CHAPTER-1

INTRODUCTION

INTRODUCTION – 1

Among all the health centers in the world that use medicinal plants as sources of their medicines, India is one of them. The plants that are utilized for manufacture of Traditional systems of medicine all over the world are termed as “Medicinal plants”. Owing to effective and chemical free treatment, the Traditional system of medicine has been adopted. Since ancient times, India has been a land of high depository of medicinal plants and the traditional knowledge of their benefits. According to a report, traditional medicine is the only available source of health care for 65% of India’s population. In Ayurveda, around 8000 herbal therapies have been reported and 67, 81, 290, 1100 and 1270 number of medicinal plants species has been recorded in *Rigveda*, *Yajurveda*, *Atharvaveda*, *Charak Samhita* and *Sushrut Samhita* respectively. Out of 17,564 plants, 5200 plants have been recognized for veterinary, human and plant health care in Ayurveda. Ranging from trans-Himalaya down to the coast, the medicinal plants are scattered all over different types of vegetation, forests and a variety of geographical regions. As per the reports of World Health Organization (WHO), 80 % of the world's population depends largely on traditional medicine as their primary health care remedy.

The medicinal plants form an integral part of the biodiversity. Their contribution and therapeutic values to the forestry sector has been realized lately. Forests and wild habitats are home to around 85% of medicinal plant diversity of India. According to Ved and Goraya (2008), 82% of high consumption botanicals in trade originate from wild sources. This fact arouses interest and concern about the medicinal plant resources in the forests. Medicinal plants are the pillar of local poor village people especially for fulfilling their health needs along with Ayurveda, Unani, Siddha and Homoeopathy. A large number of medicinal plant species formulate thousands of home remedies and several classical drugs. Medicinal plants

are of three types basically:

a. Preventive

b. Promotive

c. Curative

It is estimated that of the total medicinal plant diversity, more than two-third are used for promotive and preventive uses and rest for curative purposes. Promotive and

Preventive purposes overrule the curative purposes, which we use in the form of cosmetics, eye care, skin care, dental care, beauty care and many other utilities for all round health care. As household practices, medicinal plants take care of water purification, fumigation and sanitation. During festivals and rituals, some specific medicinal plants serve several purposes to the communities performing them. They too constitute in the season's special diet and preparations pertaining to several occasions and celebrations throughout the year.

Several local communities have formulated their lifestyle with hundreds of traditional therapies and medicinal plant remedies. The Traditional system of medicine has been broadened with the view of their applications based on region and community specific medicinal plants. Some of the specialized fields of health care viz., childcare, traditional birth attendants, antidotes against bites of poisonous organisms, bone setting, and mother and postnatal care.

In India, different clinical and medical streams held a diverse variety of medicinal plants that are listed in Table 1.

Table 1: Medicinal Plants diversity across various medical streams

	Ayurveda	**Folk**	**Homeopath**	**Modern**	**Sidha**	**Tibetan**	**Unani**
Ayurveda	**2351**	900	189	80	1028	341	880
Folk	900	**5137**	164	86	971	235	573
Homeopath	189	164	**506**	100	167	77	173
Modern	80	86	100	**204**	65	25	75
Sidha	1028	971	167	65	**1785**	277	641
Tibetan	341	235	77	25	277	**350**	275
Unani	880	573	173	75	641	275	**979**

Medicinal plants are marked as a contributor of industrial resources as well. Apart from natural pharmaceuticals, they are well known to us as cosmeceuticals and nutraceuticals too. Podophyllotoxin, Artemisinin, Vincristine, Camptothecin, Paclitaxel, Vinblastine etc. are major plant products and derivatives of drug industries. Around 80% of such products preferred in the pharmaceutical industry are of plant origin (Somashekhar,

2011). Thus, not only they guide us therapy and remedy for several diseases but also displays a huge economic role too on the basis of foreign currency, employment generation, trade turn over, value chains and to all round economy.

The drug industry in the international market as well has high popularity and sound revenue. In 1997, the retail sale of pharmaceutical products globally was calculated as US$ 80-90 billion approximately. In 2000, the well- known drug Taxol from one plant species *Taxus baccata* was estimated to have a net retail sale of US$ 2.3 billion. The net annual worth from pharmaceuticals in India is estimated to be rupees 8800 crores and the yearly demand of medicines was calculated to be 319,500 MT, as per the census of the year 2005-2006.And the yearly business value of these drugs are restricted to rupees 1069 crores, as per the census of 2008.

All these facts throw light on how medicinal plants and the pharmaceutical industries rule the world with its high turnovers and huge profits. Some important results have been observed in India considering the medicinal plants involved in the industry and the drugs traded. According to Ved and Goraya (2008a,b), greater than 960 medicinal plant species are utilized for trade in the country and 1289 raw drug forms of these species are in use. Now out of these 960 species, 178 species are introduced to high volume trade and each registering a trade of greater than 100 MT per year.

Medicinal plants which contribute as raw materials to the medicine manufacturing industries are significant members of forests. Industrialization from these industries coupled with urbanization poses a huge threat to the organisms of the forest since it leads to soil erosion and thus the natural habitat losses MAPs biodiversity from the area. Climatic factors and Global warming also are the key factors to this loss. The tropical forests which have been the homeland for plant and animal diversity have been reported to have been lost by about 50%. The annual rate of the disappearance of forest cover in India is estimated to be 1.5mha/yr. Several key medicinal plants are near to the edge of extinction while several others are just a step away from being extinct. Thus, it is advisable to not only develop means to conserve these precious gems but also develop cultivation methods for the increasing demand in industries and household purposes. There is an urgent requirement of transition from collection to cultivation of MAP to ensure authenticity, sustainable supply and purity of raw drugs.

There has been enforcement of several laws and acts regarding environmental protection. Some among them are: Wildlife Protection Act-1972, Environmental (Protection) Act-1986, The Biological Diversity Act-2002 etc. The Govt. of India, with the help of National Medicinal Plant Board, enforced a law of establishment of in-situ and ex-situ conservatory. Apart from performing in-situ and ex-situ conservation and cultivation, these conservatories help in the cultivation of these plants to the cultivars and peasants.

Along with the flourishing drugs and high trade and commerce that these plants produce, they also throw light to the risks that they are in due to their high demand and pressure. Especially the international industries for the sake of export purposes worth millions refer to the forests and medicinal plants as the source of drugs. The topmost pressure of these life saving jewels is their high demand in the market. Thus, the survival of these jewels gets hampered with its huge requirement, thereby supplementing the needs of so many. Owing to high requirements leading to high volume extraction, damaging methods of harvesting are switched to produce within the minimum amount of time. These methods initiate high threat to the plant population and hamper the future plant generations as well, thereby affecting the population's total quantum of raw material.

To make both ends meet, cultivated sources produce less raw drugs. Among 178 medicinal plants that have a record of high-volume trade of greater than 100MT per year, 36 of them are known to be acquired from cultivated sources. Of these 36, Henna, Isabgol (*Plantago ovata*), Aswagandha (*Withania somnifera*), Senna (*Senna* sp) are reported to be cultivated at a high rate in comparison to others. Besides these, Aloe (*Aloe barbadensis*), Sweet flag (*Acorus calamus*), Muskdana (*Abelmoschus moschatus*), *Adhatoda zeylanica* have facilitated their entry in local agricultural systems.

In North India, the cultivation of Amla (Goose berry, *Emblica officinalis*) is done in sizable plantations. According to the Amla growers' association, out of the total production, only 60% finds their usage in the pharmaceutical industry and the remaining 40% are sent for preparation of culinary products like candies, juice, pickles and jam.

Some other species such as Tulsi, Long Pepper, Neem, Guggul and Sweet Basil are known to be present in the same way as Amla that is in sizable plantations. Whereas, Coriander, Black Pepper, Nutmeg, Cinnamon, Cardamom and Clove originated from

the cultivated sources. Besides these examples, owing to supply of raw materials, pharmaceutical industries usually facilitate cultivation in small holdings.

Therefore, it is quite evident that the medicinal plants are attributed to different levels of threat and often affecting their very existence. Some species have become extinct while the population size of some species reduced drastically leading to scarce product availability.

This has been an alarm to us to preserve the base of medicinal plants. There has been an urgent need to set up conservation strategies.

Foundation for Revitalization of Local Health Traditions (FRLHT) initiated exercises for fast threat assessment based on IUCN Red List Categories and Criteria. Based on this methodology, the threatened species were recognized, and their threat status was assessed in 17 different states of the country. Therefore, India's "First list of Threatened species of Medicinal plants" came into being holding a record of 326 threatened species of medicinal plants along with their assigned threat status.

The medicinal plants which are at the verge of extinction are recorded in the Threatened List of Medicinal plants. But the need is to establish a model that would facilitate their conservation. The conservation models of medicinal plants have not been an easy task in comparison to the conservation models of wildlife and biodiversity. For the conservation model to formulate there has been a high requirement of information, such as population size and density of medicinal plant population, the threats to their life, their regeneration ability, propagation techniques, the critical socio-economic elements operating in their habitat, the management issues etc. Thus, it is difficult to construct a conservation model keeping in mind so much information.

1.1. Origin of MPCAs Concept

This rare, endangered and threatened list of valuable medicinal plants offers a list of prioritized medicinal plants in our country, which need conservation and proper utilization. But the challenge is to find a valuable replica that ensures their conservation. While there are experienced conservation models obtainable in respect of wildlife and many other forms of biological diversity. The current understanding of the entire whole scenario is not so comprehensive, and it is rather challenging. Information about natural distribution and size of medicinal and aromatic plant populations, the causes and kinds

of threats, which affect such populations, the issues, related to their regeneration. The critical socio-economic rudiments that operate in a habitat.

However, a compelling model appears in the form of MPCAs. The term MPCA (Medicinal Plants Conservation Area) denotes a forest patch or area of about few hectors selected for conserving distinctive populations or diversity of medicinal plants in their wild natural ecosystem. The MPCAs model is thus an *in-situ* conservation initiative in which the populations are acceptable to flourish, while the conventional forestry administration operations are kept to minimum (FRLHT, 2006).

Govt. of India has reported that for 65% of its population utilizes traditional medicines is the only available source of health care through various herbal modes. Across the various ecosystems, local communities know the use of around 8,000 plant species out of 17,564 species. These medicinal plants are distributed in all bio-geographic regions, vegetation types & landscape in this country. Owing to raising trend in demand of herbal products, there is a possibility of increasing tendency of indiscriminate & unrecorded removal of medicinal plants from the forests. Therefore, the medicinal plants need to be conserved in their natural forests habitat & thus the idea conceived as formation and establishment of MPCA (Medicinal plant conservation Area).

1.2. About MPCAs

At present, this conservation model has been made possible and formulated in the form of MPCA (Medicinal Plants Conservation Area). The term MPCA (Medicinal Plants Conservation Area) refers to a patch of forestland of about 200 ha for the purpose of conservation of diversity of medicinal plant populations in their own natural habitat. This is an in-situ practice where the conventional forest practices are minimized, thereby allowing the medicinal plant populations to flourish.

This sound initiative was first established in Karnataka, Kerala and Tamil Nadu in 1993, whose funding aided by DANIDA (Danish International Development Aid, Netherlands). Along with the joint collaboration of the state forest departments of Karnataka, Kerala and Tamil Nadu, FRLHT facilitated the recognition of MPCA's in 34 forest sites across south India from 1993 to 2004.

Some of the salient features of MPCA's are as follows: -

1. The minimum area must be 200 ha. at least.

2. Can nurture different local health traditions of the region.

3. Abundance of medicinal plant diversity along with viable breeding population.

4. Restricted area for human interference and forestry operations.

5. Vegetation profiling, sustainable harvesting, propagation of medicinal plants and other conservation strategies are set up.

6. Species are also conserved that are present in this region.

The idea of establishment of MPCA's been quite magnificent and has been instrumental to meet the conservation outcomes. Among them, the swift transition and change in the forestry operations was quite noteworthy. Looking at the conservation initiative of MPCA in South India, the forest managers all over India started to realize the need of conservation of medicinal plants in the forestry sectors. The timber and wildlife focused conservation strategies gradually extended medicinal plants as well. Therefore, the MPCA program brought in a fresh air of realization and facilitation of newly modified conservation strategies in the forests of India.

With the grand success of the novel initiative of the MPCA program, all forest areas started adopting this strategy in the long run, By the end of 2011, 112 MPCA's were developed across several forest areas in the country.

Moreover, the Initiatives of FRLHT threw light on many areas that were formerly associated with adulterants. The MPCA also widened the view of supply, trade and demand of medicinal plants, variety of folk medicinal therapies and documentation of herbal remedies of the traditional knowledge.

Some of the conservation outcomes of MPCA are as follows: -

a) Combined the lists of state wise medicinal plants.

b) Exhibited methodology of CAMP for assessment of threat of medicinal plants

c) Visualized adoption of IUCN threat categories.

d) Validation of botanical identity of medicinal plants with the help of making a correlation of the local names in 13 different languages along with their accepted botanical names.

e) A Multi subject database on Medicinal plants of India has been constructed to ascertain the ecology and reproductive biology, images of raw drug, geographical distribution, herbarium and distribution maps, medicinal uses, botanical profile and propagation.

f) The National Herbarium of Medicinal plants recognized Exclusive Herbarium of Medicinal plants of the Country.

g) Different Forestry Training Institutes facilitated Training module capsules pertaining to Conservation of Medicinal plants for the frontline forestry staff and NGOs.

h) Information and Communication products pertaining to Medicinal plants and Medicinal applications.

Some of the challenges awaiting for the MPCA's are as follows: -

- There are still a lot of red listed threatened species that need to be brought under MPCA. Thus, for this purpose, the MPCA network needs to be expanded.
- Facilitation of Open-Air Centre for Conservation education and learning and formulate links to educational and research institutes.
- Setting up population studies of selected Red listed species.
- Taking up reconnaissance surveys of selected Red listed species.
- Initiating Status surveys of selected Red listed species.
- Studying the Harvesting and Collection-Produce Flow-Market links of species that are in high volume trade with the help of small-time market studies.
- Development of small-time field studies to tabulate additional field data on Seed biology of red listed species.
- Undertaking small time field studies to obtain additional field results on Phenology and Reproductive biology.
- Producing substantial examples and case studies to surplus the understanding of medicinal plants.

- Taking up studies to facilitate the propagation of medicinal plants.
- Undertaking species recovery initiatives.
- Encouraging studies to realize the cultural links of medicinal plants.

1.3. MPCAs-Global Scenario

Medicinal plants play an important role in supporting the healthcare system viz Siddha, Ayurveda, Unani, Allopathy and Homeopathy system of medicines. According to the World Health Organization (WHO), 85% of the rural population in developing countries utilizes locally accessible medicinal plants for their major healthcare needs. About 8500 species of medicinal plants are used by the traditional system of medicines, local communities and tribal people all over India. About 92% of the country's medicinal plants are found in medicinal plant conservation areas (MPCAs). *In-situ* conservation sites of medicinal plants are established in other countries also such as Zimbabwe, Sri Lanka, Jordan, Egypt, Ethiopia, Central America and Caribbean.

1.3.1.MPCAs –Indian scenario

In 1993, India led a marvelous initiative through an NGO called Foundation for Revitalization of Local Health Traditions (FRLHT) along with State Forest Departments in India to establish *in-situ* conservation sites for important medicinal plants known as Medicinal Plants Conservation areas (MPCAs). It was important to initiate MPCAs as medicinal plants are allied to health and livelihood protection of ethnic and rural people. Considered as a pioneering *in-situ* conservation effort, currently a network of 106 – 108 MPCAs are operational across 11 – 12 states in India. The MPCAs are established in biological diversity areas such as Himalaya, North-East India and Western Ghats, covering different bio-geographic regions. Apart from biodiversity and natural heritage, few MPCAs have cultural, historical and religious significance also. There are 72 MPCAs already established by NMPB across 13states (Biswas et al., 2017).

Out of 19,530 species of Angiosperms recorded in India (Vatsavaya et al 2010), West Bengal is having 3,691 species (21.36%), spread over 11 Forest Types of the State out of 16 Forest Types found in India, covering Littoral and Swamp Forests the Mangroves of Sundarban to Northern Montane Wet Temperate Forests of Darjeeling. The floral diversity of Bengal exists over four distinct Biogeographic areas ranging from Eastern Coast to Central Himalayas and represents a wide range of rare, endangered, threatened

and endemic flora (Govt. of West Bengal, 2010). On the basis of recommendations of CAMP meeting, considering the Forest Types and Biogeographic Areas seven MPCAs, representing at least one flagship species in the MPCAs, have been created in West Bengal (Fig. 1, Table 2) under the Project. Established MPCAs are Garpanchkot (250 ha) and Bonnie Camp (300 ha) in Silviculture South Division of Sundarban. Tonglu (230 ha), Dhotrey (180 ha) in Silviculture Hills Division; North Sevoke (100 ha), North Rajabhatkhawa (400 ha), Sursuti (100 ha) in Silviculture North Division. MPCAs have been recommended to be managed as "hands off " vital areas with certain interventions to encourage identification, natural regeneration, preservation, monitoring etc. by involving Forest Protection Committee Members (FPCM) through awareness and confidence building exercises.

Table 2: Details of seven MPCAs established in West Bengal

Name of MPCA	**Year Established**	**Forest types**	**Area (ha)**	**Latitude**	**Longitude**
Bonnie Camp	2008-09	Littoral and Swamp – Mangrove (4B)	300	21° 83'	**88° 63'**
Dhotrey	2008-09	Montane wet temperate (11B)	180	27° 05'	**88° 07'**
Garpanchkot	2008-09	Tropical dry deciduous (5B)	250	23° 63'	**86° 77'**
North Rajabhatkhawa	2008-09	Tropical moist deciduous (3C)	400	26° 68'	**89° 55'**
North Sevoke	2008-09	Tropical moist deciduous (3C)	100	26° 87'	**88° 45'**
Sursuti	2008-09	Tropical moist deciduous (3C)	100	26° 63'	**86° 77'**
Tonglu	2008-09	Montane wet temperate (11B)	230	27° 03'	**88° 08'**

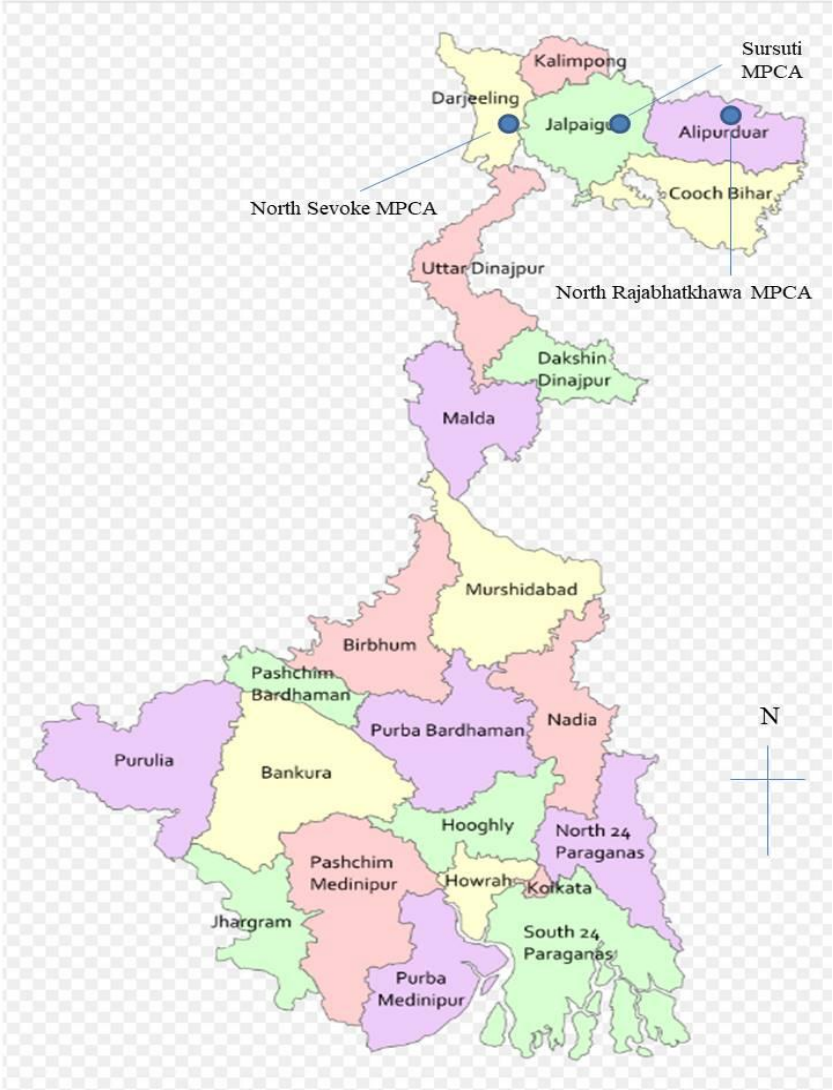

Fig. 1: Location map of seven MPCAs in West Bengal (Source: www.google.co.in)

1.4. Importance of MPCAs

The use of plants in order to achieve a medicinal purpose is called alternative medicine (AM). AM has been used in all cultures particularly Asian and western culture. Unfortunately, most people nowadays still believe that the only trusted and effective medicine is the medicine that has a dosage form. Several mostly used pills or capsules consumed daily coming originally from plant compounds such as Aspirin, Paclitaxel, Digoxin, and many more. In the past, our ancient ancestors used plants and herbs to preserve and flavor food, reduce pain, treat headaches, and even prevent diseases including epidemics. The traditional knowledge on healing properties of medicinal

plants has been transmitted over the centuries within and among human societies. Active compounds formed during secondary metabolism are mainly responsible for the important biological properties in plants used in various purposes, including treatment of infectious diseases throughout the globe. Currently, many studies are warning people about the risk and danger of pathogenic microorganisms that have become resistant to discovered antimicrobials. Information on the antimicrobial activity of numerous plants active compounds are scientifically confirmed, hence, still numerous studies are needed to understand the antimicrobials compounds and the mechanisms involved in microbial growth inhibition. Several institutions, including TFRI, ICFRE, the FSI, the BSI, and CIMAP, have conducted medicinal plants surveys revealing continuing losses of the biodiversity resource base (Tiwari and Rani 2004).

The State of West Bengal is a mega Biodiversity State, having 3,580 Species (21.33%) spread over 10 forest types of State out of 16 forest types found in India. It is also well known that Biodiversity and species richness is more in Northern part of Bengal in comparison to Southern part of Bengal. Considering the fact, an assessment was made by the forest department of Wet Bengal with the help of group of expert Botanists, FRLHT (NGO) and other experts related to this field and on the basis of their recommendation during 2008, Seven MPCAs (Medicinal Plant Conservation Area and Table 2) have been established and 46 medicinal plant species have been identified as flagship species, out of those seven MPCAs, three MPCAs (i.e. North Rajabhatkhawa MPCA, Sursuti MPCA and North Sevoke MPCA, Fig. 1) representing unique biodiversity and very rich medicinal plant resources in Terai & Duars region of West Bengal. The area is also covered under IUCN recognition as Himalaya Hotspot for Conservation (Conservation International 2005). Considering the diversity and species richness, three MPCAs i.e. North Rajabhatkhawa MPCA, Sursuti MPCA and North Sevoke MPCA have been chosen as study area. Preliminary study has been done over the area by North Bengal University, Botany Dept. in collaboration with West Bengal Forest Department, Research Wing and recorded presence of huge number of medicinal plant potential. The study area of all three MPCAs have been chosen in Biodiversity or Conservation working Circle maintained under the management of working plan of West Bengal Forest, so that there will be no manipulation by any management practice in future also. Therefore, the MPCA study area shall remain undisturbed. There are illegal collector and traders are involved for illegal trading of medicinal plant resources.

In order to prevent such huge exploitation of natural resources following conservation strategies have been adopted:

1. *In-situ* & *ex-situ* conservation of medicinal plants over the areas.
2. Cultivation of economically important medicinal plant with the help of Registered Forest Protection Committee inhabiting the adjoining forest.
3. Forest Protection Committee (FPC) members realized their own wealth available in their adjoining forest. Strategy has been adopted for cultivation of some economically important medicinal plants with by back strategy in consultation with reliable drag industry and cultivation will be done strategically so that FPC members can have ensured income & thus the system in turn will automatically minimize illegal harvesting of medicinal plants from natural habitat. Thus, our target MPCAs resources will be conserved and preserved.
4. Also, to arrange some training facility and installation of storage go-down to facilitate processed or semi-processed medicinal plant products as harvested from cultivation will help them on way to marketing. This strategy will help FPC members to get healthy & ensured economic return and also conserve plant resources in natural habitat (MPCAs).

Many medicinal plants are reported as threatened species and even some of them are on the verge of extinction due to over exploitation. It has also been felt that the threat to species increase as the people become aware of their uses. It is, therefore, vital to protect, conserve and propagate the medicinal plants occurring in the forest areas. It is only the forest areas that can successfully ensure a long term *in-situ* conservation and sustainable availability of the medicinal plants. For this purpose, earlier Medicinal Plants Conservation Area (MPCAs) and presently Medicinal Plants Conservation Development Areas (MPCDAs) have come into the existence for conservation & management of medicinal plants in their natural habitats.

OBJECTIVES OF THE PROPOSED WORK

The principal objectives of the proposed dissertation are listed below:

1. Present status of medicinal plants with complete taxonomic revision at three MPCAs, North Bengal plains.
2. To determine the community and population structure of Medicinal plants within the MPCAs
3. To know the soil quality of MPCAs.
4. Record of traditional knowledge on the utility of different species of medicinal plants
5. Threats and conservation of medicinal plants of MPCAs.