8.1. DISCUSSIONS

8.1.1. **Wild edible plants and fruits:** Consumption of wild food plants formed not only an integral part of the culture and tradition of the tribal and other indigenous communities but also contributes a significant amount to the diet and economy of these peoples. A wide range of wild plant species are consumed by these peoples as green leafy vegetables, roots, shoots, flowers, fruits as well as edible mushrooms. Analyses of the nutritional content has been done in a number of studies (Maundu et al., 1999; Nordeide et al., 1996; Orech et al., 2007; Shackleton et al., 1998; Sundriyal and Sundriyal, 2001) and reported that the nutritional value of many traditional leafy vegetables is higher than several known common cultivated vegetables. Many of these edible plants are rich in nutrient content and formed as good sources of carbohydrate, vitamins and minerals. It plays an important role in meeting the nutritional requirement of the tribal population and other indigenous communities mainly in developing countries of the world. Therefore, analysis of the nutritional value of some of the most commonly preferred and consumed wild plants will help to identify and prioritized species that can be included in traditional agriculture or agro-forestry system based on their nutritional values. These species can also provide ecological security as they are more disease resistance, grow in diverse climatic and habitat conditions and ensure sufficient production despite adverse conditions.

World over, the tribal population still stores a vast knowledge on utilization of local plants as food material and other specific uses (Sundriyal et al., 1998). The Nagas and the Kukis are also not an exception in storing this rich traditional knowledge on plant use. These two tribal communities formed the dominant groups that inhabit in
the hill districts of Manipur. Ethnically, these two tribal groups belonged to the Tibeto-Burman Mongoloid racial stock. They possess rich valuable reservoirs of traditional knowledge on plants used largely due to the prevalence of rich diversity of vegetations as the study area falls in the Indo-Burma global biodiversity hotspot. Also many of these wild edible plant species are found to be sold in the local markets particularly by poor and economically marginalized families, thereby generating a supplementary income to their household economy. This marketing plays an important role in the socio-economic development of any area as it helps serve the people and the region. Although market survey and listing on the use of wild edible plants and fruits have been reported by some workers from Manipur (Singh and Singh, 1985; Singh et al., 1988; Devi et al., 2010; Salam et al., 2010; Jain et al., 2011) and elsewhere in the North eastern region including the Sikkim Himalaya (Samant and Dhar, 1997; Sundriyal and Sundriyal, 2004; Kayang, 2007; Sarma et al., 2010) however more detailed study on the assessment and evaluation of local dependency on leafy wild edible plants and fruits have not been reported earlier and it has been observed that the present study is one of such work involving more detailed investigations on the use of wild edible plants at the local level. Also so far, no such attempt has been made to explore the wild edible plants from the district. Moreover, a fairly good number of these edible plants are also reported to have both therapeutic and dietary functions and hence are used as medicinal food remedy. But the nutritional values and toxic side effects of wild edible plant resources of the region have not been properly investigated and are still remains underutilized. Therefore, the recorded wild edible plants may serve as a baseline data for future studies on nutritional evaluation and possible side effects. It will also be helpful to identify and then prioritize plants that may improve nutritional values and increase
the dietary diversity. Some of these wild edible plants may serve as a potential valuable food sources if brought into cultivation and could be part of a strategy to be used as sources of supplementary food. Further, during interview and discussion with the local elders and young individuals revealed that the traditional knowledge of the use of these wild edible plant resources is eroding among the younger generations. The main reasons for the lost of this valuable knowledge according to the local informants are increasing socio-economic conditions, not organized documented records, changing occupations among the younger generations as they are mostly engage their work in organized sectors rather than in their traditional agricultural activities and introduction of new varieties of agricultural crops. Similar observation was also reported by other workers (Lindeberg et al., 2003; Maikhuri et al., 2004).

With exception of some common and well known used species, a number of lesser known edible plants such as *Rhynchotechum ellipticum* (Wall. ex Dietr.) DC., *Chenopodium album* Linn., *Diplazium esculentum* (Retz.) Sw., *Eurya japonica* Thunb., *Wendlandia glabrata* DC., etc. which have been used as leafy vegetables have no knowledge about its use among many of the young people. This is a serious concern on the preservation and transmission or dissemination of traditional knowledge on the one hand and conservation and management of the region’s biodiversity resources on the other. The concept of biodiversity conservation will be more meaningful only when both traditional knowledge about the use of its local flora is properly recorded and documented along with the preservation and management of the resources particularly the threatened and endangered species in a more sustainable way. A number of publications (Grivetti and Ogle, 2000; Kala, 2007; Maikhuri et al., 2000; Ogoye-Ndegwa and Aagaard-Hansen, 2003) also emphasized the importance of the diversity of wild edible plants and traditional
knowledge on the use of these wild food plants in the search for new sources of food from the wild. Therefore, proper and organized documentation of local plants used is requiring for identification of potential species for prioritization of conservation through sustainable management so that the resources and knowledge can be preserved, managed and utilized. In other words, conservation and sustainable management of wild edible plants and fruits will help to enhance and maintain the regional floral diversity with minimal adverse impact on the biodiversity. North eastern region in general and Manipur state in particular, not much effort or study has been made till date to determine the food potentials or local availabilities of these edible wild plant resources and also the quantum of collection marketed. Hence, no strategy for conservation of this important group of plants has been developed.

8.1.2. **Ethnomedicinal plants**: Traditional medicine or ethnomedicine is a set of empirical practices embedded is the knowledge of a social group often transmitted orally from generation to generation with the intent to solve health problems. It is alternative to western medicine and is strongly linked to religious beliefs and practices of indigenous cultures (Upadhyay et al., 2010). Virtually it forms the basis of primary healthcare in almost all the developing countries of the world. The main reasons for the use of traditional medicine by the indigenous and rural communities are (a) there are cases where local herbal treatment are found more potent and effective than modern drugs and hence local people have faith on plants used as a medicine (b) easy accessibility and availability of local medicinal plants (c) less accessibility or no access to modern drugs due to remoteness of their place of settlement and (d) low financial status of the rural people to afford relatively high cost modern medicine. Usually the knowledge of the used of this herbal medicine is
kept with utmost secrecy by the practitioners because they believe that the medicinal preparations would lose its efficacy when the knowledge is divulged to others. Therefore in most cases the medicine men revealed the knowledge about specific use of a plant to one of the most reliable members in the family or a close relative and this oral tradition of passing the knowledge often continue through down the generations. Similar transferred of indigenous knowledge through oral tradition was also reported by other workers (Jain and Saklani, 1991; Rokaya et al., 2010; Rajkumar and Shivanna, 2009; Uprety et al., 2010) from other parts of India. In other words, since the knowledge has been transmitted orally without any systematic written records, as such there is a high chance that the knowledge is exposed to great risk of disappearance in the future. The main reason could be like dead of the medicine man before passing the knowledge to other members in the family or close relative and also may be in the process correct knowledge is not properly transmitted. For instance, such cases have been reported in Ecuador, where original knowledge on the use of plants had declined due to the lack of systematic knowledge transmission (Bussmann and Sharon, 2006). Further, during interviewed and discussion with the local informants revealed similar cases of losing traditional knowledge partly due to heavy dependent of the local population on modern healthcare system and also because may be the knowledge is not properly pass on to others by the herbal practitioners. In addition, the plant populations are also destroyed from their natural habitats by other anthropogenic activities like deforestation, habitat encroachment through traditional shifting cultivation, forest fires, etc. Thus, in order to protect plants and indigenous knowledge for conservation and sustainable management, there is an urgent need for more documentation, identification and prioritization of important medicinal plants, development of database and proper harvesting
techniques, formulation of cultivation techniques for potential species, community participatory management and awareness programs in the district.

Manipur, which is well known for its rich floral biodiversity with many endemic species and ethnic cultures, requires urgent needs for more ethnobotanical field exploration and study. A large majority of the plants used in local traditional medicine in the state or elsewhere in the region lacks phyto-therapeutic evidences. Therefore it is requires that steps must be taken up to perform phytochemical or pharmacological studies to explore and validate the potential of local plants used in medicine. The present study revealed a rich heritage of medicinal knowledge and high diversity of ethnomedicinal plant from the study area. During the survey, about 120 medicinal plants including 8 species of plant having ethno veterinary importance were recorded. The uses of plants documented in this study were also compared with previously published literatures from other workers in the state and elsewhere were observed and recorded (Table-20). Few plant species such as Clerodendron colebrookianum Walp. ex. Walp., Dicentra scandens (D. Don.) Walp., Gymnopetalum cochinensis (Lour.) Kurz., Panax pseudoginseng Wall., Phlagocanthus curviflorus Nees, Oroxylon indicum (Linn.) Vent., Thalictrum foliolosum DC., etc. used by the tribal people of the district against high BP, fevers, jaundice, gastritis, killing maggots and wound healing in cattle’s have good evidence of effectiveness. The information documented on the medicinal uses of some selected plants does may be used for future studies on phytochemical and pharmacological investigations. Many of the species documented in this study were previously reported to have phytochemical or pharmacological properties. For example the used of Acorus calamus for stomachache and throat problem is
supported by other studies (Devkota et al., 1999; Shinwari and Khan, 2000) mentioning that the stem and rhizomes have antimicrobial properties. *Asparagus filicinus* used for diarrhea has been proven to have significant anti-diarrhea activity (Bopana and Saxena, 2007). The plant *Oroxylum indicum* is used in Asian folk medicine for the treatment of abdominal tumors (Soe and Myongure, 2004). The plant is also reported to have anti-cancer properties (Lambertini et al., 2004; Costa-Lotufo et al., 2005). The rhizome of *Paris polyphylla* is used in traditional Chinese medicine as a haemostatic and antimicrobial (Song et al., 2001; Shanshan et al., 2004). Studies of the aqueous, ethanolic and methanolic extracts showed anticancer activity on several types of cancer cell lines. More extensive phytochemical and pharmacological studies further identified steroid saponins as the main antitumor active components (Song et al., 2001; Ravikumar et al., 1979; Shi et al., 1992). Similiarly *Swertia chiraita* used to cure cough, cold, fever, malaria and headache is mentioned as antipyretic or anti-inflammatory and antibacterial or anti-fungal in other studies (Chowdhury et al., 1995; Devkota et al., 1999; Bharyava et al., 2009).

Modern scientific evaluation of medicinal plants and herbs is mainly concerned with validating the traditional used of plants and identifying the active components of extract and preparation (Palombo, 2006). The information of such traditional uses of plant in medicine can be gathered either from plants used in organized traditional medical system such as Ayurveda, Unani and traditional Chinese medicine (Bannerman et al., 1975; Bannerman, 1979) or from herbalism, folklore and shamanism which concentrate on an apprenticeship system of information passed to the next generation through a traditional healer or herbalist (Rastogi and Dhawan, 1982). Phytochemical analysis and evaluation of pharmacological activity on
Ethnomedicinal plant extracts has resulted in identification of a large number of plant secondary metabolites such as phenolics and polyphenols, alkaloids, terpenoids, essential oils, etc. exhibiting such activity. For example, in one of the studies conducted by Fabricant and Farnsworth (2001), out of the 122 identified compounds obtained from 94 species of plants that are used globally as drugs, about 80% have been demonstrated to have an identical ethnomedical use or related to the current use of the active elements of the plant. Also it is worth mentioned that not all the plant parts contain similar content or concentration of the active constituents. In many plants, different parts contain totally different phytochemical substances (Aburjai et al., 2005; Bruneton, 1999). From phytochemical screening result (Table 22), it is observed that all the plants contain one or the other group of different pharmacologically active phytochemicals such as alkaloid, flavonoids, saponins and tannins. Alkaloids are tested with high amount in the methanolic extracts of Dicentra scandens (D. Don.) Walp. root tuber, Mahonia manipurensis Takeda stem bark and Thalictrum foliolosum DC. root as graded with +++ ve. The local people used these plants for treating fevers, high BP, stomachache, toothache and skin diseases. The antimicrobial properties of alkaloids have been well established. Berberine, a quaternary alkaloid for instant which occur widely in different species of the genera Mahonia and Thalictrum inhibits the growth of many microorganisms including fungi, protozoa and bacteria (Amin et al., 1969; Hahn and Ciak, 1976). This alkaloid is also potentially effective against plasmodia (Omulokoli et al., 1997). The studies further suggest that this substance have shown fever reducing and hypotensive properties causing a reduction in blood pressure (Verpoorte, 1998; Arayne et al., 2007). This perhaps could probably support the information about the traditional uses of these plants in the treatment and management of these diseases by the tribal
communities of the district. Similarly, phenolic and polyphenolic compounds such as saponins and tannins are also detected in high amount in the methanolic extracts particularly in species such as Begonia picta Smith, Juglan regia Linn., Musseandra glabra Vahl, Myrica nagii (non Thunb.) Hook., Potentilla fulgens Wall., Rubus ellipticus Smith, Saussurea deltoidea Linn., Scutellaria discolor Coleb., Costus speciosus Koening Sm., Paris polyphylla Sm., Panax pseudoginseng Wall., Sapindus mukorossii Gaertn., etc. The local people used these plants to treat against gastrointestinal disorders such as diarrhea and dysentery, constipation, stomachache, gastritis, burns and inflammation, fever, tooth ache, ear infection, aphrodisiac and wound healing. Both these classes of compounds are widely distributed in higher plants and many have been traditionally used for a wide range of anti-infective and other pharmacological activities. Tannins are known to exhibits the properties of antidiarrhea, antihaemorrhagic and wound healing activities (Asquith and Butler, 1986; Ogunleye and Ibitoye, 2003). Similarly, biological and pharmacological properties of saponins have been reported in several reviews by different workers with the most recent being Lacaille-Dubois and Wagner (1996); Sparg et al., (2004), etc. Some important biological activities exhibited by saponidal compounds include anti-inflammatory (Just et al., 1998; Li et al., 2002), antimicrobial (Escalante et al., 2002; Konishi et al., 1998; Quiroga et al., 2001), antiparasitic (Traore et al., 2000), cytotoxic and antitumor (Lee et al., 1999; Xiao et al., 1999), etc. Therefore the traditional used of these plants against gastrointestinal disorders such as diarrhea and dysentery, fever, tooth ache and wound healing may be attributed mainly due to the presence of these groups of plant secondary metabolites. Likewise flavonoids, another chemically diverse group of plant phenolic compounds widely occur in different parts of higher plant such as fruits, nuts, seeds, stems, flowers, etc. They
possesses marked biological activities and many of them are formed as active principles of medicinal plants exhibiting wide range of pharmacological effects (Debruyne et al., 1999; Kong et al., 2003; Marles et al., 2003; Yilmaz and Toledo, 2004). For centuries, preparations containing these compounds as the principal physiologically active constituents have been used to treat human diseases. Increasingly, this class of natural products is becoming the subject of anti-infective research and many groups have isolated and identified the structures of flavonoids possessing antifungal, antiviral and antibacterial activity (Cushnie and Lamb, 2005). The present preliminary phytochemical investigation detected that this particular class of compounds are also occur with high amount in plants such as Begonia picta Smith, Myrica nagii (non Thunb.) Hook., Paris polyphylla Sm., Potentilla fulgens Wall. ex Hook., Scutellaria discolor Coleb., etc. Locally, these plants are used for treating such ailments or diseases like cut or external injury, diarrhea, dysentery, fevers and toothache thereby supporting the information of its uses. In other words, activity directed fractionation bioassay is require in isolating and identified the bioactive compounds presents in the plant extract. Also there is possibility that different phytochemical components could act synergistically to produce the observed therapeutic effects. Hence fractionation and separating the individual components may lead to a loss or less effective against the desired activity. Therefore it is worth mentioned that continue examination of those plants used in traditional medicine systems is required not only to verify and validate the scientific basis for bioactivity but also such investigations will enable us to assessed and understand the quality, efficacy and safety of such preparations or extracts. In other words, appropriately designed clinical trials will provide the necessary evidence to support the efficacy of plant that is used in traditional medicine systems.
8.2. CONCLUSION

The study revealed a rich diversity of wild edible and ethnomedicinal plants used by both the Naga and the Kuki tribal communities from the district. The ethnobotanical plants particularly edible wild plants are collected by the local people not only for household used but a good amount of the collections are available for selling in the local markets for household income generation. A total of 100 edible wild plants (63 edible plants and 37 edible fruits) belonging to 60 taxonomic families and 83 genera are documented. 29 species (46.03%) of edible plants and 14 species (37.83%) of edible fruits recorded in the present study are hitherto unreported from the state and are new records from the area. A case study on the assessment and evaluation of local dependency on selected wild edible plants and fruits revealed that there is a high dependency of local community on the wild resources. Analysis of the number of household percent involved in collection on few selected edible plants and fruits revealed that the dependencies varies significantly from species to species in the three localities under study and are ranges from 29.36% (Lentinula lateritia (Berk.) Pegler) to 100% household (Musa sps. and Oenanthe stolonifera Wall.) in case of wild edible plants. Similarly, in the case of wild edible fruits the value ranges from 9.52% to 57.14% for Juglan regia Linn. and Prunus persica (Linn.) Batsch respectively. Also, comparing the percent of total monetary value for each selected species revealed that Lentinula lateritia (Berk.) Pegler generated maximum amount (52.96%) for edible plants while Docynia indica Dcne. (28.75%) contributed the highest total monetary value for edible fruits selected in this study. Further comparison of the quantum of collection and number of households involved in collection of both the selected edible plants and fruits in the three localities showed that Emeifiithumei is highest. This is mainly because of the more accessibility and
availability of the resources in the village vicinity and forest area, low economic status of the villagers as most of them are engage on traditional agriculture farming and hence exerts more dependence pressure on the wild or forest resources, less accessibility to local markets as the village is located about 13 Km away from the NH-39 and hence dependence on outside vegetable products selling in the local markets is low. Also it has been observed and reported during interviewed and discussion with local informants that some wild edible plants such as *Oenanthe stolonifera, Elatostema sessile, Chimonobambusa callosa, Musa* species, etc. are collected more than others from the wild by the local people. They collect these edible plants both for household used as well as selling in the local markets for supplementary income generation. This led to rapid depletion of its population from their natural habitats which are a serious concern and a threat for their sustainability and conservation.

Moreover, a total of 120 different species of medicinal plants belonging to 56 families and 109 genera are recorded to have been used for treating 53 different diseases or ailments. Analysis of the value of informant consensus factor showed that it ranges from 0.62-1.0 indicating that there is a well defined selection criterion of the plants used and also exchange of informations among the different informants in the study area. There has been not report of cultivation of medicinal plants by the local people from the surveyed sites and the preparations are made by collecting the plants from the wild. This is a serious concern from the point of conservation and sustainability of the resources because such collection from the wild may lead to depletion of the population or even extinction of the resources particularly the rare and endangered species if it goes unabated. A good example of such cases recorded
from the district is *Panax pseudoginseng* Wall. and *Paris polyphylla* Sm. Excessive collection of these high value medicinal plants for trade outside the state and region in recent years leads to wipe out of the whole population from their natural habitats. In other words, overharvesting of medicinal plants may have a profound and deleterious effect on critically needed resources (Cordell and Colvard, 2012). Moreover, preliminary phytochemical screening of some lesser known locally used ethnomedicinal plants detected a variety of bioactive compounds such as alkaloids, flavonoids, saponins, tannins, etc. A large number of *in vivo*, *in vitro* as well as clinical studies carried out by various workers are available in literatures and reported that these types of phytochemicals exhibits a wide range of pharmacological activities thereby validating its uses in traditional or folklore medicine. From a total of 23 different species of locally used ethnomedicinal plants selected in this study, alkaloids have been detected in 6 different species, flavonoid and tannin in 18 species each and saponin in 11 different species. Further, phytochemical analysis of protoberberine alkaloids from *M. manipurensis* Takeda stem bark extract resulted in the separation and isolation of two compounds marked as FR-II and FR-III. A comparison of both chromatographic fingerprints of TLC and HPLC as well as with the spectroscopic data of UV and MS spectra of the two fractions with the standards Berberine chloride and Palmatine chloride hydrate showed that the values of these two fractions are very closely match with the two standards indicating that the two fractions isolated in this study are probably to be of these two compounds.
PLATE-I: Showing study area. (A) General view of part of the district (B) View of Kodzi-ri forest in the foot hill of Mt. Tenipu (Esii) (C) Liyai Khullen (D) Maopondung (E) Emeifiithumei
PLATE -II

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H
PLATE-II: Showing marketable wild edible fruits (A) *Prunus nepalensis* (B) *Docynia indica* (C) *Juglan regia* (D) *Rhus semialata* (E) *Spondias acuminata* (F) *Emblica officinalis* (G) *Myrica farquhariana* (H) *Elaeocarpus floribundus* (I) *Calamus floribundus* (J) *Baccaurea sapida* (K) & (L) Shops selling varieties of wild edible fruits at Mao Gate
PLATE-III: Showing wild edible fruit plants from their natural habitats (A) *Viburnum foetidum* B) *Castanopsis tribuloides* (C) *Spondias acuminata* (D) *Diospyros kaki* (E) *Rubus rugosus* (F) *Emblica officinalis* (G) *Juglan regia* (H) *Rubus ellipticus*
PLATE-IV: Showing some wild edible plants growing from their natural habitats
(A) Oenanthe stolonifera  (B) Acacia oxyphylla  (C) Momordica dioica  (D) Rhynchotechum ellipticum  (E) Diplazium esculentum  (F) Polygonum molle  (G) Elatostema sessile  (H) Solanum spirale
PLATE-V

A

B

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PLATE-V: View of the Sellers selling different vegetables in the markets. A, B & C Senapati market; D & E (Arundinaria callosa), F & G (Rhus semialata and Schizophyllum commune) Motbung bazaar; H (Lentinula lateritia), I (Auricularia delicata), J (Zanthoxylum armatum) & K Mao Gate; L (Litsea cubeba), M (Eurya acuminata) & N (Trichodesma khasianum) Kangpokpi bazaar.
PLATE-VI: Some locally used ethnomedicinal plants from their natural habitat (A) Mahonia manipurensis (B) Paris polyphylla (C) Dicentra scandens (D) Costus speciosus (E) Clerodendron colebrookianum (F) Acorus calamus (G) Oroxylon indicum (H) Mimosa pudica (I) Gymnopetalum cochinensis (J) Panax pseudo-ginseng (K) Scutellaria discolor (L) Thalictrum foliolosum (M) Melia composita (N) Spilanthes acmella var. oleracea (O) Melothria maderaspatana (P) Drymaria cordata (Q) Paederia foetida (R) Viscum articulatum (S) Potentilla fulgens (T) Lygodium japonicum (U) Pratia begonifolia (V) Ricinus communis
PLATE-VII: Interview conducted with the local informants and some local herbalists (A) Maopondung (B) Upper Khabung (C) Liyai Khullen (D) Herbalists Kaikholam Lhungjang (left) and Seikhosat Paolalam (centre) in Motbung (E) Changloubung (F) herbalist Sani Maikho (left) along with one local informant in Paomata Centre (G) Herbalist Sheli Asor diagnosing a patient in Karong (H) Collection of *Mahonia manipurensis* plant for chemical analysis
PLATE-VIII: Some selected locally used ethnomedicinal plant parts for phytochemical screening (A) Costus speciosus rhizome (B) Dicentra scandens root tubers (C) Mahonia manipurensis stem bark (D) Panax psuodo-ginseng rhizome (E) Paris polyphylla rhizome (F) Oroxylon indicum stem bark (G) Begonia picta root tubers (H) Curcuma aeruginosa rhizome
PLATE-IX: Phytochemical screening results of selected ethnomedicinal plants (A) & (B) flavonoids in *Potentilla fulgens* and *Paris polyphylla*; (C) & (D) saponins in *Costus speciosus* and *Paris polyphylla*; (E), (F) & (G) tannins in *Rubus ellipticus*, *Juglan regia* and *Oroxylon indicum*; (H) & (I) alkaloids in *Mahonia manipurensis* and *Dicentra scandens*; (J), (K) and (L) TLC of alkaloid fractions