

GOOD AGRICULTURAL AND COLLECTION PRACTICES FOR MEDICINAL PLANTS

Illustrated Booklet for Farmers and Collectors



Enabling poor rural people
to overcome poverty



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PREFACE

Good Agricultural and Collection Practices (GACP) for Medicinal Plants are a set of guidelines aimed at advising medicinal plant producers on how to improve the safety, efficacy and quality standards of raw materials used in the preparation of herbal medicines. The guidelines were written in 2003 by the World Health Organisation and were intended for a global audience, covering principles that apply to all medicinal plant producers, from tribal collectors in remote forests to hi-tech farmers in industrialised countries. With such a diverse target audience the guidelines inevitably cover topics that are not appropriate for all producers. One of the objectives of the guidelines was therefore to create a basis upon which further country or region-specific standards can be developed that are targeted specifically towards the farmers and collectors of that area.

With this objective in mind, the National Medicinal Plants Board, in collaboration with the WHO Country Office for India, developed a set of guidelines and standards for Good Agricultural Practices (GAP) and Good Field Collection Practices (GFPC) in 2009. These guidelines and standards targeted specifically towards medicinal plant producers in the Indian subcontinent. This booklet is part of an initiative taken by the FAO in 2010 to develop training material that further simplifies the standards into a format that allows for easier comprehension and adoption by farmers and collectors. In addition to this booklet a training video and a trainer's manual have also been developed, all of which have been designed to be used together to achieve the best GACP training results.

This illustrated GACP booklet, as well as the training video and trainer's manual are developed by the FAO in collaboration with the Directorate of Medicinal and Aromatic Plant Research, Gujarat of Indian Council of Agricultural Research as part of an IFAD funded project "Organic Production of Underutilized Medicinal, Aromatic and Natural Dye Plants Programme for Sustainable Livelihoods in South Asia (GCP/RAS/208/IFA)".

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I. INTRODUCTION

Good Agricultural and Collection Practices (GACP) for Medicinal Plants are a set of guidelines for farmers and collectors on how to produce high quality raw materials for the herbal medicine industry.

During the last few decades there has been an enormous growth in global demand for herbal products. This has presented growing numbers of people in rural areas with valuable opportunities to generate income from cultivation or collection of medicinal plants.

As the herbal industry has grown it has also come under scrutiny due to concerns over the quality of raw material being used in herbal medicines. There have been a number of widely publicised cases in which consumers have suffered from adverse health effects having used herbal medicines containing contaminated or adulterated medicinal plant material.

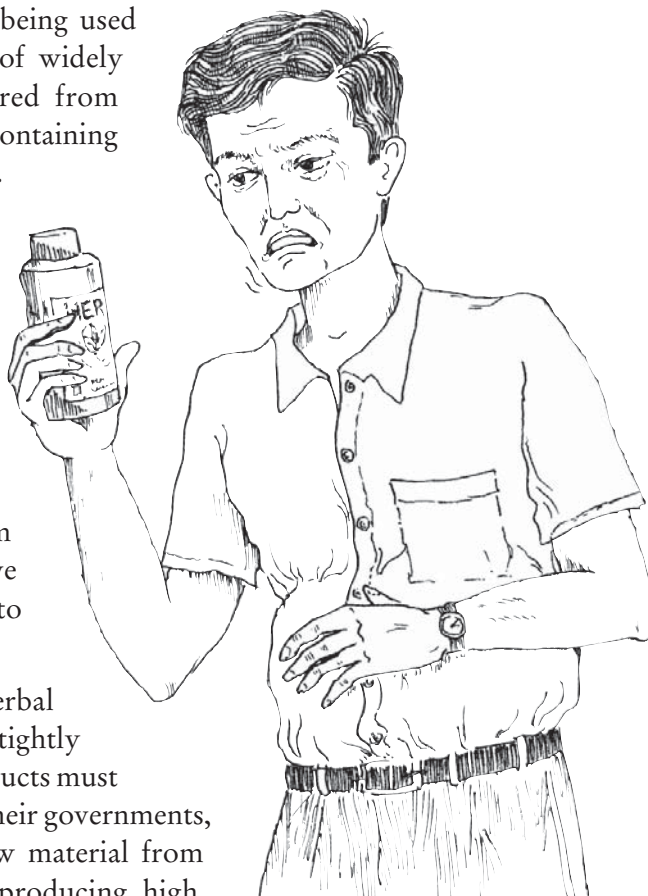
Although these cases are rare, they have highlighted the lack of regulation in the herbal industry and have put governments around the world under pressure to create stricter regulations that provide consumers with greater safety and quality assurance.

The growing demand for herbal medicines has also led to concerns about the environmental impact of large-scale commercial collection from the wild. Many valuable medicinal plant species have become threatened, rare or even endangered due to over-exploitation from their natural habitat.

Due to these concerns, the manufacturing of herbal medicines in many countries is becoming more tightly regulated; the companies who produce the final products must now adhere to the increasingly strict regulations of their governments, which require them to demand higher quality raw material from their suppliers. Ultimately the responsibility of producing high quality raw material lies with the farmers and collectors as well as those involved in primary processing of medicinal plants. These primary stages of production are key in determining the quality of the end product.

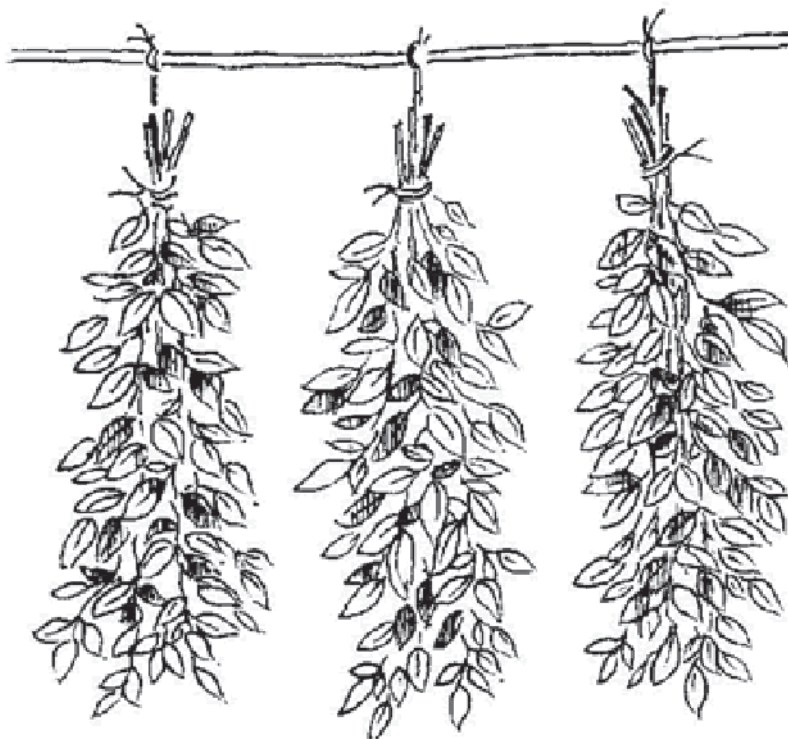
The purpose of the GACP guidelines is to provide guidance to medicinal plant growers and collectors on how to meet the increasingly stringent demands of the herbal industry. Adhering to GACP is currently a voluntary initiative; some buyers demand their suppliers to follow the standards, others do not. Some buyers may not even be aware of the standards. Generally speaking though, GACP is increasingly being recognised by buyers as a highly desirable – or even necessary – form of value addition, which helps them sell their products and can thus help medicinal plant growers or collectors gain access to high value premium markets.

Due to the huge diversity of medicinal plant species, the different environments in which they are produced and the different resources available to producers, the way in which GACP is implemented can vary enormously. The objective of the GACP guidelines is therefore to present the key underlying



principles that apply to all species, environments and producers. Farmers and collectors can then apply these principles to their own situation using the locally available resources.

This booklet explores the underlying principles of GACP by listing both correct and incorrect practices at each stage of cultivation, wild collection and post-harvest processing and provides illustrated examples of how they can be implemented in simple and affordable ways.

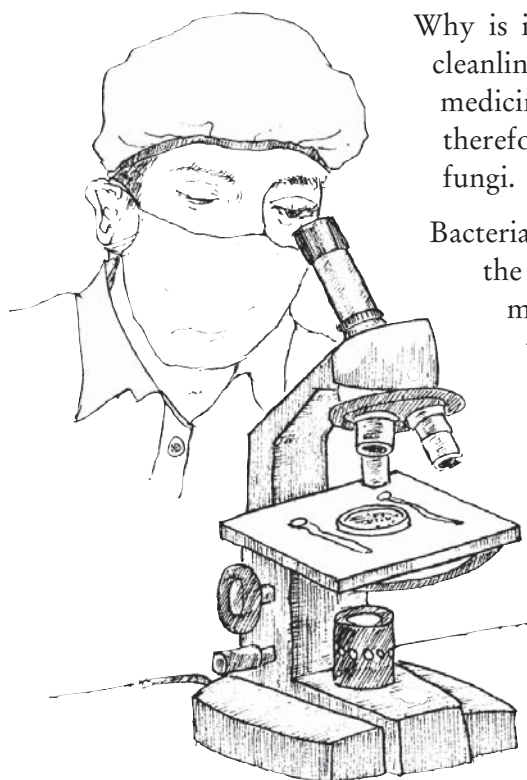


2. GENERAL PRINCIPLES

The most important underlying principle of GACP is Hygiene and Cleanliness. Maintaining a hygienic production system is of critical importance at each and every stage of a medicinal plants journey, from the selection of seeds or planting material through to manufacturing the final product. The GACP guidelines provide a variety of specific instructions on how to maintain a hygienic production system, yet the main point to remember is:

Anything that the medicinal plant material comes into contact with must be
SPOTLESSLY CLEAN

This includes hands, tools, containers, sacks, tarpaulins, washing tubs, drying racks, and so on. Anything that touches the medicinal plants or the medicinal plants are placed on should be thoroughly cleaned in advance.



Why is it so important to maintain such high levels of hygiene and cleanliness? The reason is that these plants will be used to manufacture medicines; they are intended to improve people's health and it is therefore essential that they are not contaminated by bacteria or fungi.

Bacteria and fungi (also known as microbes) are too small to see with the naked eye but exist in large quantities on dirty surfaces. If medicinal plant parts come into contact with these surfaces, they too will carry these microbes. If large numbers of these microbes find their way into the medicines and are subsequently consumed by people who are in poor health, there are chances that their health may further deteriorate.

To prevent the risk of herbal medicines being contaminated with microbes many buyers test the medicinal plant material before buying it from their suppliers. If they find that the quantity of certain microbes exceeds their specified limit then they are likely to reject the material.

Another principle of GACP that is of critical importance is Correct Identification. Sometimes different medicinal plant species look very similar, or they share the same common name; the result is that the wrong species can find their way into herbal medicines, potentially causing serious health consequences to the consumer.

Rather than identifying medicinal plant species by their local or common names, which can vary significantly from place to place, they should always be identified by their botanical name. This will ensure that everyone is speaking the same 'language' and there is no confusion during communication between farmers, collectors, processors and buyers.

The following DOs and DON'Ts summarise the guidelines outlined by GACP to prevent potential health hazards caused by medicinal plant material contaminated by microbes or incorrect plant species.

2.1 Hygiene and Cleanliness



DO

- Wash your hands, preferably using soap under flowing clean water, before handling any medicinal plants
- Maintain personal cleanliness and hygiene while handling medicinal plants, e.g. clean clothes, clean body, regular bathing, well-cut nails etc.
- Wash all tools before they come into contact with medicinal plants
- Clean all surfaces that the medicinal plant parts will come into contact with during and after harvest
- Promote and help maintain cleanliness in the community



Figure 1.1: Washing hands before handling medicinal plants reduces the risk of microbial contamination



DO NOT

- Do not handle medicinal plants with dirty hands
- Do not harvest medicinal plants using dirty tools and containers
- Do not place harvested medicinal plant parts on dirty surfaces
- Do not urinate, defecate, spit, throw waste etc. in the vicinity of medicinal plant production or allow others to do the same
- Do not allow animals such as dogs, cats, rats etc. to urinate or come in contact with medicinal plants
- Do not handle medicinal plants if you have an infectious disease or open wound

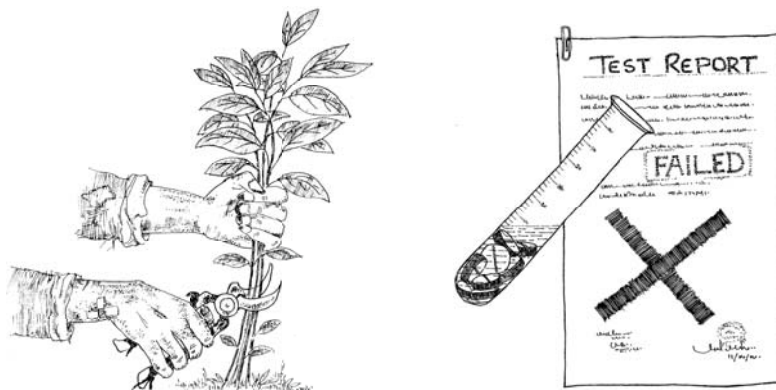


Figure 1.2: If medicinal plants are harvested with dirty hands and tools there is a much higher chance that the produce will fail quality tests due to microbial contamination

2.2 Correct Identification



DO

- Seek guidance from an expert if you are in any doubt about the identification of a species
- Visit a government-recognised herbarium to verify that you are collecting the correct species
- Send a sample to a government-recognised institute for verification if you are in doubt about the identification of a species
- Ask your buyer to prepare a 'plant monograph' with a description and photographs of the species that you will be growing or collecting.

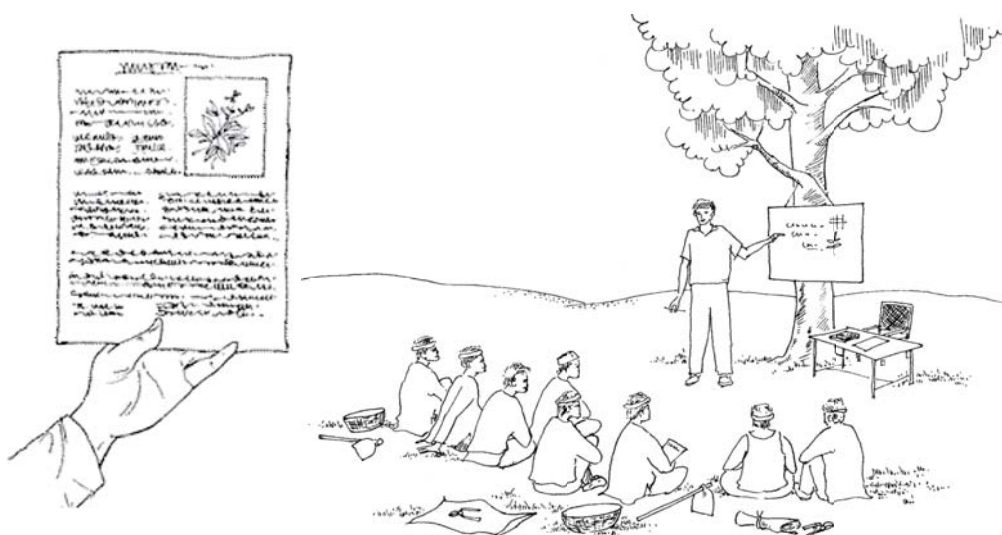


Figure 2.1: If you are growing or collecting a medicinal plant species that you are not familiar with then you should request training from a local expert



DO NOT

- Do not collect any medicinal plant species if you have any doubt about its identification
- Do not use other species that may look similar or share the same name

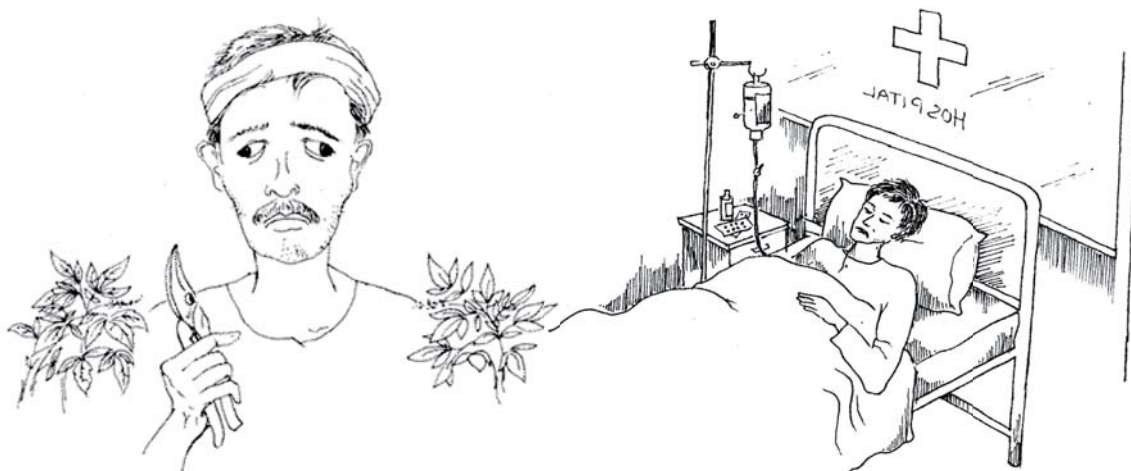


Figure 2.2: Using incorrect medicinal plant species in herbal medicines can cause serious health problems to the consumer

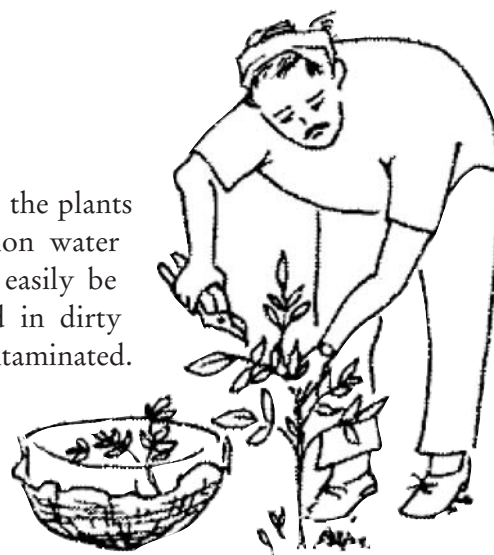
3. GOOD AGRICULTURAL PRACTICES FOR MEDICINAL PLANTS

The large majority of traded medicinal plants are still collected from the wild. However, due to the growing demand for herbal medicines and the subsequent over-harvesting and depletion of medicinal plants in their natural habitat, more and more people are turning to cultivation to meet the requirements of the industry. Good Agricultural Practices (GAPs) for medicinal plants follow most of the same key principles as for other crops; the main difference is that medicinal plants are grown to be used as medicines and the main objective is therefore to maximise the medicinal properties of the relevant plant parts and ensure that they are safe to use.

The main principles of GAPs are:

1. *Prevention of Contamination*

During cultivation there are many different risks that can cause the plants to become contaminated. For example, if the soil or irrigation water is contaminated with pesticides and industrial waste this can easily be absorbed by the plant, or if the harvested plants are placed in dirty containers there are high chances that they will become contaminated. Many buyers now insist on testing the medicinal plant material and if traces of pesticide residue, heavy metals, or excessive levels of bacteria or fungi are found then the produce may be rejected.



2. *Best Active Ingredients*

Ultimately the medicinal plant material will be used to manufacture herbal medicines. This means that maximising the medicinal properties of the relevant plant parts should always be a priority during cultivation. The location of the cultivation site, the variety of the species used, the irrigation cycles, the harvest time are some of the factors that may influence the potency of the active ingredients. These should all be researched and planned to ensure that the medicinal plant material contains the highest level of active ingredients possible.

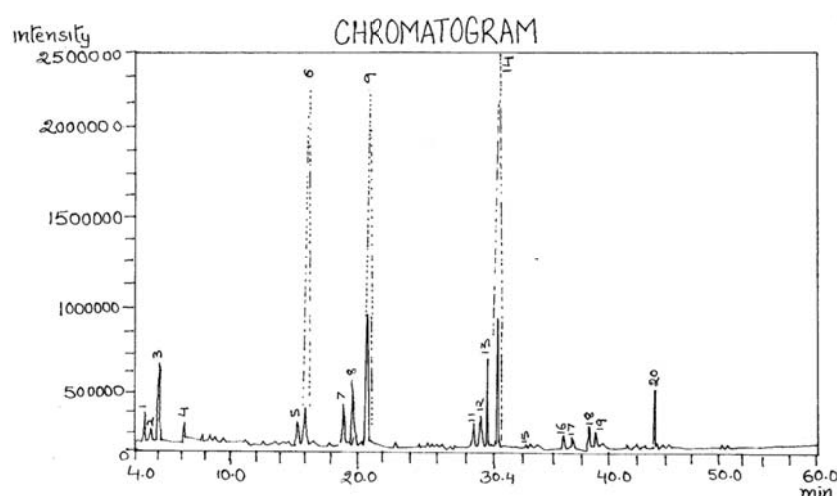


Figure 3.0.1: When medicinal plant material is tested in a laboratory for their active ingredients the test results may look like this Chromatogram. This can give an indication of the quality of the produce and can also determine the price

3. Best Yield and Income

Good Agricultural Practices also explore how to optimise the yield of the crop, and therefore the income for the farmer. For example, the quality of the seed, the spacing between the plants and the rows, plant nutrition, weed management, insect pest and disease management, irrigation methods and the harvest stage and time all have a significant impact on the yield, as well as the quality of the crop. The GAP guidelines explore the key principles that the farmer needs to follow at each stage of cultivation to optimise the yield and income from the crop.

4. Documentation and Traceability

One of the key themes of GACP is to be able to trace medicinal plant material back to its origin. If it is traceable then it becomes much easier to identify and therefore address any quality related issues that may arise at a later date. This is only possible if there is a documentation system in place to keep records at each stage of production. Record keeping is therefore a major focus of the GACP guidelines.

The DOs and DON'Ts in this section summarise the GAP guidelines related to medicinal plant cultivation, covering the main principles that should be followed to prevent contamination, optimise yield and the levels of active ingredients in the produce, as well as the records that need to be kept to ensure complete traceability of the final product.

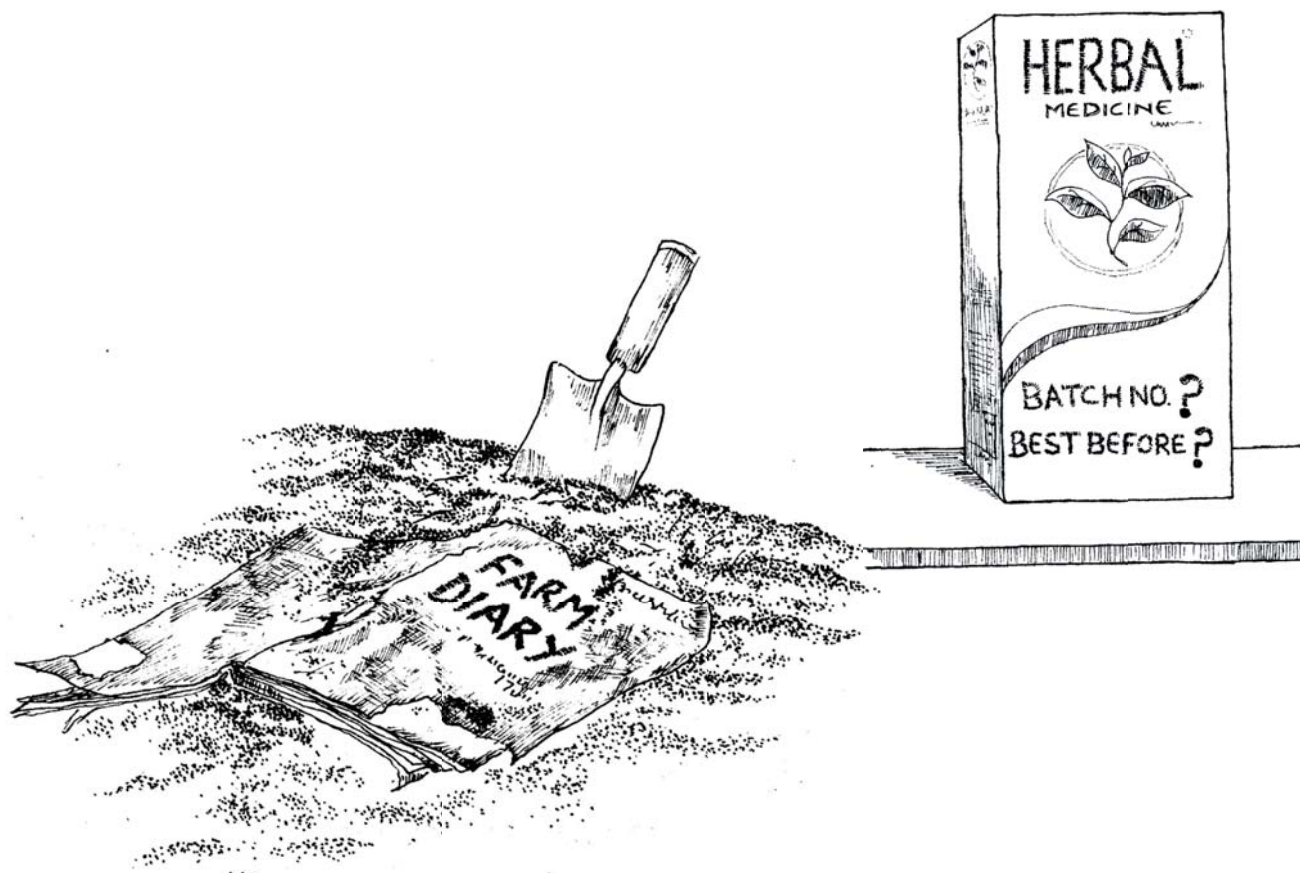


Figure 3.0.2: If records are not kept in the farmer's diary then there will be no information on the date of harvest and therefore very difficult for the manufacturer to know by which date it should be used

3.1 Site Selection



DO

- Grow only those medicinal plants which are recommended for cultivation in that area
- Choose land that has access to a clean and reliable source of irrigation water
- Make sure there is sufficient space between your fields and other fields where pesticides are used to prevent any sprays from contaminating your crops

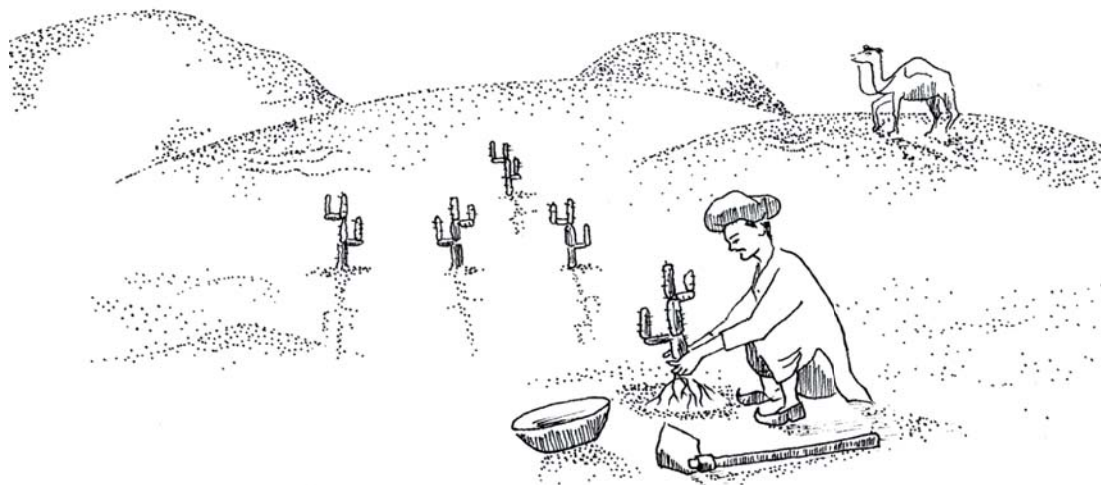


Figure 3.1.1 The best results will be achieved by selecting a cultivation site that as far as possible replicates the natural habitat of the species



DO NOT

- Do not grow medicinal plants near potential sources of contamination such as industrial sites or busy roads
- Do not grow medicinal plants where there is a risk of contamination from pesticides being sprayed in neighbouring fields

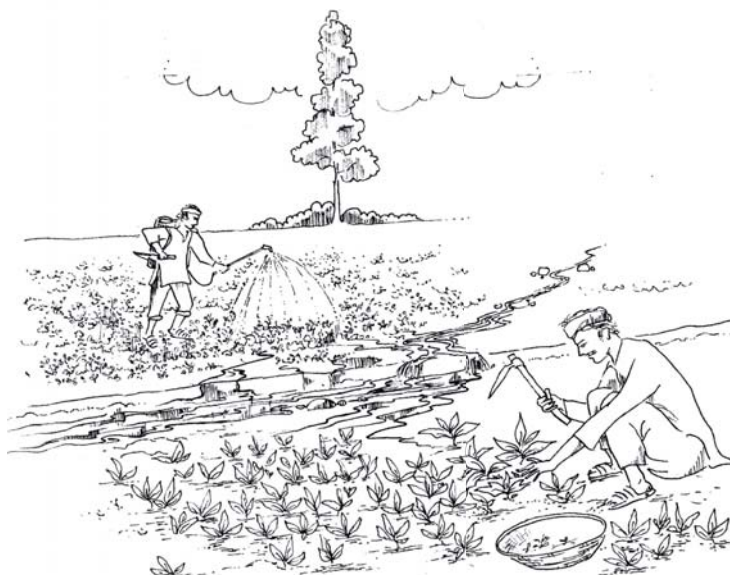


Figure 3.1.2: These medicinal plants are being cultivated next to a field where pesticides are being sprayed. This is likely to contaminate the plants, which will lead to the medicinal plant material being rejected by the buyer

3.2 Land Preparation



DO

- Nourish the soil with plenty of organic matter
- Ensure that compost is well decomposed before use
- Prepare the land according to the specific needs of the medicinal plant species
- If possible, send a soil sample to a nearby laboratory for testing and plan any addition of plant nutrients accordingly



Figure 3.2.1: Adding plenty of well-rotted compost will increase the yield of the plants as well as their resistance against pests and diseases



DO NOT

- Do not use compost made from city waste
- Do not apply fresh manure for plant nutrition
- Do not allow people to defecate in the plot where the medicinal plants are to be grown
- Do not use compost made from human excreta



Figure 3.2.2: This farmer is adding low-cost compost made from city waste. This is likely to contain many contaminants, especially heavy metals, which may be absorbed by the medicinal plants

3.3 Sowing / Planting



DO

- Use seeds that were harvested during the previous season
- Use seeds that are in good condition and free of pests
- Procure seeds or planting material from reliable sources
- Sow seeds or transplant seedlings at the correct time
- Where required, treat the seeds before sowing, preferably through organic means.
- Ensure correct spacing between plants and rows
- If you plan to plant other crops as an 'intercrop' then select compatible species which do not compete with main crop for inputs
- If you are collecting your own seeds label the seed packets with details of the species, the origin and date of harvest or collection



Figure 3.3.1: These seeds are in good condition and free of pests, which increases the chance of healthy germination.



DO NOT

- Do not use seeds or planting material that are in poor condition or if you do not know where they came from and when they were harvested
- Do not use seeds or planting material if you do not know exactly which species and variety they belong to

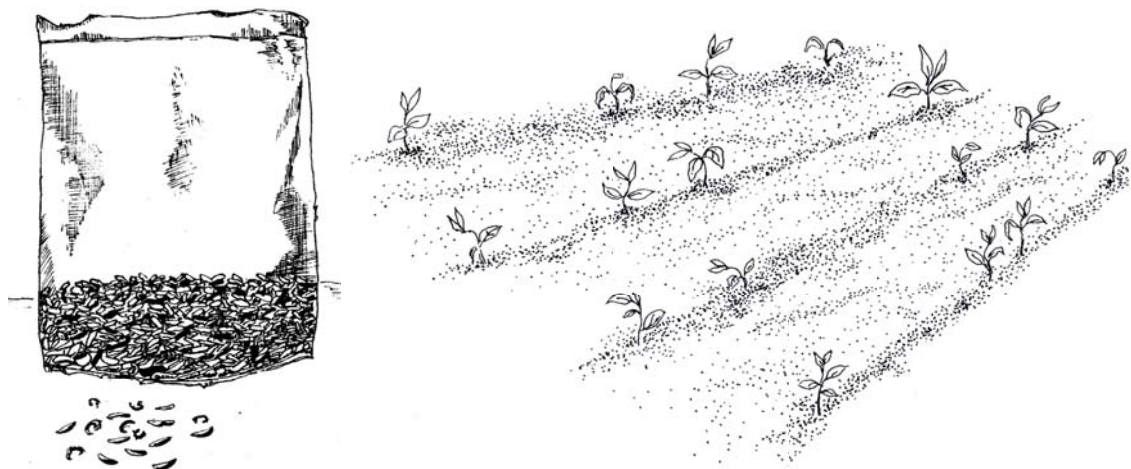


Figure 3.3.2: These seeds are from an unknown source and are not in good condition; the result is poor germination as shown in the illustration on the right

3.4 Irrigation



DO

- Apply a mulch to conserve soil moisture
- If possible, test the irrigation water for any contaminants and adopt appropriate measures to prevent contamination
- Irrigate medicinal plants according to the specific water requirements of the species – if in doubt, seek guidance from an expert and plan the irrigation schedule accordingly.
- Use water from a clean source

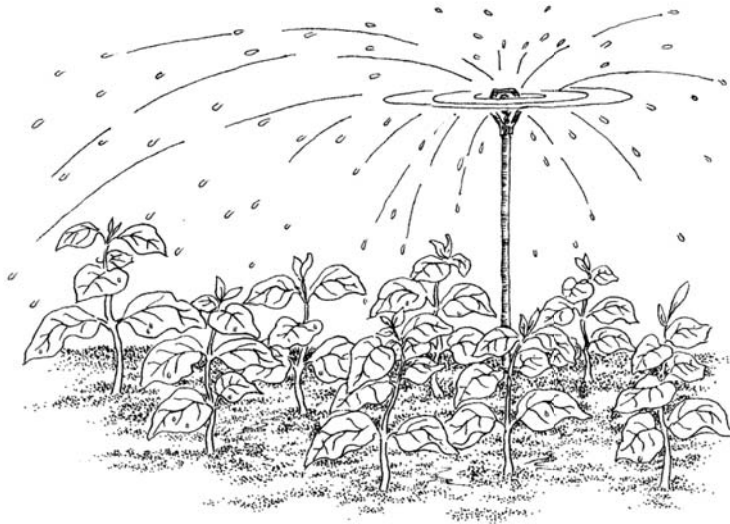


Figure 3.4.1: Irrigating the plants with an appropriate regularity and quantity of water will increase the chances of a healthy crop and thus ensure optimum yield



DO NOT

- Do not irrigate the plants too little or too much
- Do not use water that may be contaminated by chemicals or waste materials
- Do not use any empty pesticide containers while irrigating the field



Figure 3.4.2: Too much or too little irrigation will lead to poor yields or even a crop failure

3.5 Weeding



DO

- Manage weeds before they start competing with the main crop for nutrients and light
- Use mulch to maintain moisture in the soil and to inhibit growth of weeds

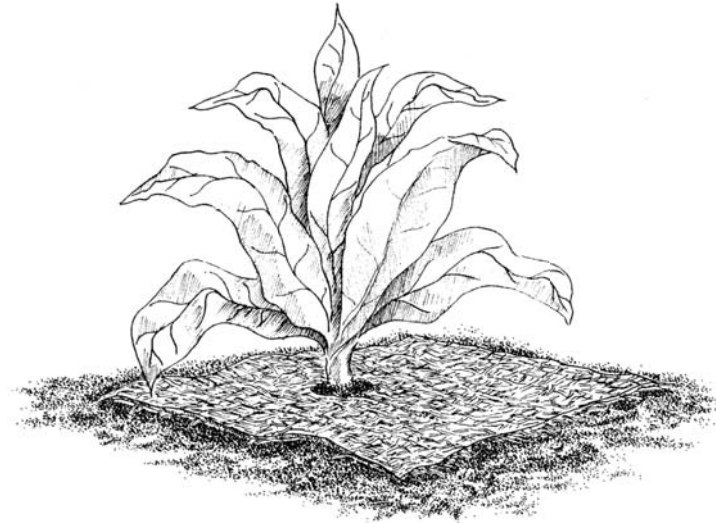


Figure 3.5.1: A mulch is any material that is spread on the ground to help suppress weeds and retain moisture in the soil. It can also be used to enrich the soil and prevent soil borne diseases



DO NOT

- Do not use chemical herbicides to eradicate weeds
- Do not allow weeds to produce seeds–this will increase weed growth the following year
- Do not allow the soil to dry up due to excessive weeding



Figure 3.5.2: If weeds are not controlled they will reduce the yield and quality of the medicinal plants

3.6 Insect Pests and Diseases



DO

- Select medicinal plant species that are resistant to local insect pests and diseases
- Maximise resistance against insect pests and diseases through adjusting sowing time, appropriate seed treatment, balanced plant nutrition and timely irrigation
- Use organic practices such as use of companion crops, trap crops, light-traps, crop rotation etc.
- Identify and promote multiplication of predatory insects and birds
- Try to solve the problem with an organic pesticide, either made from locally available resources or buy a product from a reputed manufacturer or institution
- Use chemical pesticides only if there are no other options, and only if there is sufficient time between application and harvest to guarantee that the chemical cannot be detected in the medicinal plant material.
- If a chemical pesticide is used then ensure you use the correct dosage
- Seek guidance from an expert to plan and adopt integrated pest management practices on your farm.



Figure 3.6.1: One of the best ways to control pests is to encourage predators such as birds and insects that eat the pests that may otherwise damage your crop



DO NOT

- Do not grow medicinal plant species that are not adapted to the local environment and may be susceptible to the local pests
- Do not use chemical pesticides under any circumstances if your farm is certified organic

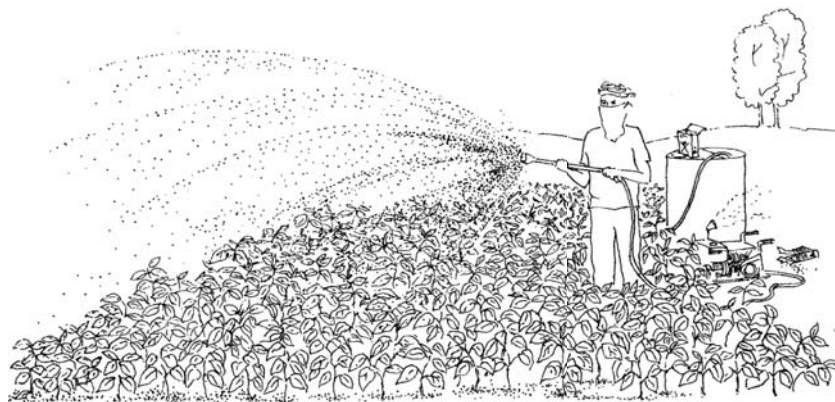


Figure 3.6.2: Chemical pesticides can be extremely harmful to the health of humans and the environment and where possible should be avoided

3.7 Harvest



DO

- Clean all tools and containers before harvesting
- Harvest at the right stage to ensure maximum levels of active ingredients
- Harvest the plants in dry weather
- Keep sacks of freshly harvested green leafy herbs in the shade to prevent degradation caused by build up of heat
- Place harvested medicinal plants in a clean container or sack



Figure 3.7.1: Harvested produce should be placed in a clean container



Figure 3.7.2: The harvested medicinal plants should be kept in the shade to minimise degradation caused by build-up of heat inside the sacks



DO NOT

- Do not harvest weeds with the medicinal plants
- Do not use recycled sacks without thoroughly cleaning them before use
- Do not use sacks that have previously been used to store agrochemicals
- Do not place harvested plant parts on the ground
- Do not harvest herbs when it is raining, or early in the morning when there is dew on the ground
- Do not harvest green leafy herbs during the hottest part of the day



Figure 3.7.3: If the harvested produce is placed on the ground then it is likely to be contaminated with small particles of mud and other extraneous matter that requires a lot of effort to clean out afterwards



Figure 3.7.4: To store / pack harvested material, never use fertilizer sacks or containers previously used for agrochemicals, detergents etc.

3.8 GAP Documentation

DO



- Keep a farmers diary with details of all on-farm activities. If you require help in keeping records, request assistance from your buyer.
- Use 'harvest tags' to record details of each harvest and the plant materials subsequent processing activities



Figure 3.8.1: Documentation should begin with the name of the species, details of where the seeds or planting material came from and the date of collection. Seed packets should always be well labelled



Figure 3.8.2: The sowing date should be recorded in the farmer's diary. At this stage it is good to allocate the crop with a unique 'crop number', which can be referred to throughout the documentation process

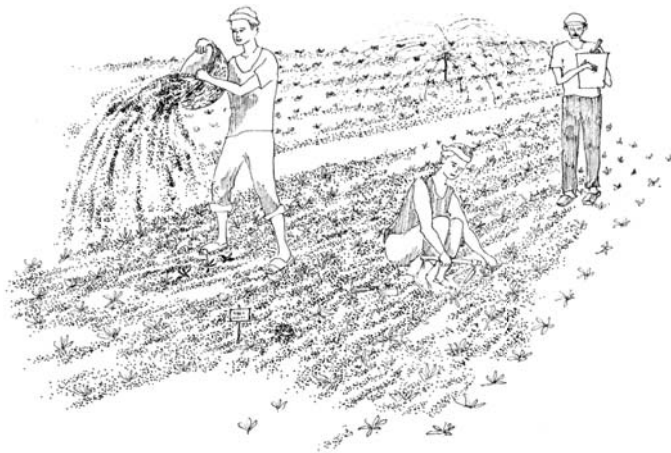


Figure 3.8.3: All activities on the farm, including application of compost and any other inputs, weeding and irrigation should be recorded in the farmer's diary



Figure 3.8.4: At the time of harvest the date, quantity harvested and a batch number should be recorded in the farmer's diary and on a label or harvest tag

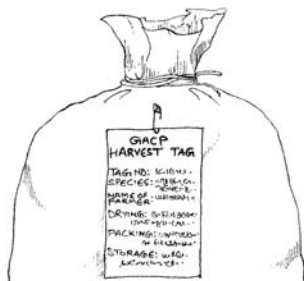


Figure 3.8.5: A harvest tag should provide all details of the origin of the crop and provide space for recording all details of post-harvest processing. This tag should travel with the sack to its final destination

4. GOOD COLLECTION PRACTICES FOR MEDICINAL PLANTS

Some medicinal plant species are not recommended for cultivation. This may be because they are difficult to propagate, or because they take a long time to grow and are therefore not profitable to cultivate, or because there are large quantities growing in the wild that are able to regenerate quickly after being harvested. Sustainable wild collection of these species provides a valuable source of income for many communities living in biodiversity rich areas, especially for collectors who own little or no agricultural land of their own. It is therefore likely that wild collection will continue to be a major source of medicinal plants for the herbal industry, and it is essential that collectors are trained in Good Collection Practices to protect this valuable resource for themselves and future generations.

The main principles of Good Collection Practices are:

1. *Sustainability*

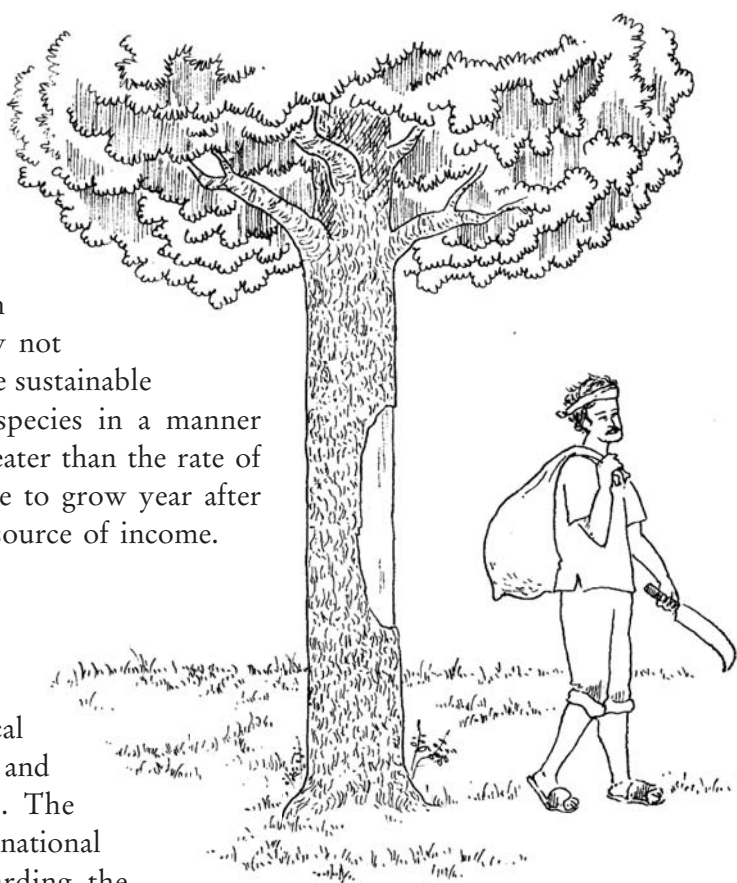
In recent decades unsustainable collection practices has caused rapid depletion of many medicinal plant species from their natural habitat. Some species or plant parts regenerate quickly after being harvested, other species take much longer. Flowers, fruits and leaves, for example, regenerate much more easily than roots and barks. In some cases the plants may not be able to regenerate at all. For the harvest to be sustainable the collectors must collect medicinal plants species in a manner that ensures that the rate of regeneration is greater than the rate of extraction. In this way the plants will continue to grow year after year and provide the collector with a regular source of income.

2. *Collection Regulations*

Wild collection usually takes place on public land that is either owned by the government or the local community and is subject to local regulations stating who has collection rights and which species they are permitted to collect. The collection of medicinal plants is also subject to national and international regulations, especially regarding the collection of threatened and endangered species. Collectors should be aware of all of these regulations and adhere to them at all times.

3. *Prevention of Contamination, Degradation and Damage*

Although there may be less risk of contamination from agrochemicals etc. in forests and uncultivated areas than in private agricultural land, there are still many potential risks during the harvest and transportation of the medicinal plant material to the processing site. These risks can be minimised through careful planning to ensure that all the materials that are required for hygienic collection and transportation are packed before setting out to the collection site.



4. *Optimisation of Active Ingredients*

To maximise the potency of medicinal plants collected from the wild there are three main factors to take into consideration: the collection site, the collection time and the maturity of the plant. Factors such as altitude, soil type, and climate can have a significant effect on the active ingredients of the plants. Similarly, collecting plants at different times of the year or different stages of the plants' maturity can also have an impact on the plants' medicinal properties.

5. *Documentation and Traceability*

Documentation during wild collection is essential for the harvested plant material to be traceable. It is particularly important to keep a record of the location of collection and the quantities collected as well as observations of whether the plant population has successfully regenerated since the previous collection.

The DOs and DON'Ts in this section summarise the GACP guidelines related to medicinal plant collection, covering sustainability, collection regulations, prevention of contamination, maximisation of yield and levels of active ingredients, as well as the records that need to be kept to ensure traceability of the final product.



Figure 4.0.1: The collector here has uprooted the entire plants, leaving no chance for them to regenerate. This practice is unsustainable and will cause rapid depletion of the plant population.

4.1 Planning



DO

- Obtain a collection permit from the relevant authorities, if required
- Explore the area before collection to assess whether there is enough of the plant species for the collection to be sustainable
- Ensure there is an experienced collector who can provide guidance to others who are less experienced
- Take clean sacks and tools when setting out for collection
- Pack a pen, diary and labels for keeping records



Figure 4.1.1: The collector here is packing clean sacks, tools and a pen and diary for keeping records.



DO NOT

- Do not harvest medicinal plants, if you have any doubt about the identification of the species
- Do not set out for collection without taking all required tools and equipment
- Do not set out for collection with old, dirty or contaminated sacks



Figure 4.1.2: If you pack old dirty sacks there are high chances that the medicinal plant material that you put in the sacks will become contaminated

4.2 Collection Time



DO

- Collect medicinal plants at a time that maximises chances of plant regeneration
- Collect medicinal plants at the correct time of the year to ensure maximum potency of the plants' medicinal properties

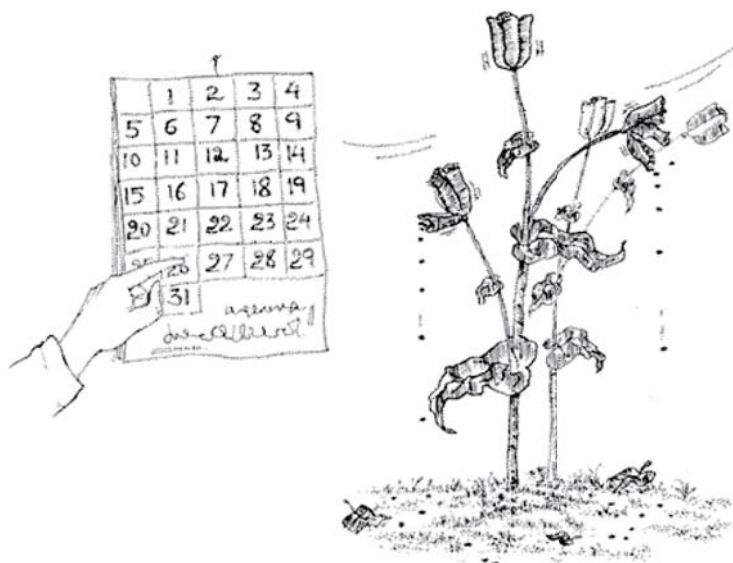


Figure 4.2.1: This plant should only be collected once the seeds have matured so that it will naturally regenerate the following year



DO NOT

- Do not collect medicinal plants before they are mature, or – if the plant regenerates through seed – before the seeds have ripened.
- Do not collect plant during the rainy season unless you have a means to dry the material properly immediately after collection

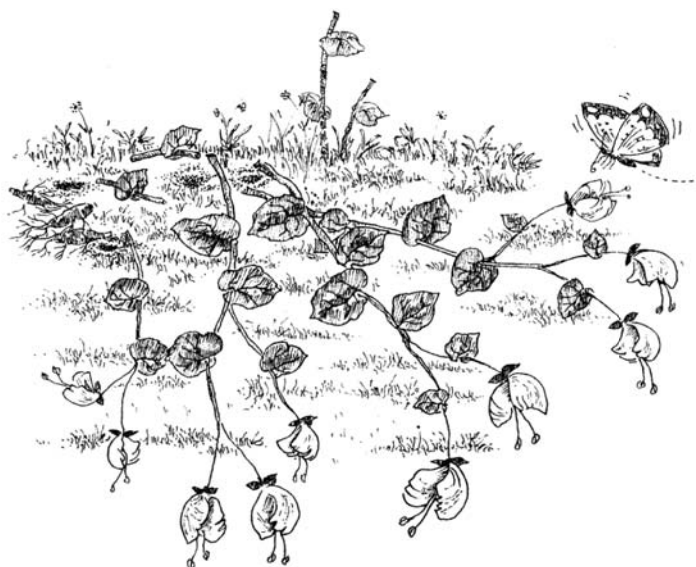


Figure 4.2.2: The same plant is shown here having been harvested during the flowering period. Harvesting the plants before seeds have been produced means that the plant cannot regenerate

4.3 Collection Sites



DO

- Only collect medicinal plants in areas where you have collection rights
- Collect medicinal plants in clean locations, away from potential sources of contamination
- Respect the local customs, traditions and beliefs of the area
- Collect from only those sites where the target species grows in large quantities
- Keep a record of the place where you collect so that you can observe the plants' regeneration in the future



Figure 4.3.1: The collector here has a collection permit issued by the Forest Department



DO NOT

- Do not offend the local community by collecting plants from inappropriate locations, such as places of worship
- Do not collect medicinal plants in areas where you do not have collection rights
- Do not collect medicinal plants from anywhere near potential sources of contamination

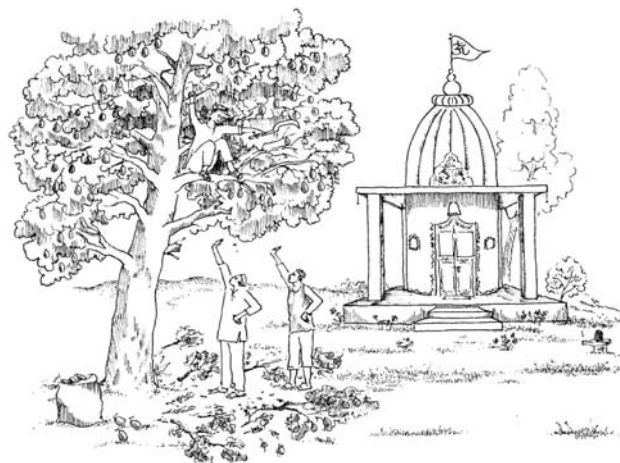


Figure 4.3.2: The collector here is cutting branches from a tree that is revered as sacred by the local people, causing them great offence

4.4 Collection Methods



DO

- Harvest the plants in dry weather
- Harvest at the right time to ensure maximum levels of active ingredients
- Ensure that your collection methods are sustainable and do not have any negative impact on the environment
- Place harvested medicinal plants in a clean container or sack
- Keep green leafy herbs in the shade to prevent them from wilting after harvest
- When in doubt of regeneration, do not collect more than 70% of any plant population

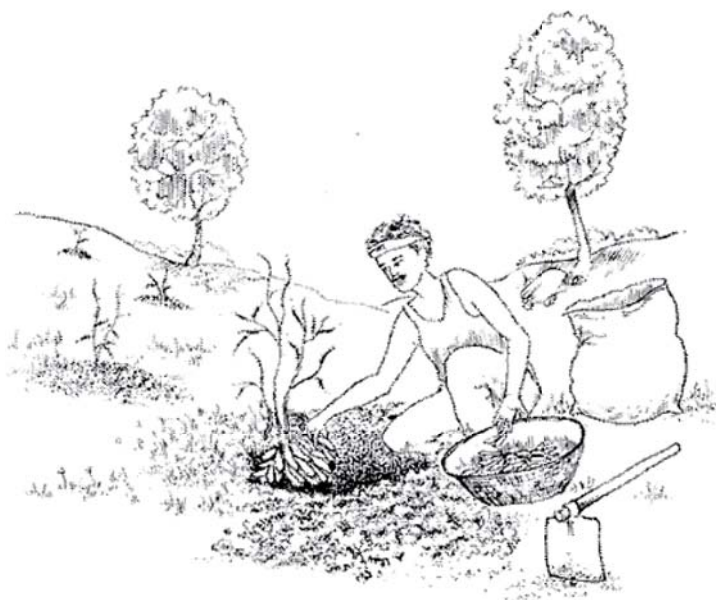


Figure 4.4.1: The collector here is removing the tubers from only one side of the plant. The main stem and the tubers on the other side of the plant remain undisturbed and thus the plant can quickly regenerate



Figure 4.4.2: Bark should only be harvested from one side of the tree and should not be harvested again until the bark in the previously harvested area has regenerated



DO NOT

- Do not harvest medicinal plants in a manner that will affect their ability to regenerate in the future.
- Do not keep harvested green leafy herbs in direct sunlight
- Do not harvest weeds or other undesired matter with the plants
- Do not use recycled sacks without thoroughly cleaning them before use
- Do not use sacks that have previously been used to store fertilisers
- Do not place harvested plant parts on the ground
- Do not harvest medicinal plants when it is raining, or early in the morning when there is dew on the ground
- Do not harvest any medicinal plants that are in poor condition or diseased
- Do not collect fallen fruits from the ground, if they are physically damaged
- Do not store different types of collected plant material in the same sack or container



Figure 4.4.3: The collector here is collecting fruits that have fallen from the tree – where possible this should be avoided as there are high chances that they will have been damaged or eaten by insects



Figure 4.4.4: The bark should never be stripped from all the way around the trunk of a tree as this will cause the tree to die

4.5 GCP Documentation

DO



- Maintain records of all harvests in a 'Collector's Diary'
- Prepare printed 'harvest tags' that can be attached to the sacks at the time of harvest



Figure 4.5.1: Collectors should keep a record of all their collection activities in a 'collector's diary'. Records should include which species were collected, the date, location and quantity of harvest



Figure 4.5.2: In addition to keeping records in his/her collector's diary the collector should also write the details of the harvest in a 'harvest tag' and attach it to the sack

DO NOT



- Do not misplace your collector's diary or leave it anywhere where it could be misused or damaged.
- Do not set out for collection without labels for keeping records of where the harvested material has come from

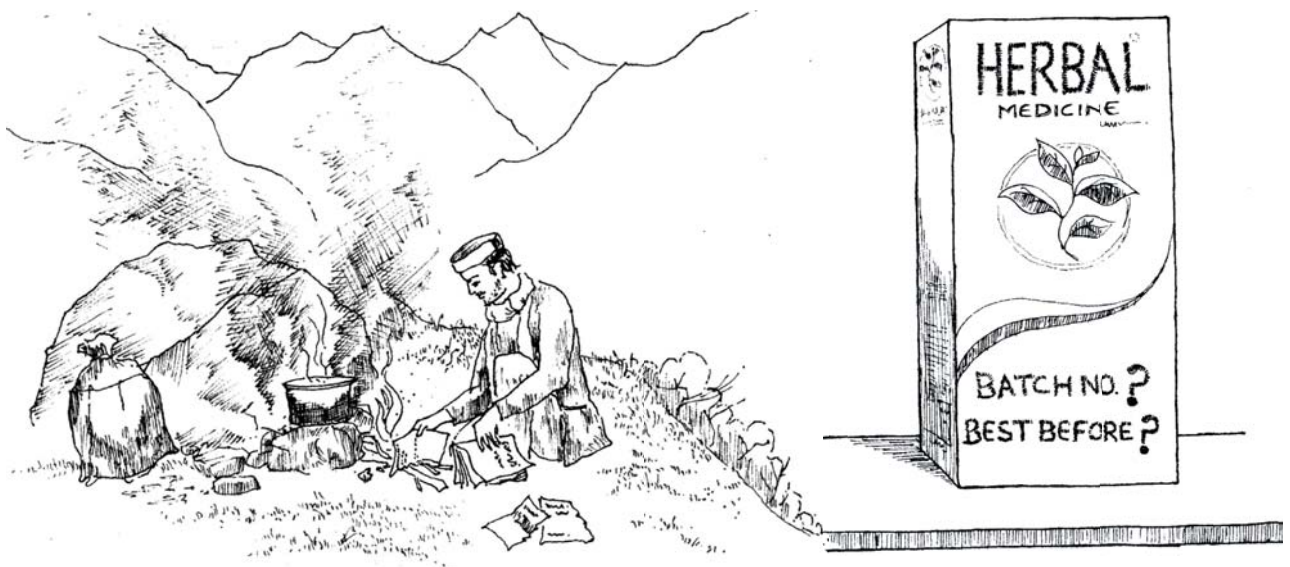


Figure 4.5.3: This collector is using his diary to light a fire... without the information on the date of harvest the herbal medicine manufacturer cannot know when the best before date is

5. POST HARVEST PROCESSING

Post harvest processing is usually the most critical stage in determining the end quality of the medicinal plant material. Once the plants have been harvested there are many potential risks; they are likely to be handled by many different people, placed on different surfaces, transported on polluted roads or stored for days or weeks in people's houses, all of which involve considerable chances of contamination, degradation and/or damage. The best way to prevent this from happening is to anticipate all the potential risks and take preventative measures before any problems occur. If problems are not prevented before they occur then it can be very difficult, or even impossible, to repair the damage.

Remember: PREVENTION is better than CURE!

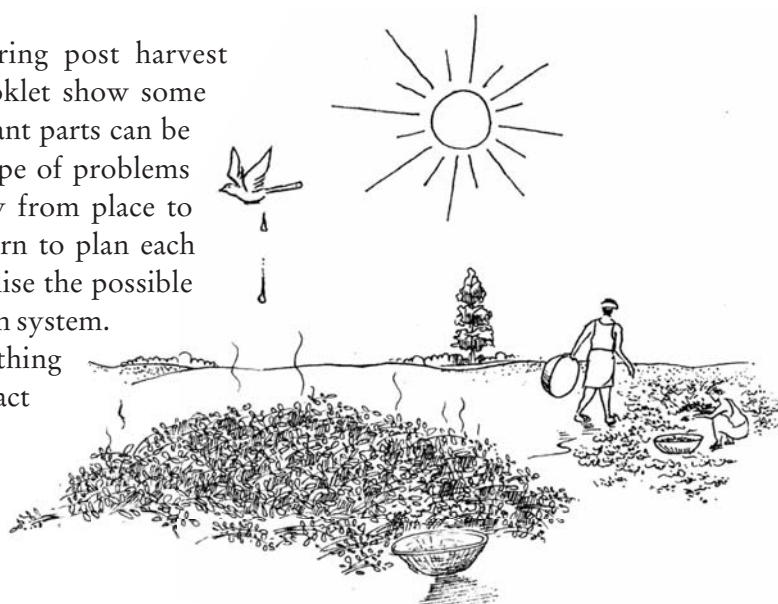
Below are some of the key GACP principles of Post Harvest Processing:

1. *Preventing Contamination*

Contamination is the biggest risk during post harvest processing. The illustrations in this booklet show some examples of how harvested medicinal plant parts can be contaminated during processing. The type of problems that are likely to occur is likely to vary from place to place. Each producer must therefore learn to plan each stage of processing in advance and visualise the possible risks that apply to his/her own production system.

Contamination can be caused by anything that the plant material comes into contact with – this includes fumes and aromas as well as dust, animals, birds, other plant species, soil, bacteria, fungus or anything else that may have an adverse effect on the purity of the medicinal plant material. Just as the

potential risks vary from place to place, so do the solutions to these issues. The producer must learn to understand the principles of GACP and apply them to his/her production system using the locally available resources.



2. *Protection against Degradation, Damage and Discolouring*

The main purpose of most post-harvest processing activities is to convert the fresh plant material into a stable form so that its medicinal properties can be preserved for future use. This is most commonly achieved through drying, however it can also be done through methods such as making extracts, tinctures and essential oils. There are many factors that may cause the freshly harvested medicinal plant material to deteriorate. This may be caused by excess heat, humidity or moisture, all of which are risks that begin as soon as the plants are harvested. Generally speaking the most important principles to follow are to process and pack the material as quickly as possible, to keep it cool and dry, and to protect it from being crushed by excess weight. If the material needs to be dried, then it should be done in the correct manner as per the requirements of the species and the particular part of the plant being used.

3. Documentation and Traceability

The documentation of post harvest processing activities should be a continuation of the documentation initiated during cultivation or wild collection. Records should be kept of each activity in such a way that the batch number of the final product refers to a complete history of the medicinal plant material. If different batches are combined during processing then a record should be kept of this as well.

The DOs and DON'Ts in this section summarise the GACP guidelines related to post-harvest processing, covering each step of the medicinal plant's journey from leaving the harvest site to sorting, washing, drying, grading, packing and storage, with details of all the records that need to be kept to ensure complete traceability of the final product.

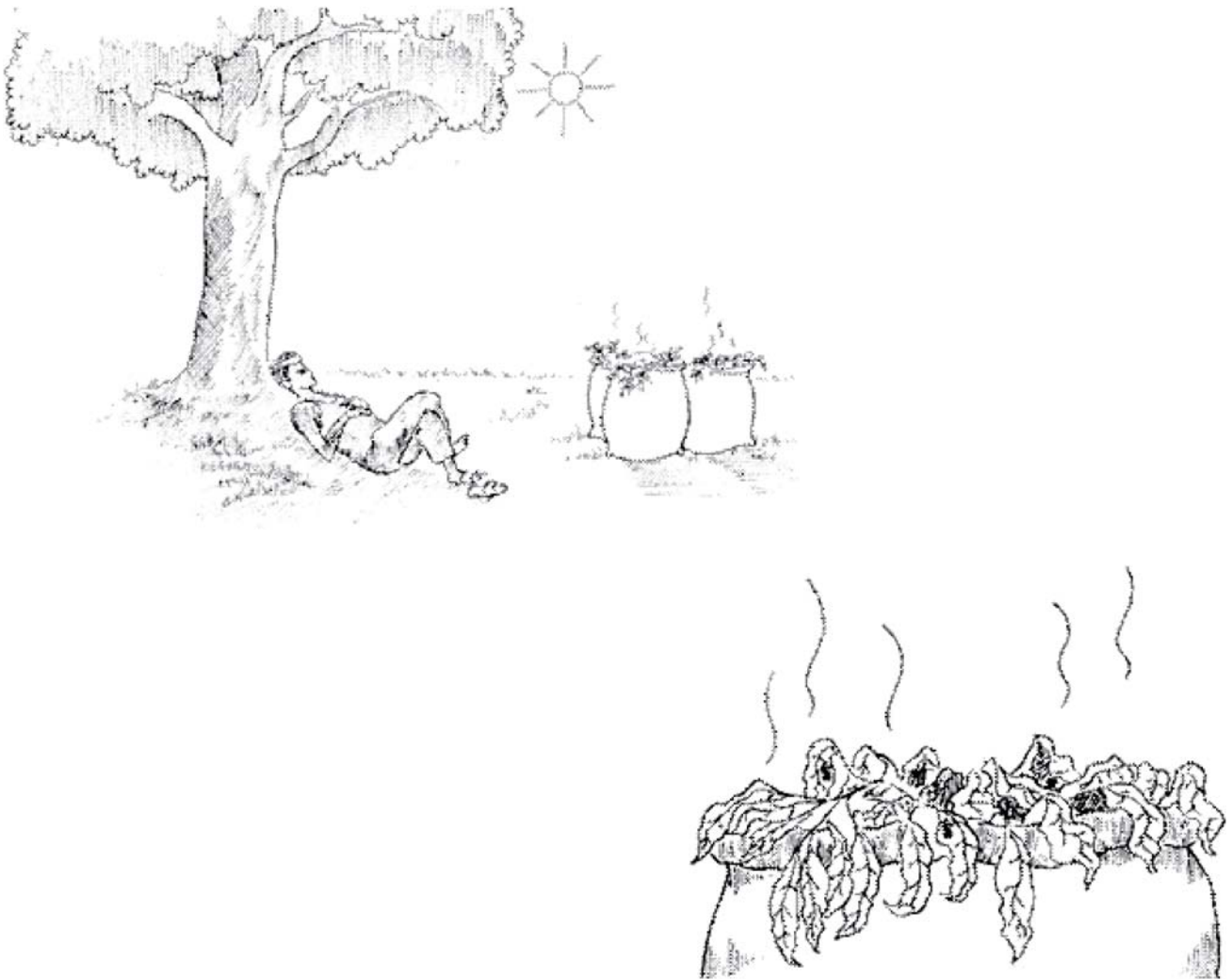


Figure 5.0.1: If sacks of freshly harvested herbs are not transported quickly to the processing site then there is a risk that the plants will start to degrade due to build-up of heat

5.1 Transportation to the Processing Unit



DO

- Transport the harvested medicinal plant parts for processing as quickly as possible
- Clean the vehicle thoroughly before use (and ensure it is dry after washing)
- Keep different medicinal plant parts clearly separated during transportation
- Protect the plants from heat and rain during transportation



Figure 5.1.1: Transporting the freshly harvested plants for processing as quickly as possible minimises risk of degradation of the plants and their medicinal properties



DO NOT

- Do not delay transportation
- Do not allow the sacks to become too hot or damp
- Do not transport the sacks along with any potential sources of contamination such as pesticides, fertilisers etc.

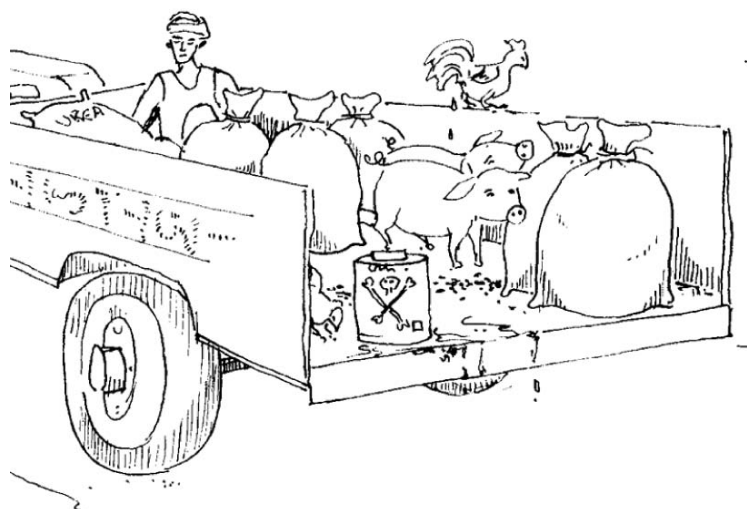


Figure 5.1.2: Harvested medicinal herbs should never be transported along with potential sources of contamination such as livestock and chemicals

5.2 Processing Site



DO

- Choose a clean location, protected from direct sunlight with access to water
- Create a shade over the working area if there is strong sunlight
- Protect the working area from rain

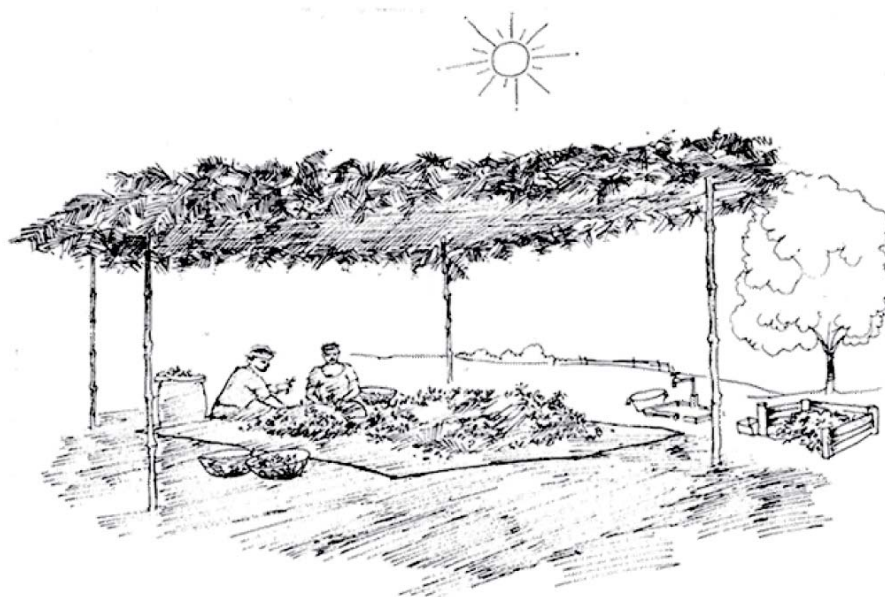


Figure 5.2.1: This processing site is protected from sunlight and has access to a clean source of water



DO NOT

- Do not choose a site that is anywhere near potential sources of contamination
- Do not choose a processing site that is a long distance from the place of harvest



Figure 5.2.2: Processing should never be done nearby potential sources of contamination such as roads and city waste

5.3 Primary Sorting



DO

- Use a clean surface, preferably a cemented floor or a tarpaulin sheet that is in good condition, for laying out the harvested / collected plant material
- Remove all weeds and other extraneous physical matter
- Carefully remove unwanted plant parts
- Make clear pathways to walk between the herbs

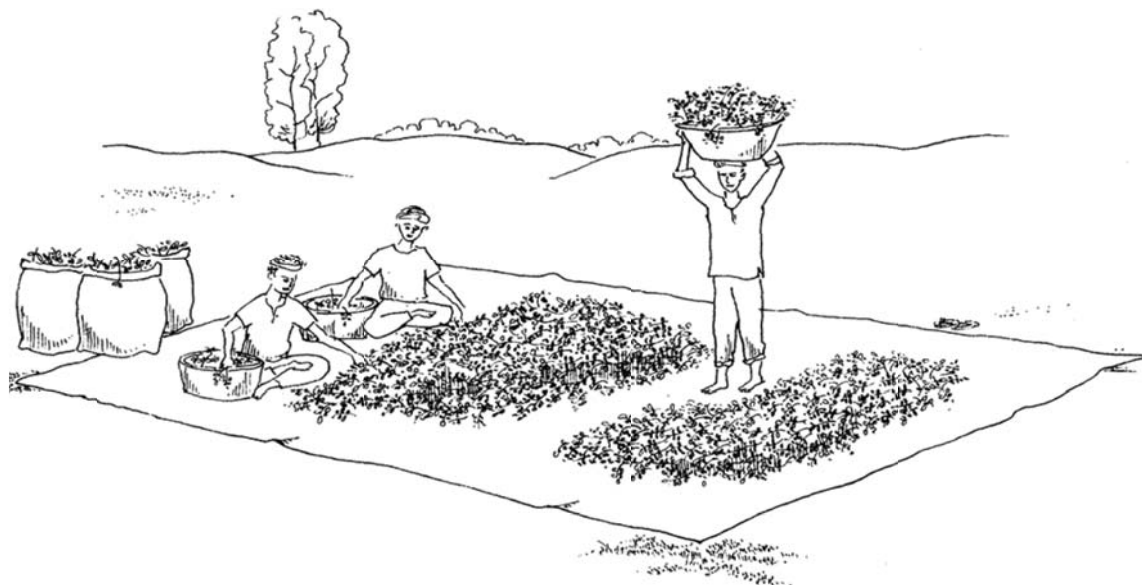


Figure 5.3.1: A clear pathway has been made between the medicinal plant parts to encourage people not to walk on them



DO NOT

- Do not use old tarpaulins, especially if small plastic pieces are flaking off
- Do not handle medicinal plant material if you have an infectious disease or open wounds
- Do not walk on the medicinal plant parts

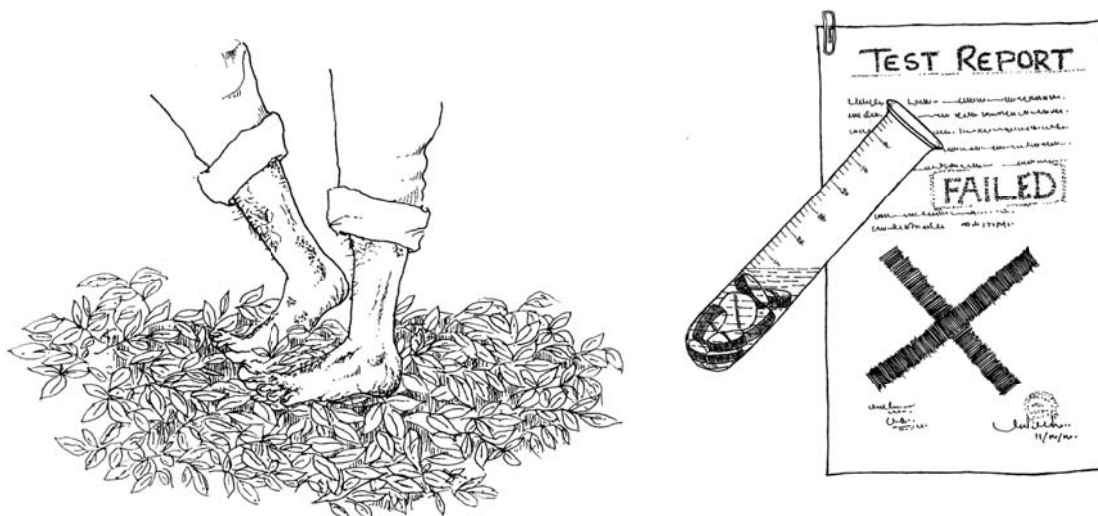


Figure 5.3.2: Walking on the harvested medicinal plant parts is likely to lead to microbial contamination due to bacteria on the feet

5.4 Washing



DO

- Wash the medicinal plant parts in clean water
- Use a number of different tubs for further rinsing after the initial wash
- Drain the water off the herbs before drying
- Use a high powered spray nozzle to clean off mud from roots and rhizomes



Figure 5.4.1: The first tub is used to wash off mud and other contaminants, the second tub is used for a first rinse, and the third tub is used for a second rinse. The water in the third tub should remain clear after washing



Figure 5.4.2: The water should be drained off before putting the medicinal plant parts in a dryer. This can be done on a 'dripping rack' as shown here, which is also a good opportunity to examine the material and remove any substandard material or foreign matter



DO NOT

- Do not wash seeds and delicate flowers
- Do not place the washed plant parts on an unclean surface after washing
- Do not use water that may be contaminated with chemicals and bacteria



Figure 5.4.3: The herbs here are being placed directly on the ground after washing. This will make them even dirtier than before they were washed.



Figure 5.4.4: In some villages there is limited access to water. In this example the collector is sharing the village tap with another woman who is washing her clothes. The chemicals in the clothes washing soap are likely to contaminate the herbs. Such situations should be avoided

5.5 Drying



DO

- Plan and build a suitable drying system in advance of harvest
- Dry the plant material as soon as you can after harvest
- Raise the harvested plant parts off the ground
- Create airflow over the plant material
- Protect the plants from insect, dust, animals, birds etc.
- Protect the plants from rain
- Lay the plants out in thin layers
- Dry the plant parts at the correct temperature
- Dry the plant material for the correct duration
- Label the plants that are drying with information of where they came from and the date that the drying started



Figure 5.5.1: The medicinal plant material should be raised off the ground



Figure 5.5.2: The best results will be achieved if there is a flow of warm, dry air blowing over the herbs

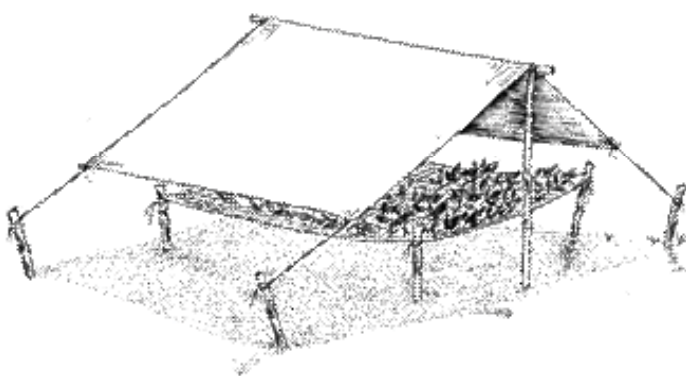


Figure 5.5.3: Green leafy herbs and/or aromatic herbs should always be dried in the shade as they will become discoloured or lose volatile oils in direct sunlight

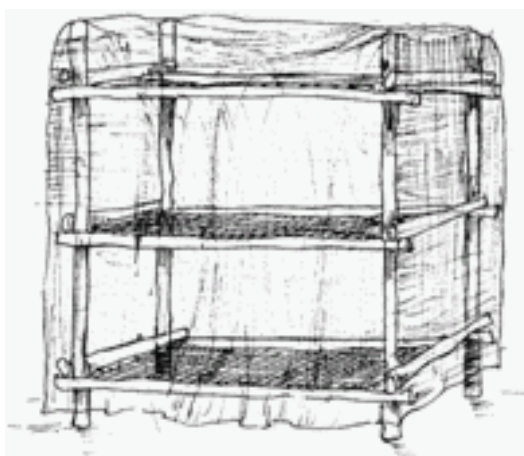


Figure 5.5.4: Efforts should also be made to protect the herbs from dust, insects and other potential contaminants

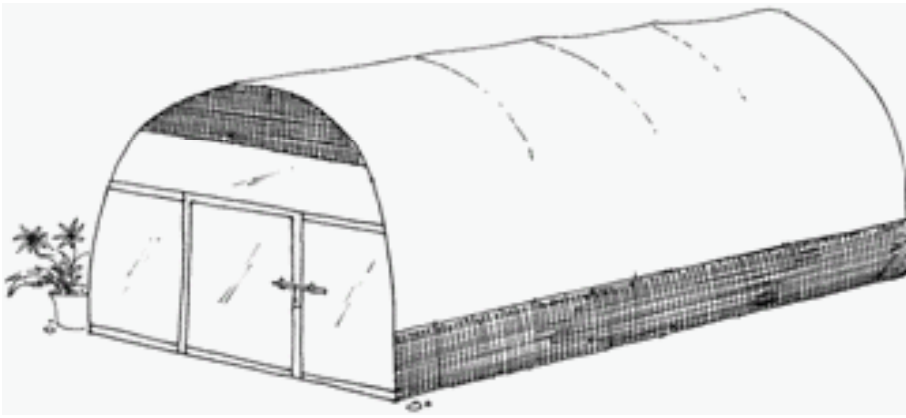


Figure 5.5.5: Another method is to construct a solar dryer – this heats in the sun and creates a flow of warm air through the air vents

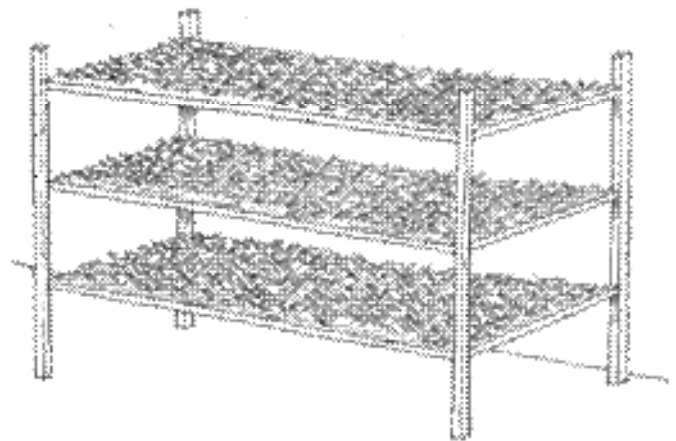


Figure 5.5.6: The medicinal plant material should be laid out in thin layers to maximise airflow and ensure uniform drying

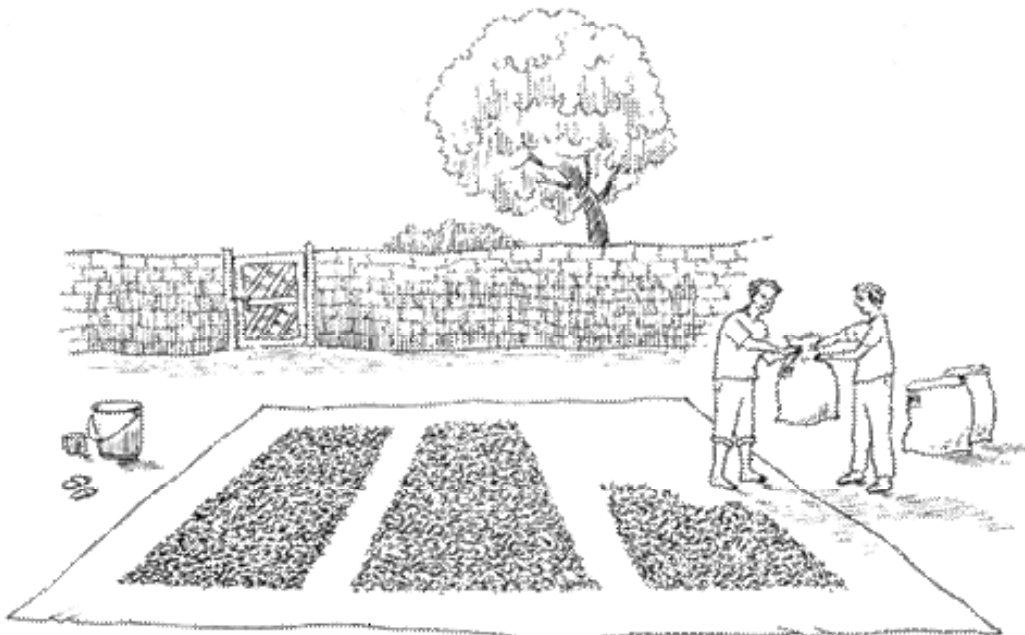


Figure 5.5.7: Medicinal plants should only be dried on the ground if there is no alternative. If this method is used then the material should be dried on a clean tarpaulin, defined paths should be made between the plant parts and people should only walk on the tarpaulin having cleaned their feet. The plant material should be covered or taken inside at night to prevent re-absorption of moisture

Drying Guidelines for Different Plant Parts:



Aerial Parts:

Leaves are normally the most tender of plant parts and can easily bruise (and turn black), so should be handled as little as possible during the drying process. Green leafy herbs tend to lose their green colour in direct sunlight so should always be dried in the shade.



Stems and Stalks:

Stems and stalks should be dried until they can be snapped. If they are bendy it normally means that they need to be dried for longer. To test whether woody stems are dry you can try scratching the bark with your nail – if it comes off easily and is green then it needs to be dried further.



Flowers:

Flowers need to be dried immediately after harvest as they contain subtle properties that should be fixed in their vibrant state. Care should be taken not to over-dry them as this can cause them to crumble into powder with any handling. If it is too hot or too cold, or there is not enough airflow, the quality of the flowers' colour and medicinal properties will decline.



Fruits:

Large fruits may need to be cut into smaller pieces or thin slices to ensure uniform drying, while small berries can normally be dried whole. Sticky fruit pieces are likely to attract insects as well as be an adhesive for dust, pollen etc. The fruit should therefore be covered with a cloth or mosquito net, and care taken to avoid dust from sweeping, winnowing etc.

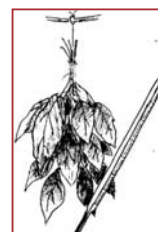


Roots and Bark:

Most bark and roots can be dried in direct sunlight, unless they are aromatic and contain volatile oils. If the bark or roots are very thick then they may need to be chopped into smaller pieces/slices.

Drying Temperature

The maximum temperature for drying most herbs is between 45°C (113°F) and 50°C (122°F). If the air is very humid then the temperature can be increased by 10°C to lower the humidity. Aromatic herbs that contain volatile oils should be dried at lower temperature; ideally at around 30°C (86°F), and not more than 35°C (95°F).





DO NOT

- Do not dry the herbs on the ground in direct sunlight without close supervision
- Do not lay the herbs out in a thick layer
- Do not place the herbs in the dryer while they are still wet
- Do not allow herbs to re-absorb moisture after drying

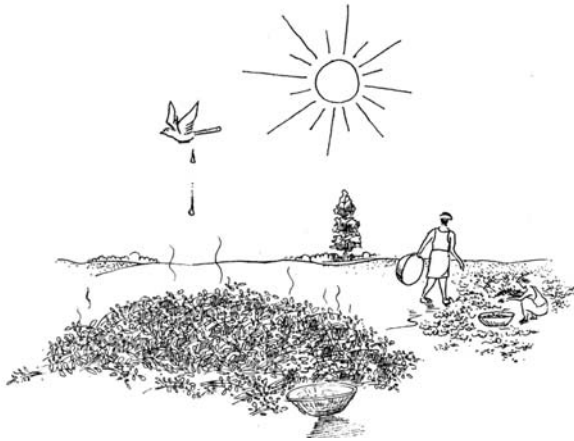


Figure 5.5.8: Drying medicinal plants in the open in direct sunlight involves a high risk of contamination caused by insects, birds and animals

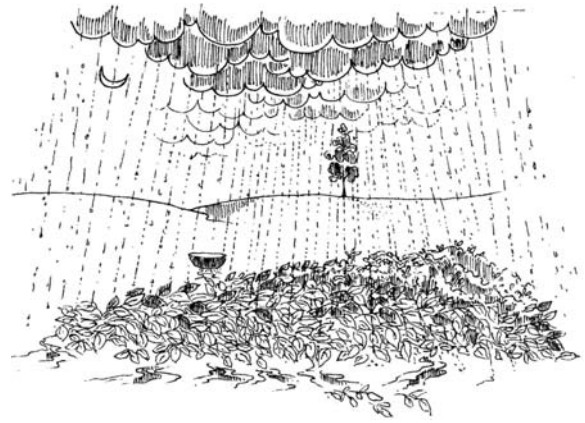


Figure 5.5.9: If medicinal plants are dried in the open there is a risk that they may be damaged by rain



Figure 5.5.10: If a strong wind blows there is a high chance that dust will be blown onto the drying plant parts



Figure 5.5.11: If the plant parts are placed directly on the ground it is likely that they will be contaminated with soil particles and other extraneous matter

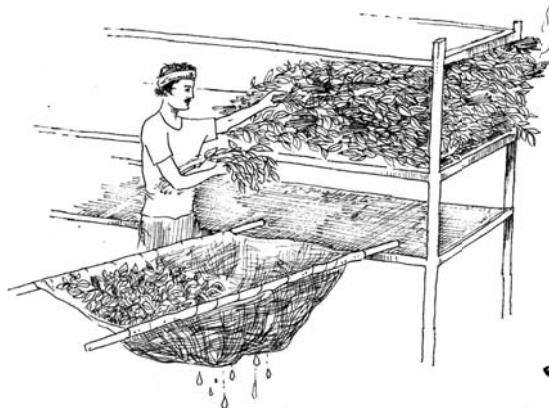
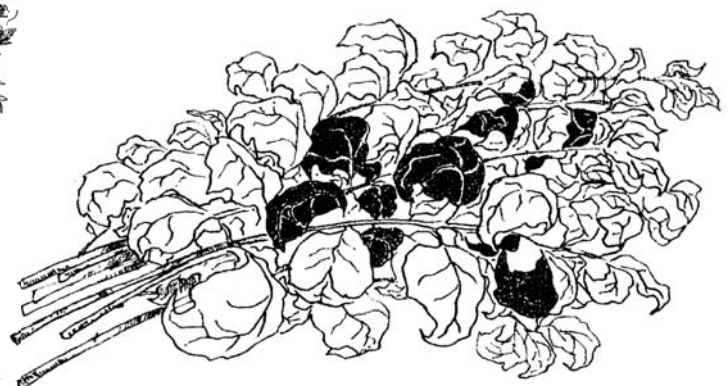


Figure 5.5.12: If medicinal plants are laid out too thickly they will start to decompose, resulting in fungal growth and discolouring of the leaves



5.6 Sorting / Grading

DO



- Remove all substandard material and any other foreign matter
- Where necessary separate the plant parts into different grades, according to their size and quality



Figure 5.6.1: The women here are working on a clean tarpaulin and placing the final material in a clean container, ready for packing

DO NOT



- Do not place your feet on the herbs while sorting
- Do not allow the dried medicinal plant parts to re-absorb any moisture after drying
- Do not allow anyone to handle medicinal plants if they have wounds or infectious diseases



Figure 5.6.2: Placing dirty feet on the medicinal plant parts while sorting and grading is likely to lead to microbial contamination

5.7 Packing



DO

- Pack the medicinal plant parts into a clean sack, ensuring it is clearly labelled
- Where possible use new sacks. If this is not possible then ensure they are well cleaned and dried before use



Figure 5.7.1: The dried herbs here are being packed into a clean sack that is clearly labelled



DO NOT

- Do not use sacks that have previously been used to store agrochemicals
- Do not pack herbs unless they are completely dry



Figure 5.7.2: If the medicinal plant parts are stored in a re-used urea sack they will be mixed with small traces of urea and subsequently fail quality tests or cause health problems to the consumer

5.8 Storage



DO

- Store medicinal plant material in a clean and dry room
- Raise the sacks off the ground
- Keep the sacks away from the wall
- Label the sacks clearly
- Keep different species separate

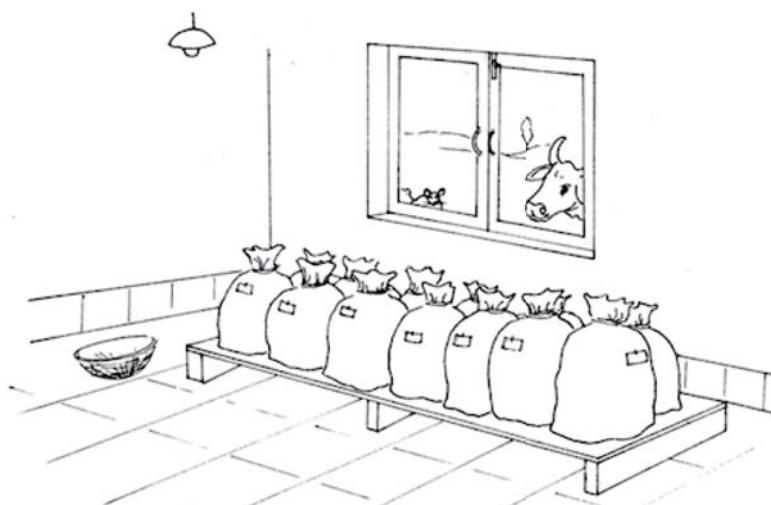


Figure 5.8.1: The sacks are raised off the ground to prevent damp. Animals, rodents and insects should be kept out of the storage room



DO NOT

- Do not store medicinal plant material in a dirty, damp room
- Do not use rat poison – this may be carried onto the herbs by the rodents
- Do not store the sacks along with agrochemicals
- Do not stack the sacks so high that the material in the lower sacks get damaged
- Do not allow animals in the storage room

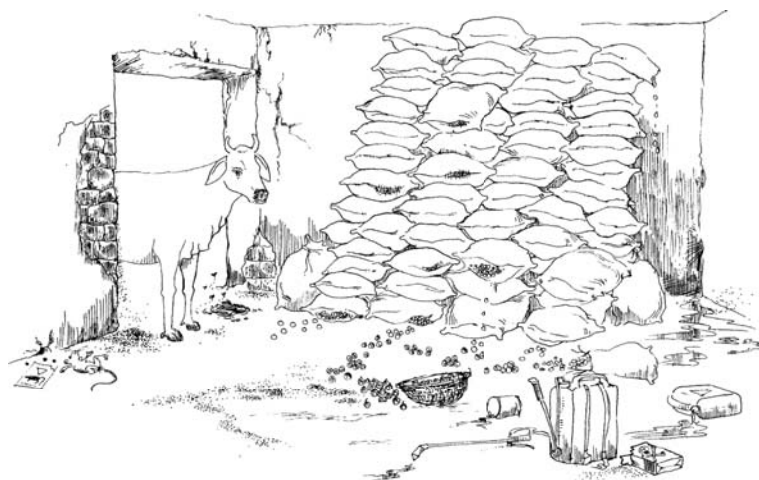


Figure 5.8.2: This storage facility demonstrates many GACP violations; over-stacking, rat poison, poor packing, no labelling, livestock in the room and agrochemicals

5.9 Documentation and Traceability during Post Harvest Processing



DO

- All processing activities should be documented in a diary
- The activities should also be documented on a label or harvest tag, which should remain attached to the sacks wherever they go
- All records should refer to the batch number allocated to the material at the time of harvest



Figure 5.9.1: A record should be kept of each processing activity



Figure 5.9.2: There should always be a label that indicates which batch is being processed

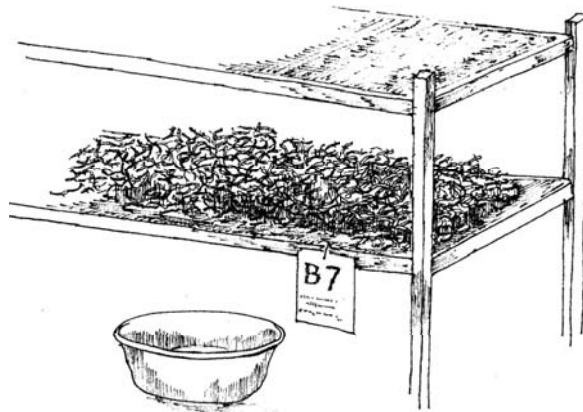


Figure 5.9.3: A label should be attached to the dryer with the batch number and the date that the drying started



Figure 5.9.4: If the material is separated into different grades then this should be recorded



Figure 5.9.5: When packed into sacks each sack should be clearly labelled with the batch number



Figure 5.9.6: The sack should then be weighed and the quantity should be recorded in the diary and onto the labels

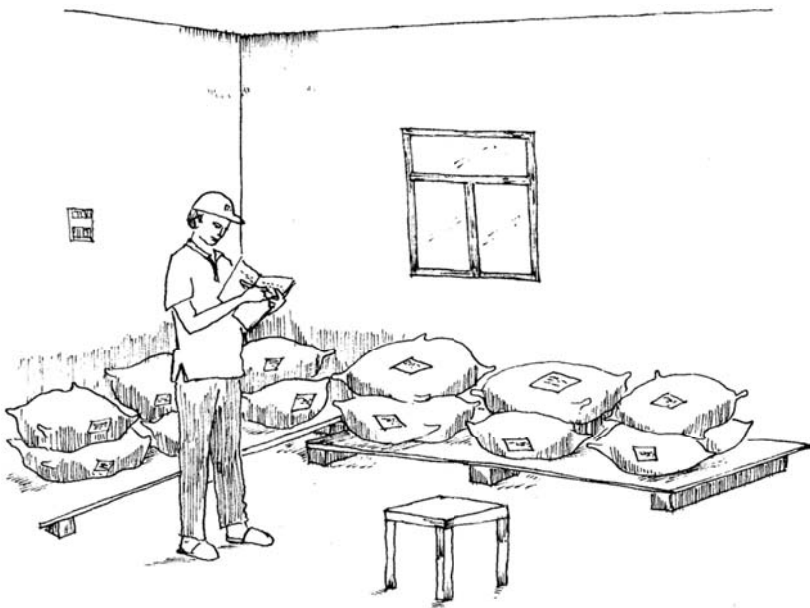


Figure 5.9.7: The storage facility should have a stock book with details of what material comes in and what goes out and each sack should be clearly labelled with the name of species, batch number and origin.

Figure 5.9.8: When the medicinal plant material is transported to the next destination a copy of all the relevant records should be handed over to the driver to pass on to the recipient at the other end

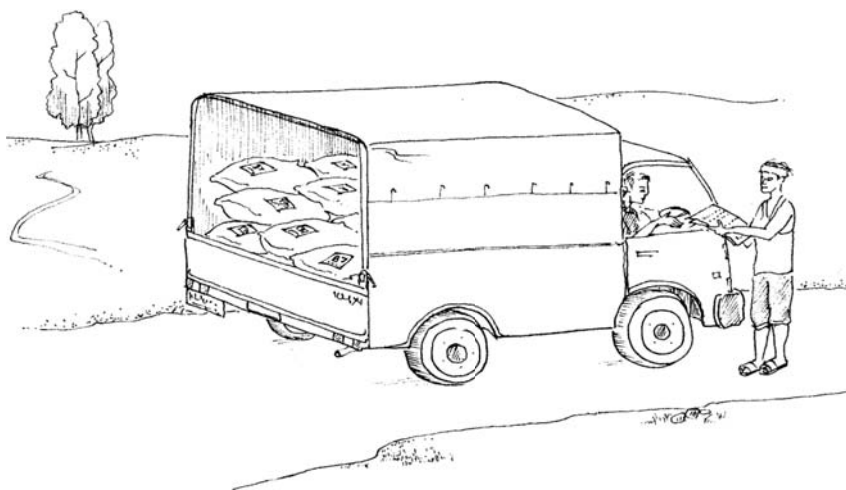


Figure 5.9.9: Having maintained records of each stage of the medicinal plant's journey from field to shelf, the batch number on the final product can be used to trace the material back to its origin

6. Conclusion

By following GACP guidelines to produce raw materials for the herbal industry, herbal medicines are guaranteed to be of a high quality; effective, safe to use and environmentally sound. Medicines produced in this way will provide long-lasting benefit to both producers and users of the herbs, as well as the fields and forests in which they are cultivated and collected.



Figure 6.0.1: Growing high quality herbs not only benefits the consumer; the farmers and collectors are also likely to build a strong relationship with their buyers, and will command a higher price in the market. They are less likely to waste any medicinal plant material from crop losses, or degradation or damage. The end result is a happy farmer / collector, a healthy environment, efficient herbal drug manufacturers and many satisfied consumers of the herbal medicine



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