegetables with different sources in studied areas was described in Table 4.18. In summer season, most of the respondents (74.68%) in group I consumed vegetables by mean of buying. While the respondents in group IV mainly got by gathering of traditional vegetables from the wild forest. F test shows that there are highly significant differences among the altitude groups in the buying and gathering activities in the summer. In higher altitude group, there was low temperature in summer and people who live in these two groups can get wild vegetables. Instead of cultivating traditional vegetables for their daily consumption, rural farmers prefer to collect them from the natural vegetation. Vegetables were available for (40.01%) respondents in group III by growing and there is significant difference in growing activity among the groups (Dixon and Gulliver 2003).

In rainy season, vegetable consumption of group I was mainly supplied by buying (71.60%) and that of group II (43.05%), III (50.59%) and IV (60.64%) were mainly supplied by gathering of traditional vegetables. F test shows that there are highly significant differences in buying and gathering activities among the different altitude groups. Like in summer season, the highest number of respondents (42.62%) who live in group III obtained vegetables by growing and there is a significant difference in the sources of availability of traditional vegetables among these groups. Therefore, most of the species are available locally during the rainy season.

Most of the respondents from all groups were available vegetables by means of buying activity in winter season. And the less respondents (1.14%) from group I received traditional vegetables by gathering. The householders (89.82%) from group I were mainly relied on buying and the householders (nearly 40 %) from higher altitude groups of III and IV bought vegetables. F test shows that there are highly significant difference in buying and gathering activities among the groups in this season. In gathering activity was decreased in all altitude groups comparing to other seasons. This may be due to most of the traditional vegetables were tropical type and they could not resist low temperature in winter. Therefore, all of the altitude groups used their sources from buying, except group III (1501- 2500 ft). Group III still relied on growing and gathering of TVs and this behavior pattern suggests that the traditional vegetables could be available throughout the year as long as conditions are favorable and also this group might be the highest species richness, good soil fertility and some of plants can resist low temperature effect. The sequential resettlement patterns as well as differences in altitude and soil types are reflected in the diversity of both the vegetation and the wild vegetables gathered (Nguni and Mwila 2007).

According to the result, the lower the altitude, the more relied on buying activities in vegetables consumption and the higher the altitude, the more relied on gathering activities in studied area. The householders from group I can get vegetables easily by purchasing from markets because transportation facilities and market access were good. In Tanilier, TVs consumed were mainly from own home gardens and wild collection, while the wealthier consumers purchased them in market (Dixon et al. 2001). Except group IV (> 2500 ft), people lived in other altitude groups relied on growing, the higher the altitude, the more growing potential and that is because no enough space for growing of vegetables in highest altitude group. In the study area, TVs consumed were mainly from own home garden and wild collection, while the householders from group I purchased them in the market. Besides gathering vegetables from the wild, their cultivation in home gardens play an important role towards household food and nutritional security in Nepal (Apukutsa 2007).Cultivation and gathering indigenous for both self- consumption and sale are still very common in Nepal, particularly in remote areas and people from urban and rural communities heavily depend on gathering these vegetables from their natural habitats (Hirschmann and Vaughan 1983).

Table 4.18 Sources of seasonal availability of traditional vegetables upon varying in the study areas

Sources of Availability	Respondents (%)				
	G I (n= 24)	**G II (n=28)**	**G III (n=42)**	**G IV (n=42)**	**F-test**
Summer					
Buying	74.68	35.23	18.41	7.54	**<0.001**
Growing	20.83	31.23	40.01	37.49	**0.035**
Gathering	4.49	33.54	41.58	54.97	**0.003**
Total	**100.00**	**100.00**	**100.00**	**100.00**	
Rainy					
Buying	71.60	17.47	6.79	1.24	**<0.001**
Growing	20.50	39.48	42.62	38.12	**0.04**
Gathering	7.90	43.05	50.59	60.64	**0.001**
Total	**100.00**	**100.00**	**100.00**	**100.00**	
Winter					
Buying	89.82	61.28	35.89	41.76	**<0.001**
Growing	9.04	16.63	27.32	22.52	**0.087**
Gathering	1.14	22.09	36.79	35.72	**0.001**
Total	**100.00**	**100.00**	**100.00**	**100.00**	

I (<500); II (501-1500); III (1501-2500); IV (>2500)

The number of traditional vegetable species consumed in different seasons recorded at varying altitude (ft) zones of Pyinmana area was showed in Figure 4.1. In summer, the highest vegetables species consumed were found in lowest altitude. That may be due to the opportunity of respondents from group I to buy more vegetable species from nearby market place. Except group I, the other groups relied on rain and could not irrigate due to the poor water situation and high altitude and could not get good growing conditions for vegetables in summer season. The highest number of vegetables consumed was recorded in rainy season. Although group II and III were found the highest number of vegetable species consumed, there are not too different among the groups. The lower number of traditional vegetables species consumed was found in group III and IV in winter season because the higher altitude groups, the more poor transport condition systems. The householders from higher groups relied mainly on growing and gathering because they could not be accepted from markets due to difficult transportation system and also most of traditional vegetables are tropical types and could not resistance to lower temperature.

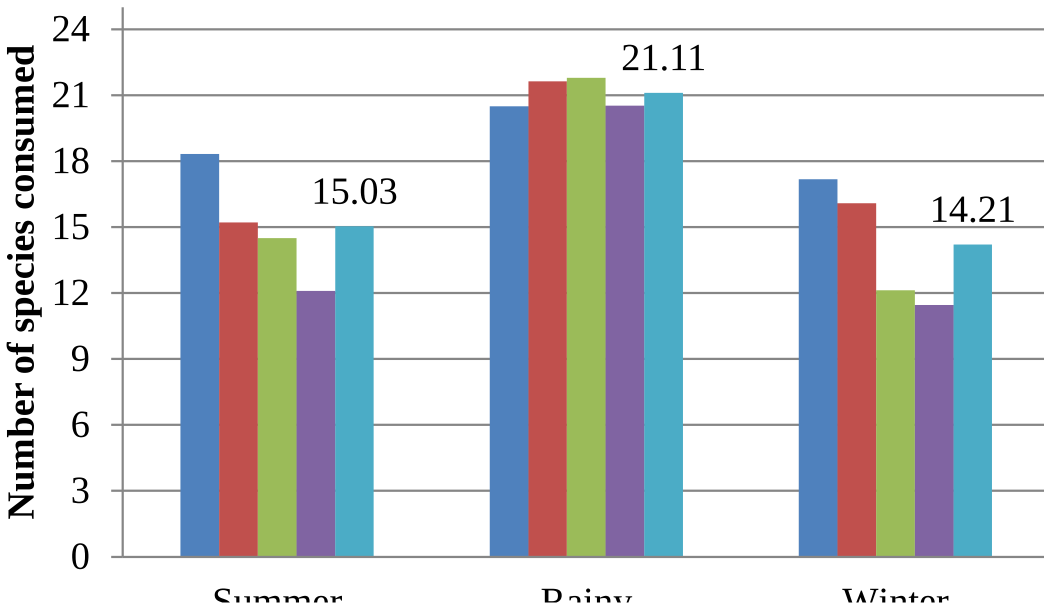

Figure 4.1 Number of traditional vegetable species consumed in different seasons recorded at varying altitude (ft) zones

4.5 Diversity of Traditional Vegetable Species

A total of 173 traditional species, 60 families and 35 orders were recorded in the field survey of 18 study villages in Pyinmana (Table 4.19). Out of these species, 122 species were known species and the other 51 species were unknown species. Species composition and richness differed according to four different altitudes.

Order distribution of traditional vegetables in different altitudes of study area was observed as the same as in species distribution. The highest numbers of traditional vegetables orders were observed in altitude of group III (1501-2500 ft), followed by group IV (>2500 ft), group II (501-1500 ft) and group I (<500 ft) (Table 4.19). Similar to species and family richness, the highest number of order (25) was occurred in Myathar village. Narrow diversity of plant family was observed in lower altitudes of group I and II (Figure 4.3). These areas may be due to not too different in natural condition, low variety of ecological condition and just only adaptable species can grow in this area. Wide diversity was occurred in the higher altitude of groups III and IV. When the elevation reaches greater than 2500 ft, order distribution of group IV declined. This may be due to low temperature and poor soil fertility.

Similar to the number of species, villages from group number III showed the highest number of 59 plant families comprising 40 number of family in Aungbeiktheik and Myathar villages (Table 4.19). Around 30 families were recorded in Santhitlwin village from group II, Mepauk and Salu from group III and Gamonetaung and Saungtaunggyi in group IV respectively. This family richness area may be due to better ecological conditions such as soil fertility and temperature, and more cultivated area than other altitude groups.

Among the families, the highest number of species (20) was found in Fabaceae family and Zingiberaceae, Cucurbitaceae, Fabaceae and Lamiaceae families comprised over 5 numbers of species in 16 selected vegetable families out of observed 51 families in study area (Figure 4.2). These families may be adaptable to the tropical climate and local growing practices. Therefore, they can survive for a long period of time and they also do not need intensive care.

Among the altitude groups, the highest 169 number of species and 97.69% of species richness was occurred in group number III (1501- 2500 ft). The villages included in group number III showed the highest species richness of vegetables with the maximum 131 of species in Myathar village and the second highest number of 95 species were found in Salu village. The minimum number of species was observed in villages from group number I and II (Table 4.14).

In the study area, 13 species observed as the least frequent vegetable species (<15% of study villages) and these species were recorded as localized species. Among them, 3 species belong to Fabaceae family (Table 4.20). Eighteen species were collected as most frequent vegetable species and they were observed in over 80% of study villages. Among all those species, 5 species belong to Cucurbitaceae, the richest species number and the three belong to Solanaceae, the second position of species number (Table 4.21).

The higher the altitude, the higher the species richness was up to 2500 ft. Beyond the 2500 ft, the species number was decreased with the increasing altitude (Figure 4.4). And also there was strong positive relationship between upland area and crop species. The larger the upland area, the more number of species was observed (Figure 4.5).

Table 4.19 Species richness of vegetables in the study areas

Group	Villages	Order	Family	Species
	Hnantaw	15	20	41
	Thitlaylone	15	20	48
G I	Ngakaungkan	16	24	44
	Yanaung	14	20	31
	Grand Total	**18**	**28**	**60**
	Richness %	**51.43**	**46.67**	**34.68**
	Santhitlwin	23	30	35
	Seikphutaung	13	16	34
G II	Thonekhwataw	12	15	43
	Phalaung	21	29	68
	Grand Total	**22**	**47**	**121**
	Richness %	**62.86**	**78.33**	**69.94**
	Mepauk	24	33	77
	Aungbeiktheik	24	40	120
G III	Myathar	25	40	131
	Thandaungboma	16	24	80
	Salu	22	34	95
	Grand Total	**34**	**59**	**169**
	Richness %	**97.14**	**98.33**	**97.69**
	Gamonetaung	23	30	65
	Wetharli	16	20	41
G IV	Phonesoe	16	20	40
	Saungtaunggyi	22	31	93
	Yepu	19	27	63
	Grand Total	**31**	**45**	**135**
	Richness %	**88.57**	**75.00**	**78.03**
***Grand Total (Occurrence of vegetables)**		**35**	**60**	**173**

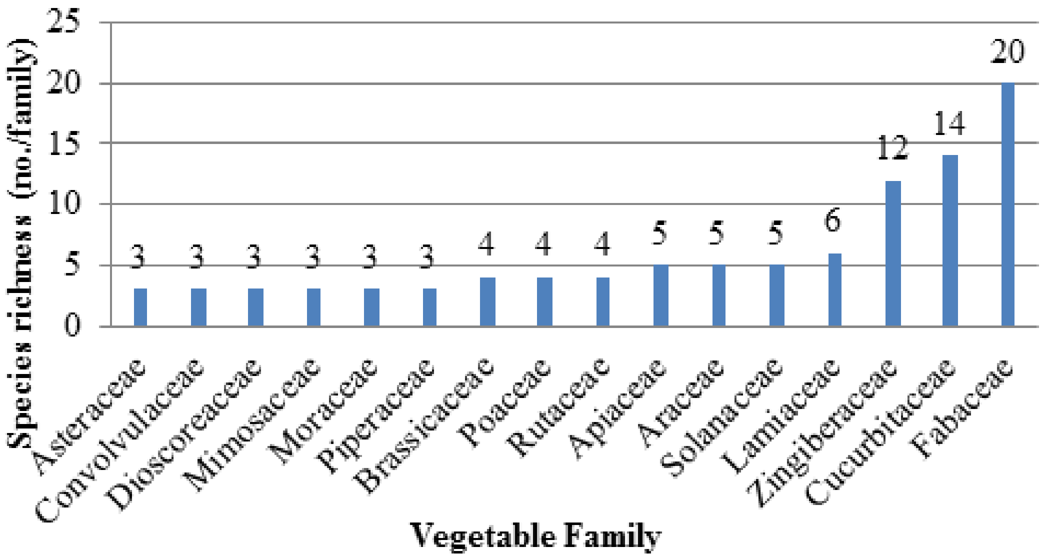

Figure 4.2 Species richness in 16 selected vegetable families out of observed 51 families in study area (35 no. of families comprising less than 3 species are excluded)

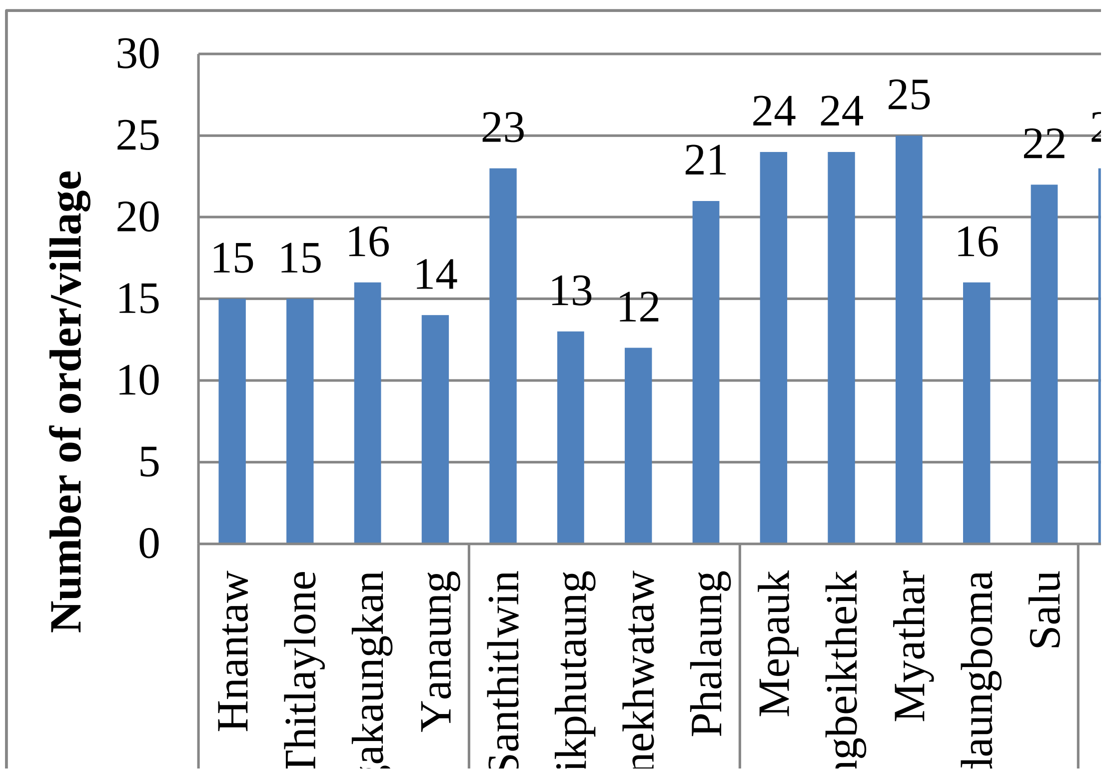

Figure 4.3 Order distributions of traditional vegetables out of recorded 28 numbers in different altitudes of study area

Table 4.20 The least frequent vegetable species observed in less than 15% of study villages

No.	Vernacular name	Common name	Botanical name	Family	Frequency (%)[a]
1	swe-daw	Bullhoof	*Bauhinia acuminata*	Fabaceae	5.56
2	shar-zaung-let-pat	Aloe	*Aloe vera*	Xanthorrhoeaceae	11.11
3	pauk-pan-phyu	Cark wood	*Sesbaina gradiflora*	Fabaceae	5.56
4	phet-sut	_	*Eriobotrya bengalensis*	Rosaceae	11.11
5	thi-pa-gan	_	*Millittia brandisiana*	Fabaceae	5.56
6	taw-shauk	_	*Paramignya longispina Hook.*	Saxifragaceae	11.11
7	pan-gyauk	_	*Statice spp.*	Plumbaginaceae	5.56
8	kyi-bar	_	_	_	5.56
9	san-dar-gi	_	_	_	5.56
10	san-phe	_	_	_	5.56
11	phyan-u	_	_	_	11.11
12	su-ywet	_	_	_	11.11
13	kyan-hin-new	_	_	_	11.11

[a]Frequency was calculated based on number of occurrence out of 18 villages.

Table 4.21 The most frequent vegetable species observed in more than 80% of study villages

No.	Vernacular name	Common name	Botanical name	Family	Frequency (%)[a]
1	myin-khwar	Penny wort	*Hydrocotyle asiatica*	Apiaceae	88.89
2	ye-ka-zun	Convolvulus	*Ipomaea aquatica*	Convolvulaceae	83.33
3	tha-kwar	Cucumber	*Cucumis sativus*	Cucurbitaceae	83.33
4	kha-we-thi	Ridged gourd	*Luffa acutangula*	Cucurbitaceae	83.33
5	kyaunk-phayon	White pumpkin	*Benincasa cerifera Savi.*	Cucurbitaceae	83.33
6	Bu	Bottle gourd	*Lagenaria vulgaris*	Cucurbitaceae	100.00
7	shwe-phayon	Pumpkin	*Cucurbita maxima*	Cucurbitaceae	100.00
8	kin-pon-chin	Soap acacia	*Acaica concinna*	Fabaceae	83.33
9	ma-gyi	Tamarind	*Tamarindus indica*	Fabaceae	94.44
10	yon-pa-te	Okra	*Hibiscus esulentus*	Malvaceae	88.89
11	chin-paung	Roselle	*Hibisccus sandariffa*	Malvaceae	88.89
12	su-poke	Black catechu	*Acacia intsia*	Mimosaceae	94.44
13	pein-hne	Jack fruit	*Artocarpus heterophyllus*	Moraceae	88.89
14	dant-tha-lun	Drum stick	*Moringa oleifera*	Moringaceae	83.33
15	hnget-pyaw	Banana	*Musa spp.*	Musaceae	100.00
16	kha-yan	Egg plant	*Solanum indicum*	Solanaceae	100.00
17	nga-yoke	Chilli	*Capsicum annuum Linn.*	Solanaceae	100.00
18	kha-yan-chin	Tomato	*Lycopersicum esculentum*	Solanaceae	100.00

[a]Frequency was calculated based on number of occurrence out of 18 villages.

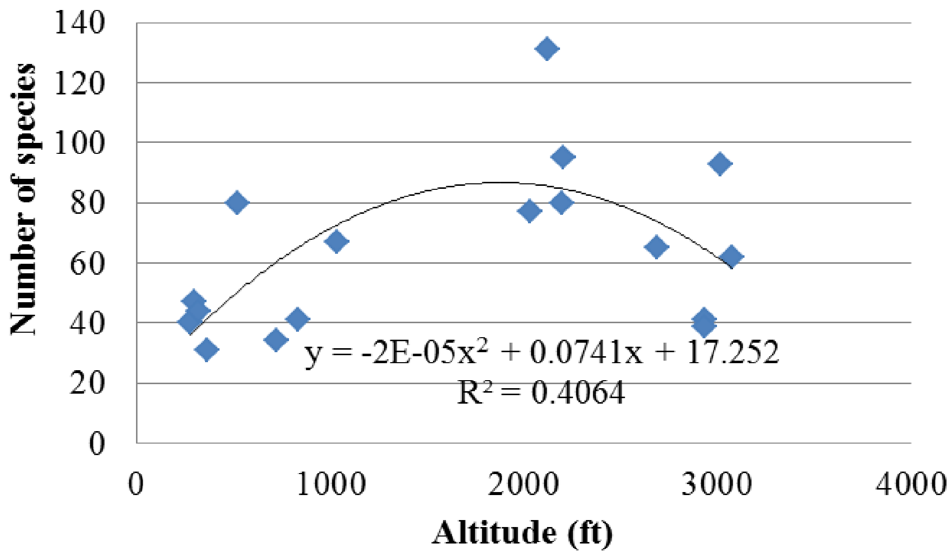

Figure 4.4 Relationship between altitude and number of vegetable species observed in 18 study villages

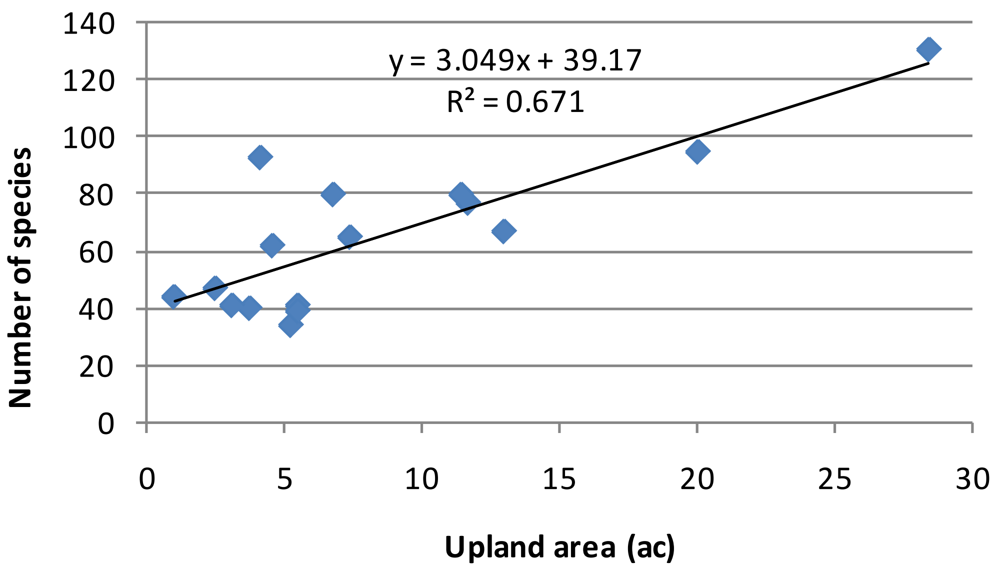

Figure 4.5 Relationship between upland area of farm and number of vegetable species observed in 18 study villages

CHAPTER V
CONCLUSION AND SUGGESTIONS

This study focused on growing and utilization of traditional vegetables in 18 selected villages of Pyinmana area differing in altitudes ranges. Moreover socio demographic figures of sample households and species richness and distribution of vegetables were also observed. Ratio of male respondents exhibited nearly three times the female. Majority of respondents were observed to be farmers with the primary education level. Most of the respondents grew TVs mainly for home consumption using their own produced seeds.

Villages in altitude of 1501-2500 feet exhibited as the habitat for most species. Regarding the consumption, the people living in the lower altitude (<500 ft) consumed vegetables mainly through buying activities and those of the highest altitude (>2500 ft) mainly through gathering. Most of the traditional vegetables are available locally during the rainy season. Among the species, 18 species were observed in over 80% of villages, while 13 species were recorded as localized species because of the least frequency of occurrence (15% of villages). The families Cucurbitaceae, Zingiberaceae, Fabaceae, and Lamiaceae were rich in species. Cucurbitaceae, Solanaceae, Apiaceae, Fabaceae, Convolvulaceae, Malvaceae, Mimosaceae, Moraceae, Musaceae, and Moringaceae were families with the most frequent vegetable species. The villages from 1501-2500 ft altitude occupied the highest numbers of species. Up to 2500 ft, the higher the altitude, and the more number of vegetable species.

In Pyinmana area, there are rich sources of traditional vegetables species and have potential for crop improvement. This area can be fill nutritional security of our country because it is located in transitional zone and can be grow the variety of vegetables. Most of the traditional vegetables are endangered and need to explore for distribution and extent for their genetic diversity.

There should be awareness campaign about the value of traditional and indigenous vegetables. The germplasm should intensively be collected and conserved on-farm as well as in gene bank. It can be recommended that people in local communities should be educated on the conservation of indigenous vegetables and post harvest handling systems. And also there is rare academic study regarding traditional vegetable species especially in Pyinmana area. There may also be a need to more research, survey, taxonomic identification and analysis of the extent and distribution of genetic diversity, together with work on local and traditional knowledge, remain priorities for many traditional vegetables.

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APPENDICES

Appendix table 1 Propagation method, edible portion and occurrence frequency of species under family Cucurbitaceae observed in the study area

No.	Myanmar name	English name	Scientific name	Propagation	Plant part used	Frequency (%)[a]
1	bue	Bottle gourd	*Lagenaria vulgaris*	Seed	leaves/fruit	100
2	pha-yon	Pumpkin	*Cucurbita maxima*	Seed	leaves/fruit	100
3	tha-khwa	Cucumber	*Cucumis sativus*	Seed	fruit	83.33
4	kha-we`	Ridged gourd	*Luffa acutangula*	Seed	fruit	83.33
5	kyauk-pha-yon	White/ Ash pumpkin	*Benincasa cerifera Savi.*	Seed	leaves/fruit	83.33
6	kyet-hinn-khar	Bitter gourd	*Momordicacharantia*	Seed	leaves/fruit	77.78
7	jinn-ga-paunn	Spiny gourd	*Momordi cadioica Roxb.*	Seed	leaves/fruit	61.11
8	taw-kinn-pon	Ivy gourd	*Coccinia cordifolia*	Seed	leaves/fruit	55.56
9	kinn-pon	Ivy gourd	*Coccinia indica W & A*	Seed	leaves/fruit	55.56
10	dha-bu-cha:	Bitter luffa	*Luffa amara*	Seed	fruit	33.33
11	gor-ra-kharr	Chayote	*Sechium edule Swartz.*	Seed	leaves/fruit	27.78
12	tha-kha-ma	Musk melon	*Cucumis melo*	Seed	fruit	22.22
13	pe`-linn myway	Snake gourd	*Trichosanthes anguina*	Seed	fruit	22.22
14	kyee-ar	Unknown	*Trichosanthes palmata*	Seed	leaves	5.56

[a] Frequency was calculated based on number of occurrence out of 18 villages.

Source: Botany.si.edu 2003, MAS 2000, MOF 2000, Johnny 2013 and U San Khin and Thripyanchi U Tha Myat 1969

Appendix table 2 Propagation method, edible portion and occurrence frequency of unknown species found in the study area

No.	Myanmar name	Propagation	Plant part used	Frequency (%)[a]
1	za-yit	cutting	stem/leaves	72.22
2	ka-larr-nan-nan	seed	leaves	66.67
3	Boke-htaun	cutting	leaves	38.89
4	Nga-pha-laung	rhizome	leaves	38.89
5	Moke-soe-nan-nan	seed	leaves	33.33
6	zar-ma-ni	seed	leaves	33.33
7	sun-let-the`	seed	leaves	33.33
8	taun-paw-nan-nan	seed	leaves	33.33
9	taun-sunn-u	tuber	root	33.33
10	taw-chauk	unknown	unknown	33.33
11	san-phe`	unknown	leaves	33.33
12	hinn-cho-yet	seed	leaves	27.78
13	say-weik-zar	seed	leaves	27.78
14	min-poke-u	tuber	tuber	27.78
15	kinn-khyay-myarr	unknown	leaves	27.78
16	ban-le`	cutting	leaves	22.22
17	gdyoe-tha-khwar	seed	fruit	22.22
18	Shanthi	seed	fruit	22.22
19	taw pein: ne:	seed	leaves/fruit	22.22
20	shwe du u	tuber	tuber	22.22
21	nga: taun shin:	unknown	leaves	22.22
22	pi thwe'pa lot	unknown	leaves	22.22
23	wartaung shin	unknown	leaves	22.22
24	biza pin	cutting	leaves	16.67

25	pan khajan	seed	flower	16.67
26	mjin: gaparthi:	seed	fruit	16.67
27	pan: zau 'htou:	seed	leaves	16.67
28	mou' hsou: ngajou'	seed	fruit	16.67
29	Gjinnat	rhizome	root	16.67
30	Gjinpyan	rhizome	root	16.67
31	pi kathar pin	unknown	leaves	16.67
32	pet kanar	unknown	leaves	16.67
33	Taungloekyaw	unknown	unknown	16.67
34	chin phanthi	seed	fruit	11.11
35	chin khajan	seed	fruit	11.11
36	Kyeinkhar	seed	leaves	11.11
37	Sapyar	seed	leaves	11.11
38	hsu:	seed	leaves/fruit	11.11
39	pe: arkyar	seed	pod	11.11
40	hpjan u	tuber	tuber	11.11
41	thin: ba'	unknown	leaves	11.11
42	ponka pan	unknown	unknown	11.11
43	kya ma naing	unknown	unknown	11.11
44	ka la baw	seed	leaves	5.56
42	Sannaghi	seed	leaves	5.56
43	kji:bar	unknown	leaves	5.56

[a] Frequency was calculated based on number of occurrence out of 18 villages.

Source: Botany.si.edu 2003, MAS 2000, MOF 2000, Johnny 2013 and U San Khin and Thripyanchi U Tha Myat 1969

Appendix table 3 Propagation method, edible portion and occurrence frequency of 12 species under family Zingiberaceae found in the study villages of Pyinmana area

No.	Myanmar name	Common name	Scientific name	Propagation	Plant part used	Frequency (%)[a]
1	gyin	Ginger	*Zingiber officinale*	rhizome	root	61.11
2	mait-tha-lin	wild ginger	*Zingiber barbatun*	rhizome	root	55.56
3	hsa-nwin	round zedoary	*Curcuma zadoari*	rhizome	root	55.56
4	tha-je' -kin:	mango ginger	*Curcuma amada*	rhizome	root	50.00
5	hsa-nwin -pan	Turmeric	*Curcuma longa*	rhizome	flower/ root	33.33
6	pha-lan-taung-mway	white costus	*Costus speciosus Smith.*	rhizome	root	33.33
7	pade: -gaw	Galangal	*Alpinia galanga*	rhizome	root	27.78
8	seik-phoo	chinese ginger	*Gastrochilus pandurata*	rhizome	root	22.22
9	ba-da' -sa	gingerwort	*Kaempferia candida*	rhizome	root	22.22
10	goun-minn	unknown	*Amomum corynostachyum*	rhizome	root	22.22
11	mar-lar-pu	unknown	*Curcuma petiolata*	rhizome	flower	16.67
12	hsa-nwin-kar	medicinal turmeric	*Curcuma comosa*	rhizome	root	16.67

[a] Frequency was calculated based on number of occurrence out of 18 villages.

Appendix table 4 Propagation method, edible portion and occurrence frequency of species under family Fabaceae observed in the study area

No.	Myanmar name	Common name	Scientific name	Propagation	Plant part used	Frequency (%)
1	hsu: bou'	black catechu	*Acacia intsia*	seed	leaves	94.44
2	magi	Tamarind	*Tamarindus indica*	seed	leaves/ fruit	94.44
3	dazaunmoun: pe:	cow pea	*Vigna catjang Walp.*	seed	pod/seed	77.78
4	nwe pe:/pe: kyarsae	indian bean	*Dolichos lablab Linn.*	seed	pod/seed	77.78
5	danjin:	Jengkol bean	*Archidendron pauciflorum*	seed	seed	72.22
6	pe: zinngoun	pigeon pea	*Cajanus cajan*	seed	pod/seed	44.44
7	mezali	ringworm shrub	*Cassia alata Linn.*	seed	leaves	38.89
8	pe: bazun	cluster bean	*Cyamopsis psoralloides*	seed	pod/seed	33.33
9	pe: zaun: ja:	winged bean; goa bean	*Psophocarpus tetragonalobus*	seed	pod/ root	33.33
10	pe: lei' pyar	butter bean	*Phaseolus lunatus Linn.*	seed	pod/seed	16.67
11	pe: daunshei	long/string bean	*Vigna sinensis*	seed	pod/seed	16.67
12	thi' pagan	Unknown	*Millettia brandisiana*	seed	leaves	16.67
13	sein: za:u	goa bean; chinese potato	*Pachyrhizus angulatus*	seed	pod/seed	11.11
14	ngu	indian laburnum	*Cassia fistula Linn.*	seed	leaves	11.11
15	mounnjinx	Bullhoof	*Bauhinia acuminata Linn.*	seed	leaves	5.56
16	sun ta ni	red *P.lunatus* bean	*Phaseolus lunatus*	seed	pod/seed	5.56

[a] Frequency was calculated based on number of occurrence out of 18 villages.

Appendix table 5 Propagation method, edible portion and occurrence frequency of root and tuber crop species observed in the study villages of Pyinmana area

No.	Myanmar name	Common name	Scientific name	Family	Propagation	Plant part used	Frequency (%)[a]
1	palo: pi nan	Cassava	*Manihot utilissima*	Euphorbiaceae	rhizome	root	77.78
2	pein: u	Taro	*Colocasia antiquorum*	Araceae	corm	leaves/ root	72.22
3	pein: ganan	Unknown	Unknown	Araceae	tuber	leaves/ root	72.22
4	gyin	Ginger	*Zingiber officinale Rosc.*	Zingiberaceae	rhizome	rhizome	61.11
5	mjau' u	white yam	*Dioscorea alata*	Dioscoreaceae	tuber	tuber	61.11
6	hsanwin	round zedoary	*Curcum zadoari Rosc.*	Zingiberaceae	rhizome	root	55.56
7	gazun u	sweet potato	*Ipomaea batatas*	Convolvulaceae	tuber	root	55.56
8	thaje' kin:	mango ginger	*Curcuma amada*	Zingiberaceae	rhizome	root	50.00
9	jin: pja:	Unknown	*Dichroa febrifuga Lour.*	Hydrangeaceae	rhizome	leaves/ root	50.00
10	gwei: dau	green wax flower	*Dregea volubilis*	Apocynaceae	seed	leaves/ flower	44.44
11	katwaye u	kidney yam	*Dioscorea esculenta*	Dioscoreaceae	tuber	root	44.44
12	wa u	elephant foot yam	*Amorphophallus paeoniifolius*	Araceae	tuber	root	38.89
13	a da lu'	arrow root	*Maranta arundinacea*	Marantaceae	rhizome	root	33.33
14	taun sun: u	Unknown	Unknown	Unknown	tuber	root	33.33
15	phalantaungmway	white costus	*Costus speciosus Smith.*	Zingiberaceae	rhizome	root	33.33
16	pade: gaw	Galangal	*Alpiniagalanga/A. officinarum*	Zingiberaceae	rhizome	root	27.78
17	lin-ne	sweet flag	*Acorus calamus Linn.*	Araceae	rhizome	root	27.78
18	min poke u	Unknown	Unknown	Unknown	tuber	tuber	27.78
19	seikphoo	chinese ginger	*Gastrochilus pandurata Rideley*	Zingiberaceae	rhizome	root	22.22
20	bada' sa	Gingerwort	*Kaempferia candida*	Zingiberaceae	rhizome	root	22.22
21	zabalin	lemon grass	*Cymbopogon citratus*	Poaceae	rhizome	root	22.22
22	gounminn	Unknown	*Amomum corynostachyum*	Zingiberaceae	rhizome	root	22.22

23	shwe du u	Unknown	Unknown	Unknown	tuber	root	22.22
2425	hsanwinkar	medicinal turmeric	*Curcuma comosa*	Zingiberaceae	rhizome	root	16.67
26	gjinnat	Unknown	Unknown	Unknown	rhizome	root	16.67
27	gjinpyan	Unknown	Unknown	Unknown	rhizome	root	16.67
28	hpjan u	Otter	Unknown	Unknown	tuber	tuber	11.11

[a] Frequency was calculated based on number of occurrence out of 18 villages.

Source: Botany.si.edu 2003, MAS 2000, MOF 2000, Johnny 2013 and U San Khin and Thripyanchi U Tha Myat 1969

Appendix table 6 Propagation method, edible portion and occurrence frequency of species observed in the study area

No.	Myanmar name	Common name	Scientific name	Family	Propagation	Plant part used	Frequency (%)[a]
1	ngapjo: bu:	banana	*Musa sapienum Linn.*	Musaceae	corm	bud/ pith of the banana stem	100.00
2	ngajou'	chilli; red pepper	*Capsicum annuum Linn.*	Solanaceae	seed	fruit	100.00
3	khajangjin	Tomato	*Lycopersicum esculentum*	Solanaceae	seed	fruit	100.00
4	pin zein:	tulasi/basil	*Ocimum canum*	Lamiaceae	seed	leaves	100.00
5	pein: ne:	jack fruit	*Artocarpus heterophyllus. Lam.*	Moraceae	seed	fruit	94.44
6	joun: badi	Okra	*Hibiscus esulentus*	Malvaceae	seed	fruit	88.89
7	mjin: khwa	penny wort	*Hydrocotyle asiatica*	Apiaceae	cutting	leaves	88.89
8	chin baun	Roselle	*Hibisccu sabdariffa*	Malvaceae	seed	leaves/fruit	88.89
9	dandalun	drumstick tree	*Moringa oleifera*	Moringaceae	seed	leaves/fruit	83.33
10	kin bun chin	soap acacia	*Acaicaconcinna*	Mimosaceae	seed	leaves	83.33
11	gazun	water convolvulus	*Ipomaea aquatica*	Convolvulaceae	cutting	leaves	83.33
12	palo: pi nan	Cassava	*Manihot utilissima*	Euphorbiaceae	tuber	tuber	77.78
13	bi za'	hemp agrinomy	*Eupatorium odoratum*	Asteraceae	seed	leaves	77.78
14	khajangazo	indian nightshade	*Solanum indicum*	Solanaceae	seed	fruit	77.78
15	thin: baw	Papaya	*Carica papaya*	Caricaceae	seedd	leaves/fruit	72.22
16	pein: u	Taro	*Colocasia antiquorum*	Araceae	tuber	leaves/	72.22

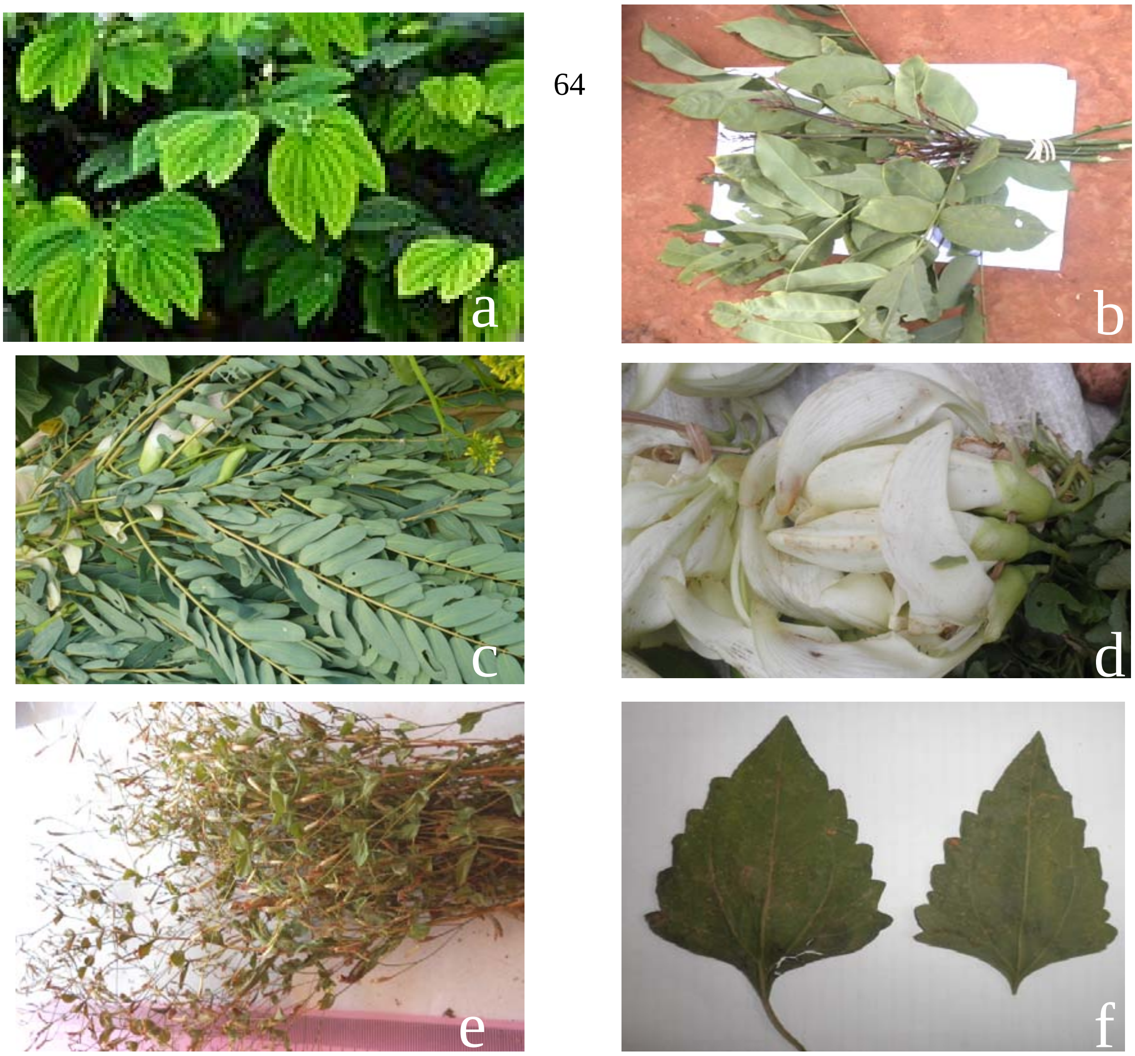
						root	
17	pein: ganan	Unknown	unknown	Araceae	tuber	leaves/ root	72.22
18	mounnjin	white mustard	*Brassica alba*	Brassicaceae	seed	leaves/fl ower	72.22
19	than baja'	Citrus	*Citrus medica / acida*	Rutaceae	seed	leaves/fr uit	66.67
20	hin nu ne	Amaranthus	*Amaranthus blitum/*	Amaranthaceae	seed	leaves	61.11
21	min: bo:	hill palm; wild sago	*Caryota mitis lour.*	Arecaceae	seed	pith	61.11
22	thaje'	Mango	*Mangiferaindica*	Anacardiaceae	seed	leaves/fr uit/ flower	61.11
23	mjau' u	white yam	*Dioscorea alata*	Dioscoreaceae	tuber	tuber	61.11
24	nan nan	Coriander	*Coriandrum sativum*	Apiaceae	seed	leaves	55.56
25	khajan: gju'	dwarf aubergine	*Solanum melongena*	Solanaceae	seed	fruit	55.56
26	shau'	lemon	*Citrus medica*	Rutaceae	seed	leaves/fr uit	55.56
27	taunoun:	sago palm of malaya	*Arenga saccharifera Labill.*	Arecaceae	seed	pith	55.56
28	gazun u	sweet potato	*Ipomaea batatas*	Convolvulaceae	tuber	tuber	55.56
29	jin: pja:	Unknown	*Dichroa febrifuga Lour.*	Hydrangeaceae	cutting	leaves/ root	50.00
30	hmji'	bamboo shoot	*Bambus vulgaris*	Poaceae	rhizome	shoot	44.44
31	pyindawthein	curry leaf	*Murraya koenigii*	Rutaceae	seed	leaves	44.44
32	thaphan	Fig	*Ficus glomerata*	Moraceae	seed	fruit	44.44
33	hsala'	Lettuce	*Lactuca sativa*	Asteraceae	seed	leaves	44.44
34	kadet	three leaved caper	*Crataeva religiosa Forst.*	Capparaceae	seed	leaves	44.44
35	katwaye u	kidney yam	*Dioscorea esculenta*	Dioscoreaceae	tuber	tuber	44.44

36	sindon ma new	Unknown	*Tinospora nudiflora Kurz.*	Menispermaceae	cutting	stem	44.44
37	thi'chou	Unknown	*Sideroxylon tomentosum*	Sapotaceae	seed	leaves	44.44
38	ou' shi'	bael fruit	*Aegle marmelos Corr.*	Rutaceae	seed	leaves/fruit	38.89
39	vbetel vine	betel vine	*Pepe rbetle Linn.*	Piperaceae	seed	leaves	38.89
40	taw kazun/taung paw kazun	Convolvulus	*Ipomoea sepiaria Koen.*	Convolvulaceae	cutting	leaves	38.89
41	wa u	elephant foot yam	*Amorphophallus paeoniifolius*	Araceae	tuber	tuber	38.89
42	kai lan	Kale	*Brassica alboglabra*	Brassicaceae	seed	leaves	38.89
43	sayemjin: khwa	king fern/ gaint fern	*Angiopteris evecta*	Marattiaceae	rhizome	rhizome	38.89
44	phanga	Myrobalan	*Terminalia chebula*	Combretaceae	seed	fruit	38.89
45	taun tama	Nill	*Cedrela serrataRoyle.*	Meliaceae	seed	leaves	38.89
46	zi: bju	Eastern gooseberry	*Emblica officinalis*	Grossulariaceae	seed	fruit	33.33
47	Ngajan budu	glorybower; bleeding-heart	*Clerodendron siphonanthus*	Lamiaceae	seed	leaves	33.33
48	mayan:	marian tree	*Bouea burmanica*	Anacardiaceae	seed	leaves/ flower	33.33
49	hin: ga: jwe'	Unknown	*Amaranthus paniculatus*	Amaranthaceae	seed	leaves	33.33
50	kazawthi	Unknown	*Myrsine semiserrata Wall.*	Myrsinaceae	seed	fruit	33.33
51	le: lu	Unknown	*Olax scandensRoxb.*	Olacaceae	seed	leaves	33.33
52	pan: mounlar	Cauliflower	*Brassica oleracea var. botrytis*	Brassicaceae	seed	flower	27.78
53	kjaunsha	Indian trumpet	*Bignonia indica*	Bignoniaceae	seed	flower	27.78
54	bonmayazar	serpentine; serpent wood	*Rauwolfia serpentina Benth.*	Apocynaceae	seed	leaves	27.78
55	lin-ne	sweet flag	*Acorus calamus Linn.*	Araceae	tuber	tuber	27.78
56	ngajou' kaun	black pepper	*Piper nigrum*	Piperaceae	seed	fruit	22.22

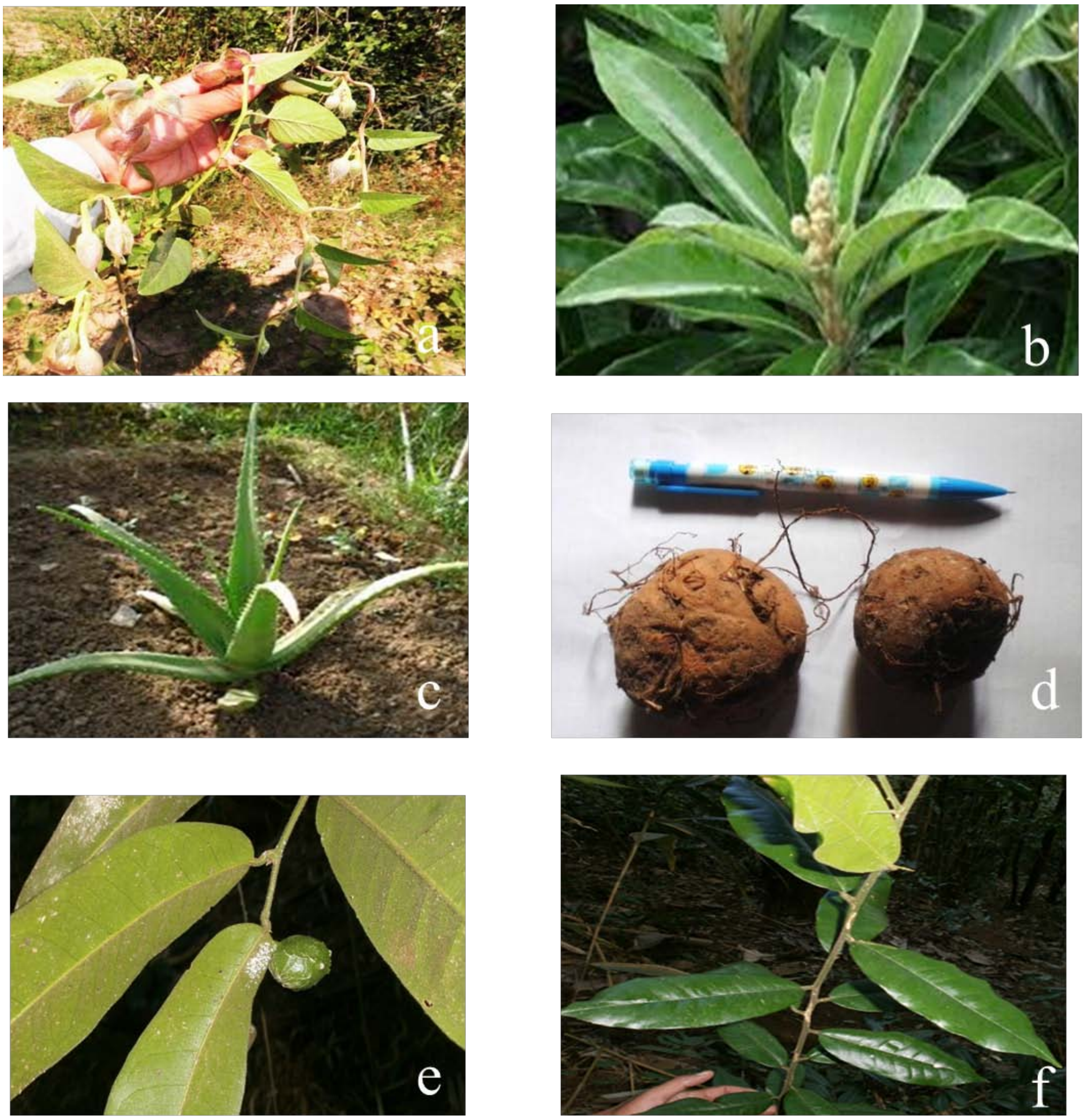
57	ziya	Cumin	*Cuminum cyminum Linn.*	Apiaceae	seed	leaves	22.22
58	samjei'	Dill	*Anethum graveolens*	Apiaceae	seed	leaves	22.22
59	zee	jujube berries	*Zizphus vulgaris Lam.*	Rhamnaceae	seed	fruit	22.22
60	pjaun:	maize/ corn	*Zea mays*	Poaceae	seed	seed	22.22
61	tama	margosa/ neem tree	*Azadirachta indica A. Juss.*	Meliaceae	seed	leaves	22.22
62	jounhmwa	common/ wild marjoram	*Origanum majorana Linn.*	Lamiaceae	seed	leaves	16.67
63	in-u	fungus of *Dipterocarpus tuberculatus*	*Dipterocarpus tuberculatus*	Dipterocarpaceae	–	–	16.67
64	kyaung- ban	indian wild pepper	*Vitex trifolia Linn. F.*	Lamiaceae	_	tuber	16.67
65	Mee malaung ban	Unknown	*Kalancho elaciniata DC.*	Crassulaceae	seed	leaves	16.67
66	shazung	Aloe	*Aloe vera*	Xanthorrhoeaceae	offset	leaves	11.11
67	sayegyauk	hemp; ganja; marijuana	*Cannabis sativa L.*	Cannabaceae	seed	leaves/fruit	11.11
68	Ye-yo	indian mulberry	*Morinda angustifolia Roxb.*	Rubiaceae	seed	leaves/fruit	11.11
69	hpe' hsu'	Nill	*Engelhardia spicata*	Juglandaceae	seed	leaves	11.11
70	taw shauk	Unknown	*Paramignya longispina Hook.*	Rutaceae	seed	leaves/fruit/root	11.11
71	pe: pou: di	Chinese artichoke	*Stachys tubrifera*	Lamiaceae	tuber	tuber	5.56
72	pan: gjau'	Unknown	*Statice spp.*	Plumbaginaceae	seed	leaves	5.56
73	kayinkhajan chin	Unknown	*Lycopersicum spp.*	Solanaceae	seed	fruit	5.56
74	khajangaun:	Unknown	*Solanum spp.*	Solanaceae	seed	fruit	5.56

[a] Frequency was calculated based on number of occurrence out of 18 villages.

Source: Botany.si.edu 2003, MAS 2000, MOF 2000, Johnny 2013 and U San Khin and Thripyanchi U Tha Myat 1969

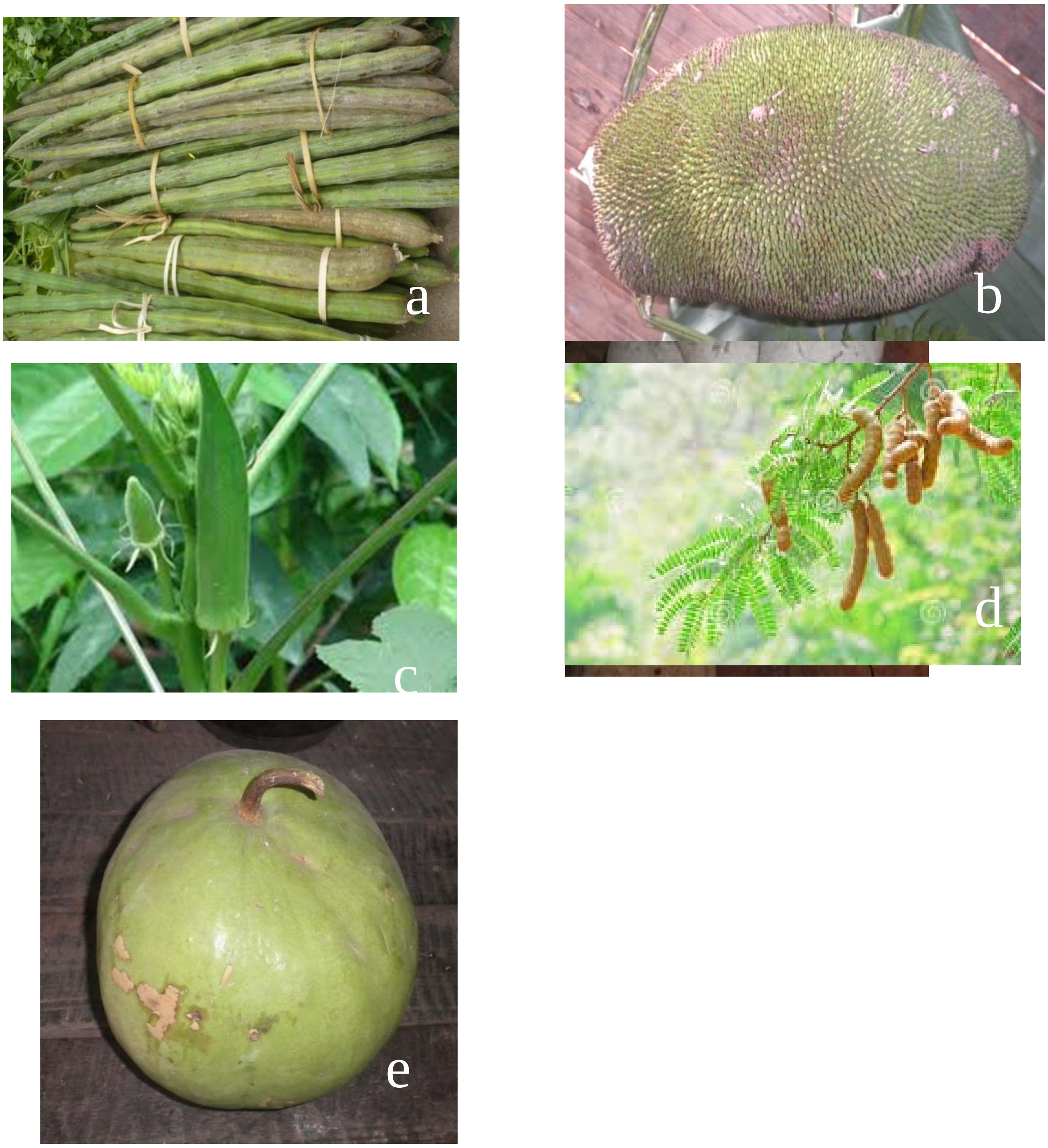


Appendix plate 1 **Some of underutilized leafy vegetables observed in less than 6 % of study villages: leaves of Cark wood (a), leaves of thit-pa-gan (b), leaves (c) and flower (d) of Bullhoof, whole plant of pan-gyauk (e), leaves of san-dar-gi (f)**

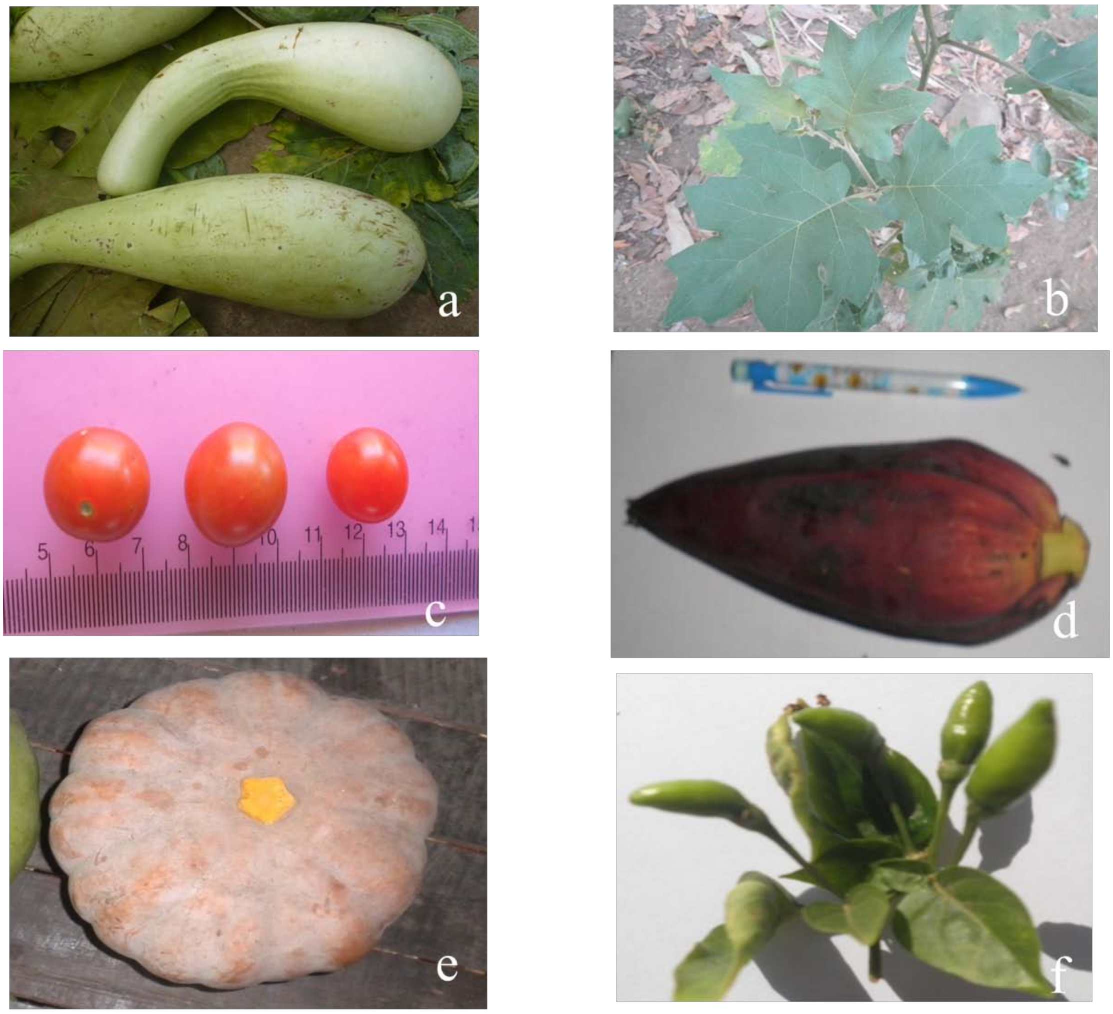


Appendix plate 2 **Some of underutilized traditional vegetables observed in less than 12 % of study villages: tendril of kyan-hin-new (a), floral part of phet-sut (b), whole plant of Aloe (c), tuber of phyan-u (d), fruit (e) and leaves (f) of taw-shauk**

Appendix plate 3 **Traditional leafy vegetables that were consumed locally more than 80% in the Pyinmana area: whole plant of Pennywort (a), leaves of Water convolvulus (b), plant of Black catechu (c), plant of Soap acacia (d), leaves and flowers of Roselle (e)**



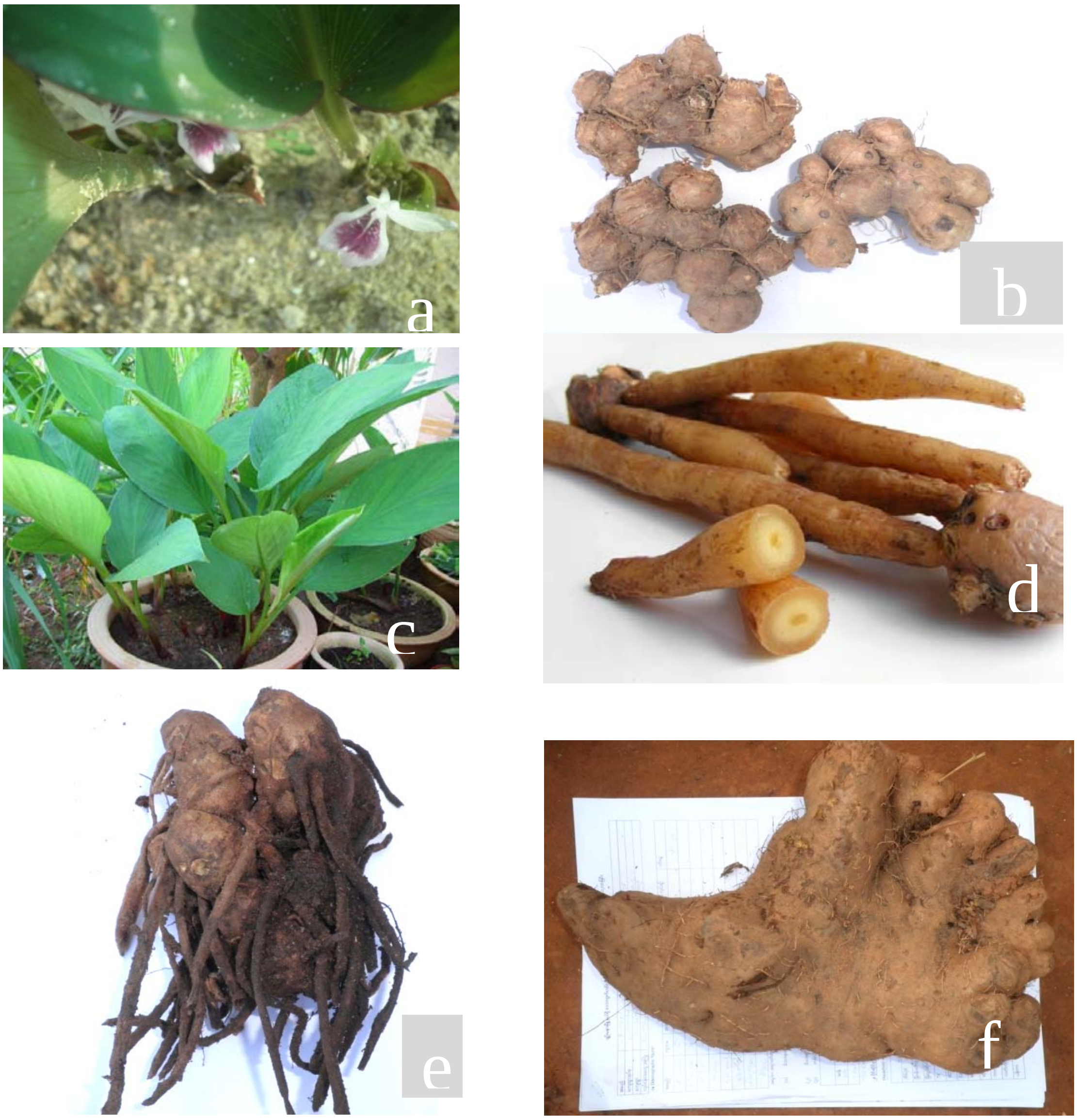
Appendix plate 4 **Some of traditional fruit vegetables observed in more than 80% of study villages: fruit of Drum stick (a), fruit of Jack fruit (b), fruit of Okra (c), fruit and leaves of Tamarind (d), fruit of White pumpkin (e) and (f)**



Appendix plate 5 Some of traditional vegetables that were observed in 100% of study villages: fruit of Bottle gourd (a), plant of eggplant (b), fruit of Tomato (c), Flower bud of Banana (d), fruit of Pumpkin (e) , fruit of Chilli (f)

Appendix plate 6 **Preliminary survey in study villages : observation of vegetables in markets that were near to sampled villages (a) and (b), group discussion with householders in study area (c), individual interviews through semi-structured questionnaires with respondents (d), (e) and (f)**

Appendix plate 7 **Main survey in study villages: individual interviews through structured questionnaires with sampled respondent (a) and (b), documentation of sample plant parts (c), measuring of altitudes in study area by using GPS (d), field observation in sampled villages (e) and (f)**


a
b
c
d
e
f

Appendix plate 8 **Traditional vegetables (roots and tuber crops) found in study area: flower of gjin net (a), rhizome of gjin net (b), plant of chinese ginger (c), rhizome of chinese ginger (d), rhizome of gjin pyan (e), tuber of white yam (f), tuber of kidney yam (g) and (h), rhizome of kind fern (say-myin-khwa) (i) and (j)**

Appendix plate 9 **Traditional vegetables (fruit) observed in study villages: fruit of chin phan thi (a), fruit of Spiny gourd (b), fruit of taw pain ne (c), fruit of joe tha khwar (d), fruit of passion fruit (e), and cross section of passion fruit (f)**


a
b
d
e

Appendix plate 10 **Some of traditional vegetables found in study area: leaves of thit cho (a), leaves of hemp agrinomy (b), plant of mouso nga yote (c), fruit of kazaw thi (d) and (e), whole plant of yone mye (f), fruit of chin kha yan (g), plant of kalar nan nan (h), pith of sago palm (i)**

Appendix plate 11 Some of traditional leafy vegetables found in study area: whole plant of boke htaung (a), leaves of boke htaung (b), leaf of thit cho (c), leaf of kyat shar (d), leaves of da yin gout (e) and (f)