



INNOVATIVE INTEGRATED TRAINING IN
HEALING PLANTS
BUSINESS

IO3 - The Total Business Plants Training Material

Module No. 1

“Organic cultivation of medicinal plants”

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3 Unit 3 Introduction of protected and endangered MPs into cultivation – impact on biodiversity

- Summary

Unit 3 deals with the introduction of protected and endangered MPs into cultivation and their impact on biodiversity. The influence of Bad Cultivation Practices on MP production and yield, and the cultivation of MP on commercial farmlands and private land are discussed. The main challenges in protection of valuable medicinal plants and production-oriented dynamic preservation of threatened MP are also outlined.

- Learning outcome descriptors

By the end of the Unit, the trainee should be able to:

- ✓ **Knowledge, understanding and professional skills:**
 1. Discuss difference between wild and cultivated plants, advantages and disadvantages.
 2. Explain different methods of organic cultivation and preservation of medicinal plants
 3. Assess the main challenges in protection of valuable MP
- ✓ **General and transferable skills:**
 1. Plan a research task.
 2. Work independently or with a minimal guidance where appropriate.
 3. Work in team with minimal guidance where appropriate.
 4. Show good written and oral communication skills.
 5. Demonstrate computer literacy
 6. Perform online (computer) search to develop information technology skills in order to retrieve information from a variety of sources.

3.1 Introduction

Medicinal Plants (MP) are useful natural resources, which over-exploitation can cause shortage of various herbs and suppression of the development of several species in nature. To meet the rising quest for these plants, it becomes very substantial to conserve the above mentioned species either by a way of large-scale cultivation or through forest conservation measures for their sustainable use. The accent should be on the cultivation of the medical plants as regular crops, instead of collecting them from the wild in order to guarantee the botanical identity, genetic improvement, quality and continuity in supply.

3.2 Wild or cultivated plants

From the beginnings of agriculture, the opinion for medicinal efficacy of wild plants is diminished or absent after cultivation is performed. The question about wild versus cultivated seems as old as the practice of agriculture itself. By theory, the cultivation of wild plant species is linked with gene pool diminution, sometimes drastically. In fact, depending on the mode of the plant reproduction and the number of individuals produced during original selection from the wild, the plant's ability for adaptation to variation of conditions and to withstand healthy may be compromised.

The biodiversity also could be affected and can influence the plant quality. In general, the wild ecosystem is used as a model for establishment agricultural conditions. The majority of conventional agricultural practices diminish the numbers and varieties of soil microorganisms. As the plant nutrition depend strongly on the metabolic byproducts of millions of other (micro) organisms living in this environment, a reduction in microflora biodiversity in the environment will affect plant health.

3.3 The influence of Bad Cultivation Practices

The "wild or cultivated" problem runs very deep and dues to alter the perception of the relationship with nature. In case of human population, activity has influenced wild habitat, many medicinal plants have become sparse or peril and many people consider the cultivation of medicinal plants as an ecological problem.

Throughout the development of this process of cultivation, a spectrum of practices has been introduced, from pre-agricultural gathering to high-tech industrial agriculture. During this process, the biodiversity in the agricultural ecosystem does not correlate to the degree of industrialization. If a crop possesses minimal genetic diversity it can easily be wiped out by a single type of predator.

The human trend to make, in order to save labor, a profit, and thus neglecting nature principles, works against people over the long term. All these practices devoted to quick profits in industrial agriculture are not reasonable. These are pedigree breeding and monoculture, systematic elimination of microorganisms due to the use of unnatural fertilizers, herbicides, and fungicides; genetic engineering, etc. In addition, the seed companies' merger caused continuous loss of biodiversity over the past century. In order to repair this damage, it is necessary to learn the natural requirements for plants cultivation. This challenge comprises a new awareness and respect for natural processes and can be realized through implementation of scientific advances.

3.4 Cultivation of MP on commercial farmlands and private land

The cultivation of MP on community lands is well established. There is also good processing and marketing expertise available. The easy access to resources as well as to international and traditional markets is organized. Additionally, the robust nature of some of these crops to stand testing weather conditions contributes to the positive income of these activities. However, the cultivation of MP on commercial farmlands is not that large as needed.

The demand for medicinal plants is large and increasing at a fast rate. The provision of such plant material is not as much as is required by the pharmaceutical industry. The supply is not adequate and it is considered that a useful approach to enlarge and strengthen this supply is to provide cultivation of medicinal crops on private land. Besides, many pharmaceutical companies have started to contract the cultivators directly by providing planting material and know-how.

The cultivation of medicinal plant species by farmers on private land was considered as useful in many regions because it brings increase in both the income and the employment. The cultivation process is performed for indigenous plant species, as well as for completely new crops for these districts of land.

Various case studies with farmers and manufacturers indicated important factors that justify cultivation of medicinal crops on a commercial scale. The major ones are as follow:

- Remarkable range of the demands and stable economic forecasting for growing demands;
- Culturally well-embedded cultivation practices;
- Better relative income for the farmers from MP cultivation in comparison with other crops;
- Better output in cultivation of MP in comparison with other crops, since the cultivation of the former requires fewer resources and is relatively easy;
- MP provide guaranteed markets and prices;
- MP generate larger employment than the seasonal crops; however, specific investments are often essential to start production and the return on investment is less predictable.

It is obvious that the cultivation of MP on both commercial farmlands and private land is necessary to cover the provision of quality raw material to the industry on one hand and to conserve the species identity on the other. MP producers and processors generally agree that marketing opportunities do exist but there are many problems to be solved and increased governmental support is clearly needed.

The main problems are:

- Lack of commercially manufactured specialized machinery;
- Lack of suitable storage and drying facilities;
- Lack of commercially available seeds of high quality (high-yielding cultivars)
- Lack of knowledge on crop-specific management (especially fertilizer requirements);
- Lack of approved herbicides/pesticides and harvesting techniques;

- Commercial problems sometimes outweigh the feasibility of cultivation projects due to marketing reasons.

3.5 Conservation methods

Different methods are used to avoid potential danger and existing threats to MP species. These are *in situ* and *ex situ* conservation techniques. The conservation method is determined by the biological peculiarities of the species and their sources of raw material. According to the source of raw material, MP species have been divided into three groups: sufficient, limited and insufficient.

- The species with sufficient sources of raw material are exploited like common species.
- Widespread species are characterized by a large phenotypic diversity but with low sources of raw material. Wild populations of these species are not endangered in their natural habitats. Nevertheless, sampling of their diversity has been initiated to ensure their further use in breeding.
- Species with low sources of raw material and narrow ecological adaptation are difficult to introduce into cultivation. This group of species includes rare and endangered plants.

3.6 Challenges in conservation of medicinal plants

3.6.1 Improving the conservation of medical plants through agriculture

The industrial agriculture spread intensively during the 20th century, and consequently, the understanding about the necessary changes in the natural policy context. The development of ecology in the second half of the 20th century contributed to the changing views of humans in nature. The work of the ecological scientists and created innovators in ecological agriculture offers a series of practices known as Nature Farming.

A special attention was given to the cultivation of perennial plants for food called Permaculture (“permanent agriculture”). The Permaculture and other ecological practices, consider wildness as an essential feature in preserving biodiversity and the capacity of the system in adaptation to changing conditions.

Wildness can be created in small scales like hedgerows dividing fields or in bio-strips among rows in a mixed cropping system. Meanwhile, the re-creation of wildness has become the tool for amazing innovation in the current times.

3.6.2 The conservation and the re-creation of wildness

The recent years highlight the concept of the value of wildness and biodiversity to help for understanding about how individual species contribute to the whole. It became apparent that the interactions of a wide variety of species create a dynamic, self-regulating system that takes on a life of its own. Thus, life seems to attract life. The presence of the “pests”, do not influence the healthy plants and the balance of the particular ecosystem approximates that of the wild. Therefore, the existed destruction of MP habitat as

well as other related worldwide threats, pose the question of how to preserve the conservation avoiding further breakdown?

Therefore, the existed destruction of MP habitats as well as other related worldwide threats, pose the question of how to preserve the conservation avoiding further breakdown? It is necessary to assign the value of a threatened species in order to save it because it will be easier than further to develop value. Nevertheless, the so-called “wild-simulated” or “wild-cultivated” methods are even more closely related to nature.

3.6.3 Conservation through protection

Conservation of MP can be influenced by their protection status. There are two important factors that must be taken into consideration: the harvesting restriction laws concerning certain species; and the amount of material needed for propagation, cultivation, and sustainable harvesting. In some cases, the conservation of MP species by protection is working well. In protected areas, the species come under less threat from illegal harvesting by MP gatherers. There is also less evidence of ring-barked medicinal plants, in protected than in unprotected places. Successful conservation through the protection of species has been implemented in some important places like the Kruger National Park, Hluhluwe Game Reserve, and Mkhambathi Nature Reserve. However, this approach cannot be effectively implemented everywhere, as it shows some drawbacks for MP gatherers. For this reason, a continuum model of managing MP that starts from the wild, without cutting or stepping, was worked out by communities. This model requires no labor in managing the plant species. On the contrary, it is grounded on the assumption that if the species is of people concern, weeding can take place while the species is in the wild. Although, this requires energy input, weeding of protected MP enables management in their own growing environment and thus, contributes to their conservation.

MP conservation through protection has also social perspective. Traditionally, women are the main player in medicinal plants-based activities of micro-enterprises as they fit easily within their work schedules. These activities often represent the collection and transportation of MP raw materials to the market.

On the other hand, these small businesses help to the preservation of traditional knowledge and give an opportunity to enterprises to employ youth and poor rural people.

The significance of traditional plant knowledge is obvious by the need for ‘bioprospecting’ including recruiting of native people in order to recognize the uses of local flora as well as the need to protect intellectual rights. There are social beliefs that ‘facilitate’ medicinal plant conservation. However, there is some decrease in the utilization of traditional food, because their use was associated with poverty. Many households rely on commercial food to avoid the stigma of being considered as poor due to relying on traditional food plants.



3.6.4 Conservation through management of genetic resources and genetic stability/variability

The modern approaches in determining genetic variability most commonly use three types of genetic markers– morphological, biochemical and molecular.

- Morphological markers (e.g. plant height, leaf shape, color, etc.) are the oldest and most widely applied in the determination of genetic stability/variability. However, they lack specificity because gene expression under various environmental conditions may lead to great variability of phenotypic characters in individuals.
- Biochemical markers (e.g. albumin content, isozyme profiles or content of essential oil in an individual organism) are also regarded as non-specific because biochemical characters are quite variable and strongly influenced by an individual's environment.
- Molecular markers are on the playground since the 1980s together with the development of recombinant DNA technologies. Molecular markers comprise a modern tool for determining genetic variability. They represent variability among individuals on the DNA level, which is absolute and not influenced by the environmental conditions.

Molecular markers exploited for confirmation of genetic stability/variability possess different properties, among which various advantages and disadvantages. Thus, they can be classified as dominant and co-dominant markers; markers with different genome coverage; markers with different specificity, cost, ease of analytical interpretation of the resulting data, etc.

Despite this abundance, molecular markers are all highly informative about genetic variability among individuals, populations, and cultivars. Thus, their use is universal for not only plants but also for all living organisms.

Within this context, molecular markers can be considered as essential tools in MP for:

- Cultivar identification (DNA typing) and genome mapping;
- Research and evaluation of genetic stability, variability, and relationships;

- Management of genetic resources and biodiversity;
- Study of phylogenetic relationships.

Among these practical applications, the management of genetic resources and their conservation are considered of crucial importance.

The main objective of the management of genetic resources is to ensure conservation of the existing genetic diversity of species as much as possible. The effectiveness of this process depends largely on the genetic information available on the germplasm under study.



Molecular markers provide direct genetic information for *ex-situ* and *in-situ* conservation. For *ex-situ* conservation, the acquisition of data on the diversity of collections is important. For these purposes, molecular markers can be used to:

- Recognize valuable genetic variation that is under-represented in a collection sample;
- Identify duplicate accessions and to monitor changes in genetic structure as accessions are generated;
- Assess the available genetic diversity for each species;
- Provide precise and detailed information compared to that obtained by classical phenotypic data analyses;
- Identify traits and types quickly.

From fundamental point of view, the information about molecular markers may lead to further identification of useful genes contained in a collection.

Molecular data on biodiversity provide essential information to establish core sites that accurately represent the entire collection.

For *ex-situ* conservation, molecular markers are used in:

- Determination of identity and/or similarity of accessions or individuals;
- Measurement of the structure of diversity among individuals, accessions, populations and species; and the detection of a particular allele or nucleotide sequences in a taxon, gene-bank succession or *in-situ* population.

3.6.5 Conservation through sustainable harvesting

Another method of conserving medicinal plants is sustainable harvesting of their parts, such as sustainable removal of roots and barks when plants are harvested. For instance, it is shown that the barks of the trees are able to regenerate after the harvesters placed mud on the areas where the bark was removed. In fact, this method allows the survival of the species in their own habitat. However, the application of the sustainable harvesting method is difficult, especially in case the MP gatherers intend to generate revenue from selling and gathering the plants. Although cultivation ensures long-term survival for the species, there are problems that appear through prolonged periods of the process.

In addition, there are also challenges faced by MP sellers with regard to conservation through harvesting. Many people rely seriously on traditional medicine. The reasons causing high rates of unemployment, urbanization, clearing of vegetation for agriculture and land use, and low levels of formal education are all factors leading to high demand for medicinal plants. All these occasions are linked with over-exploitation of medicinal plants, especially for commercial gatherers to receive income. Exploitation of inappropriate methods of harvesting the medicinal plants has led to a decline in many medicinal plant species, while others are the reason for extinction.

The medicinal plant trade is real and important local economic sector, actively used in many countries and overharvesting of MP, particularly of roots and seeds have reduced the regeneration of potential species. High unemployment rates, especially among women, make harvesting and selling of medicinal plants a popular alternative for their families. Hence, the great demand for medicinal plants, eventually exceeding that, which can be supplied by the wild. The bulk of medicinal plants on the markets is harvested from wild populations and in combination with increased pressure from human habitation, has led to numerous local extinctions.



The shortage of popular medicinal plants has increased the market prices. Besides the escalating prices, additional problems like poor quality of the plant materials, insufficient product stabilization, and trading conditions are arising simultaneously. This makes a serious problem and may threaten:

- The health-care services by the problems that can be caused to people using medicinal plants;
- The biodiversity of resources due to the high pressure of harvesting medicinal plants; and
- The livelihoods of people depending on the trade.

In this way the, sustainability of the medicinal plant business depends on the majority of the medicinal plant sellers using profit from the medicinal plants for their livelihoods. There is a need to introduce special educational programs that enable the medicinal plant sellers to reflect on the issues that challenge their business.

3.6.6 Conservation through legal protection practices and education

In addition to sustainable harvesting and cultivation, legal protection conservation practices also have an influence on MP conservation.

The provided efforts to sustain the populations of medicinal plant species applying national legislation in most cases have been unsuccessful. The reason is the aggressive behavior of the people invading protected areas and causing significant harm to medicinal plants.

Besides the governmental activities to mitigate the effects of threatened medicinal plants, there are measures initiated to restrict the collection of MP in order to prevent the depletion of the wild plants. In fact, a lot of efforts are still necessary to ensure medicinal plant gatherers to respect the regulations preserving medicinal plants from being used up to extinction. Although the Departments of Agriculture in some countries had introduced permits as a control measure against the unsustainable harvesting of some medicinal plants, this still does not stop the illegal removal of the species from the wild population.

Legal restrictions to strengthen the preservation of MP by governing their access and removal have to be in place. Development and implementation of commercial regulations for harvesting and trade of medicinal plants, including requirements for protection of herbs are very important.

The goal in a long-term perspective is to achieve a careful balance between restricting access to plants (to encourage economic opportunity) and to assure biodiversity conservation.

All these facts show that education in the field of conservation is of primary necessity. It could increase awareness regarding the methods that could be used to conserve MP species.

3.7 Production-oriented dynamic preservation of threatened MP

According to a recent study of the commercial importance and the threatened status of MP in Europe, about 150 species were reported to be threatened in at least one European country because of over-collecting from the wild, inappropriate trade and habitat loss. Some of the threatened medicinal plants are cold tolerant. They are particularly suitable for cultivation and possible raw material production.

By producing raw material from controlled farming systems the economic pressure imposed on some threatened plant species will be decreased, and additional income to the growers specialized in herb production will be guaranteed.

The successful schemes for dynamic preservation and conservation of MP results of plot experiments have to be checked in semi-large scale experimental conditions before educating the growers for production of these new medicinal plants.

The trade in European medicinal plants is long established but has been growing rapidly over the past decade. The conservation community, concerned practitioners and the more aware consumer are calling

for sustainable herbal products. Unfortunately, at present only few companies are concerned about sustainable and ethical sourcing.

Cultivation is generally seen as the main solution. Indeed, there is much to be said for cultivation both from a commercial as well as conservation point of view. Cultivation cannot be the sole solution in the context of a complex trade in many hundreds of species, predominantly harvested from the wild, providing livelihoods for large numbers of people in numerous European countries.

Efforts of domestication are coupled with measures to achieve sustainable management for controlled wild harvesting.

The potential strategies, aimed at more sustainable sourcing are highlighted and some of the existing initiatives of WWF-UK and WWF-Germany/TRAFFIC Europe Germany are as follows.

- European Plant Conservation Strategy and its specific MP target;
- The Global Strategy for Plant Conservation of the Convention on Biological Diversity (CBD);
- ECP/GP Working Group on Medicinal and Aromatic Plants.

3.8 References

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