Conservation of Eastern European Medicinal Plants

Arnica montana in Romania

Case Study Gârda de Sus

Management Plan

Barbara Michler

2007

Projekt Leader: Dr. Susanne Schmitt,
Dr. Wolfgang Kathe (maternity cover)
WWF-UK
Panda House, Weyside Park, Godalming, Surrey GU7 1XR, United Kingdom

Administration: Michael Balzer and team
WWF-DCP
Mariahilfer-Str. 88a/3/9
A-1070 Wien
Austria

Projekt Manager: Maria Mihul
WWF-DCP
61, Marastu Bdv.
3rd floor, 326/327/328
Sector 1, Bucharest, RO-71331
Romania

With financial support of the
Darwin Initiative
Area 3D, Third Floor, Nobel House
17 Smith Square, London SW1P 3JR
United Kingdom

Project Officer: Dr. Barbara Michler
Dr. Fischer, ifanos-Landschaftsökologie
Forchheimer Weg 46
D-91341 Röttenbach
Germany

Local Coordinator: Dr. Florin Pacurar
University of Agricultural Sciences and
Veterinary Medicine (USAMV)
Department of Fodder Production & Conservation
Cluj-Napoca, Romania

Major of the community
Gârda de Sus
Alba Iulia
Romania

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To our children

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1. Background

Medicinal and aromatic plants (MAP) have been an important resource for human healthcare from prehistoric times to present days. Schippmann *et al.* (2006) estimated, that 72 000 plant species are known to be used throughout the world and that approximately 15 000 species (21%) are threaten. About 2000 MAP species are traded in Europe for medicinal purposes. (Lange 1998). South-east Europe is one of Europe’s most important source region for medicinal plants. (Lange and Schippmann 1997). Kathe *et al.* (2003) gave an overview of MAP collection and trade in Romania.

Medicinal plants, collected from the wild are a valuable natural resource of Romania. Ciocarlan (2002) describes 3136 species (Pteridophyta and Spermatophyta) in the “Flora ilustrata a Romaniei”. Mohan (2001) listed 326 MAPs, Ghisa and Beldie (1976) listed 185 MAPs. According to Onisei *et al.* (2006) there is a long tradition of medicinal plant use as therapeutic remedies in most of the houses, villages, monasteries and hospitals of Romania. Lange in Kathe *et al.* (2003) estimated that between 1992-2000, 1080 tonnes of MAPs per year were exported from Romania. Murrain *et al.* (2004) estimated that in 2001 in Romania a quantity of 11280 (!) tones of raw material were gathered in the wild and processed.

Information about medicinal plants is often available based on annual national/regional statistics regarding species and habitat richness and export data of mostly dried material. However, little is known about the relation between species (e.g. *Arnica montana*) and the medicinally important plant part (e.g. *Arnica montana* flower heads) or between species, medicinal plant part and habitat on the one hand, and about the harvesting and processing e.g. drying circumstances of the product that is in trade on the other (e.g. *Arnicae flos*).

Based on preliminary studies of the University of Freiburg, Institute of Silviculture, Prof. Reif, and results of a research project “Proiect Apuseni”[1] (Rusdea, Reif, Povara, Konold 2005) a resource assessment of medicinal plants in a defined area in the Apuseni mountains was performed from 2000 to 2003. In the area, the status of medicinal plants was determined. The occurrence of medicinal plants was related to vegetation mapping. MAP rich vegetation types were identified (Michler 2005a, b). Reif *et al.* (2005c) determined 491 taxa, according to Dapper (1987), 242 taxa are medicinal plants. This includes plants used in folk healing, homeopathy and phythotherapy. Especially traditional managed mountain grasslands on calcareous and siliceous soils and species rich mountain meadows are rich in medicinal plants and of a large extend in the project area (Michler 2005a).

Arnica montana is the flagship species of the region. It occurs on nutrient poor, low productive, and extensively managed grassland that is used as pasture and for hay production. A resource assessment of the flower heads was performed. A habitat model of *Arnica montana* based on soil type, slope, aspect, was calculated (Fischer 1994, Michler 2005a). The model estimated more *Arnica* sites than currently exists. The difference between actual and potential habitats can be explained by either one of three factors (i) the land is covered by forest, (ii) the land is fertilized, or the land is overgrazed. The grasslands are part of a traditional subsistence-based highly diverse farming system. This kind of grassland is threatened by intensification (especially fertilisation) abandonment due to out-migration, or reforestation. Currently the farmers need the

[1] http://www.proiect-apuseni.org/

grass to make hay to feed horses and cattle. As long as horses are needed for transport and for work in the forest and as long as the local people have no other fodder sources, grassland will be managed. However, it is more convenient for the farmers to fertilize some of the hay meadows to increase the production than to keep managing all meadows extensively under exhausting working conditions. This dynamic process already started with recent moderate fertilization of meadows and more abandoned meadows, because the locals have no need for the hay or they are too old to cut the grass. Currently, the socio-economic situation and the land use is changing. Consequently, the total area covered by nutrient poor, low productive, extensively managed grasslands and the quantity of *Arnica* occurring in the grasslands will decline. In parallel, the pressure on the remaining *Arnica* populations will increase. *Arnica* has been collected for more than 30 years in the region. Declining habitat and thus a declining resource will lead to over-harvesting in the future.

In 2004, funded by the UK Darwin Initiative, WWF-UK in partnership with WWF Danube Carpathian Programme (WWF-DCP), the Agricultural and Veterinary University of Cluj (USAMV) and the commune of Gârda de Sus (Gârda) initiated a project to develop a model for the sustainable production and trade of *Arnica montana*, in Gârda de Sus commune (Michler, Kathe, Schmitt, Rotar 2004). The project was tasked to develop a model on how to strengthen the capacity and economic incentives for the conservation of traditional cultural landscapes and species-rich habitats containing medicinal plants through sustainable production and trade.

Sustainable production has to be based on: resource assessment, monitoring of habitats, monitoring of habitat management, monitoring of harvesting guidelines (e.g., non-destructive harvesting) and quotas. Incentives for harvesters and landowners can be generated through value-adding (on-site drying and quality control), enhanced income through direct sale of dried-material at favourable prices to manufacturers, and through better distribution of monetary benefits between harvesters and landowners. The development of local capacity to manage and trade the *Arnica* and other natural resources focused centrally on the development of a community-based institution.

2. Introduction

Conservation of Eastern European Medicinal Plants: *Arnica montana* in Romania

Vision

Sustainable use of our natural resources is one of the big challenges of our time and will become increasingly important. This challenge is inextricably linked to local livelihoods and to economic viability, without which the use of natural resources and ultimately nature conservation cannot be managed in a sustainable way.

The conceptional basis of this project

Many habitats of conservation importance are under threat through habitat conversion. Some of these habitats are a direct result of traditional farming practices. Once more intensive farming takes place the habitats are usually lost rapidly. Some of these habitats contain species of medicinal plants that are used locally or traded. Incentives have to be increased to allow the continuation of more extensive forms of management in order to maintain these species rich habitats and traditional cultural landscapes.

Goals of the Project

The main goal of the project was to develop a model for the sustainable production of and trade in *Arnica montana* in Gârda-de-Sus resulting in benefits to both biodiversity and livelihoods. The project was tasked to extract principles and lessons from its work that can be applied to the conservation of *Arnica* at other sites, as well as other species of medicinal plants and their habitats.

The project set out to develop a model on how to increase incentives and built capacity for the conservation of species rich, traditionally managed habitats and landscapes containing medicinal plants. The model is based on a case study of one species (*Arnica montana*) at one locality (community of Gârda-de-Sus, Apuseni mountains, Romania). Incentives that were explored included value addition (including drying on site) and quality control and enhanced income through sale of material at favourable prices to manufactures. Development of local capacity focused on harvester and landowner training in sustainable harvesting and meadow management practices and the development of a community-based organisation to manage the resource and trade in *Arnica* and other natural resources beyond the end of the project. The aim was also that the result of the project (especially on *Arnica* management) would be included in the management system of the Apuseni Mountains Nature Park (ANP) administration.

We would like to encourage that the model developed from this *Arnica* case study will be tested under a range of conditions; for example with *Arnica* at other sites in Romania, with other species of medicinal plants in Romania, and with *Arnica* or other species of medicinal plants elsewhere in Europe and the rest of the world.

Project Components

The development of fair and considerate ecological and social management systems is equally challenging and essential for the success of the project. Based on experiences from the previous project, scientific data on *Arnica* distribution, habitat and resource assessment and experiences gathered under the WWF/UNESCO/Kew People and Plants Programme (Hamilton and Hamilton 2006) key components for successful project implementation were identified:

- Research on *Arnica* resource assessment and habitat, trade chain, socio-economic context and value adding.
- Development and construction of *Arnica* drying facilities for local value adding.
- Development of a local resource management and trade organisation.
- Training and capacity building of members of local community and young-professionals in the project team.

<u>Training and capacity building</u>

The members of the project team worked closely together with farmers (land-owners) and collectors and trained them in basic scientific and technical knowledge of *Arnica* ecology, post-harvest treatment of *Arnica* flower heads and sustainable resource management. The local farmers provided the project team with their traditional knowledge with regard to meadow management. Together with the local advisory group monitoring methods were tested and a local management plan for the sustainable use of *Arnica* meadows was developed. In addition, the capacity of young scientists from USAMV (Universitatea de Stiinte Agricole si Medicina Veterinara, Cluj-Napoca) and UBB (Universitatea Babes-Bolyai) was built in community-based and interdisciplinary approaches to conservation and in technical and scientific skills.

<u>Development of a local resource management and trade organisation (RMTO)</u>

Successfully establishing a local RMTO was a key milestone of the project. Important tasks of the RMTO were the development of a local *Arnica* management plan, the setting of annual harvest quotas and developing of a detailed concept for value-added products (e.g. local drying facility of *Arnica* flowers). A company partnership was to be developed between the RMTO and a herbal company (i.e., WELEDA).

<u>Development and construction of *Arnica* drying facilities</u>

Local drying facilities for *Arnica* flower heads are an important component of the project, as quality dried *Arnica* flower is a processed and refined product that can be sold at considerably higher prices as compared to fresh *Arnica*. The drying facilities were built close to the collection sites. Methods and scale of drying had to be established.

Experimental drying in a demonstration drying facility was performed for two field season to convince collectors / farmers of the usefulness of the method and to develop the drying and ease setting up more solid drying facilities during the third year.

Research on resource assessment, *Arnica* habitats, value adding, trade chain and socio economic context

Baseline research is, together with regularly monitoring an important cornerstone in the development of a resource sustainability concept. The following research was carried out:

- Resource assessment, resource monitoring.
- Inventory of the sites.
- Recording species composition of the sites to generate a mapping key, to determine the conservation status of the vegetation type and to extract key species for habitat monitoring.
- Analysis of the trade-chain for *Arnica* flowers from Gârda-de-Sus and Western European market study.
- Value adding through improving and rating the quality of the harvested flower heads and through onsite drying.

Revenues from sustainable use of *Arnica* flower heads and local value adding can contribute to maintain the species and the habitat and to increase the income of the farms. However including the costs of monitoring, fair trade, habitat management and certification, transparency of origin and processing and business administration costs the price of the final product "*Arnicae Flos, sustainable, fair and transparent*" is higher than the one of "*Arnicae flos*" only that is sourced in the traditional way. Moreover, the maintenance of *Arnica* habitats is closely linked to extensive management of the sites and to the total socio-economic situation of the farms. Currently the farms have a highly diverse activity portfolio. However, the major income is made in the forests. This resource is declining (Auch 2006). The socio-economic situation of the local people is critical. Out-migration is already a major problem (Heidelbach 2005, Jordan and Frasineanu 2005). In consequence of this, the maintenance of *Arnica montana* and of "*Arnicae Flos, sustainable, fair and transparent*" is closely linked to a diversified sustainable regional development strategy. The local people need additional income sources to have an incentive to remain in the area. Sustainable use of local resources (timber, MAPs, mushrooms) can contribute to this. If regional development strategies focus on sustainable development that includes sustainable use of local resources and concentrate on local value adding, sustainable tourism and sustainable agriculture and forest management the traditional extra ordinary beautiful cultural landscape including all its natural resources will maintain for present and future generations.

Key activities for monitoring and to improve the quality of the collected *Arnica* flower heads were identified. A harvester manual was developed and tested and a rating scheme to evaluate the quality of the harvested material was developed and tested. Local people were trained to apply them. Tămaş, Vlase, Crişan (2006) analysed the material obtained according to the stipulations of European Pharmacopoeia. The quality of the processed flower heads fulfils the requirements. Drying experiments were performed. Local drying facilities were constructed and tested in order to dry 6000 kg of fresh *Arnica* flower heads during the short flowering period on site. A local resource and trade management organisation was found. It consists of a NGO called Ecoflora and a LTD named Ecoherba. The main purpose of Ecoflora is to protect the wild plant species and their sustainable use generating benefits for local communities and nature protection. The association is managing collecting, drying and monitoring of *Arnica* flower heads. The LTD Ecoherba is the business branch of Ecoflora. The LTD is managing the export and the contact with the buyers. Ecoflora/Ecoherba succeeded to export dried *Arnica* flower heads (Michler 2007). A company partnership (5-years) has been signed with Weleda Germany who is at present the sole trading partner of Ecoherba. The sourcing, the drying process and the trade is transparent. Within the research topics, three masters thesis and three diploma thesis were completed by students from Cluj:

- Nicoleta Garda (2007), management of *Arnica* sites, diploma thesis.
- Adriana Morea (2007), drying of *Arnica* flower heads, master thesis.
- Cosma Mona (2006), vegetation of *Arnica* sites, diploma thesis.
- Michael Klemens, supply chain research (2005), tourist survey (2006) on attitude to buy local *Arnica* products, diploma and master thesis.
- Razvan Popa, herbivore species, damaging *Arnica montana*, insects living in *Arnica* habitats (2007), master thesis.

Local people were trained in monitoring, harvesting methods and sensitised to over-harvesting and habitat loss. Moreover together with them *Arnica* flower heads were bought, rated, and dried.

3. Purpose, priorities

The purpose of the plan is to provide a model for the sustainable production and trade of *Arnica montana*. The model is based on local resource management, on site value adding and local trade management. Benefits for biodiversity are gained through maintenance of the species *Arnica montana* and its biodiversity rich habitats. Benefits for livelihoods are generated directly through local value adding and indirectly through maintenance of the cultural landscape. The latter is an important component of a sustainable tourism concept. Tourism is regarded as a major chance for regional sustainable development (Rusdea *et al.* 2005).

4. Goal, objectives, activities

The goal of the management plan is to conserve current populations of the species *Arnica montana* and to use the flower heads sustainably for the benefit of local livelihoods. Moreover, the species rich grassland as part of the cultural landscape should be maintained. In Table 1 objectives and activities are listed. Comparing the annual monitoring with the results of the baseline studies and analysing the trend will ensure sustainability. Currently the grassland management is subsistence based and the *Arnica* flower heads are a by-product of this management. Probably there is no future in subsistence-based agriculture. To maintain the species rich grassland, research on habitat management costs should be performed to have a baseline study to apply for compensation payments and to make contracts with the farmers on management practices. It is strictly recommended to add more local value to *Arnica* flower heads and to include other MAPS in the product line-up of Ecoflora/Ecoherba. Direct marketing of local products to tourists is regarded as a major potentiality to look ahead. The locals can sell the products by themselves; this supports their individualistic life style and seems to be with good prospects.

Table 1: Objectives and activities

Objective	Activities
Maintain the current *Arnica* populations	Monitoring of resource. Monitoring of harvested flower heads. Monitoring of habitat. Monitoring habitat management. Analysing data.
Insure sustainable use	Comparing monitoring result with baseline studies. External evaluation.
Maintain the species rich grasslands	Baseline study on management costs. Apply for subsidies to maintain traditional grassland management Make contracts with the farmers on management practices.
Local value adding	Rating quality.

Objective	Activities
	Drying of fresh *Arnica* flower heads for Export. Drying of fresh *Arnica* flower heads for direct marketing. Preparing *Arnica* tincture and *Arnica* oil for direct marketing. Preparing an oil macerate from fresh *Arnica* flower heads for direct marketing.
Generate local income from *Arnica* sale	Encouraging local business. Apply for subsidies to increase local business know ledges. Especially in business administration and business planning training is necessary.
Create new local products	Perform baseline studies in drying mushrooms and other herbs.

4.1. Structure of the management plan

The management plan provides general information, results of baseline ecological research, on resource assessment, habitat management of *Arnica montana* and collecting practice, value adding and ethical trade management of "*Arnicae Flos*" as developed and established in cooperation with the members of the Gârda de Sus commune.

The results of the baseline studies and the outputs of the activities related to the other project components are documented in the management plan in form of short chapters and as appendices. Activities deriving from the research and required for the sustainable management, value adding and trade are documented as operational procedures (OP). In Figure 1, the relationship of project components and management plan components on the one hand and documentation of results and operational procedures (OP) in the management plan on the other is illustrated.

In Appendices (1-21) OPS to prepare the fieldwork, to perform the monitoring of the resource, the habitat and the harvested flower heads, to source and rate quality, to build drying facilities, to dry *Arnica* flower heads, to monitor the drying process to manage the grassland and to export *Arnica* flower heads, are given.

Baseline studies in resource assessment and grassland management and biodiversity of the habitats are presented below. Transparent monitoring methods have been developed. A regular third party evaluation is recommended to check the state of the resource based on the annual monitoring data and statistical analyses of the data.

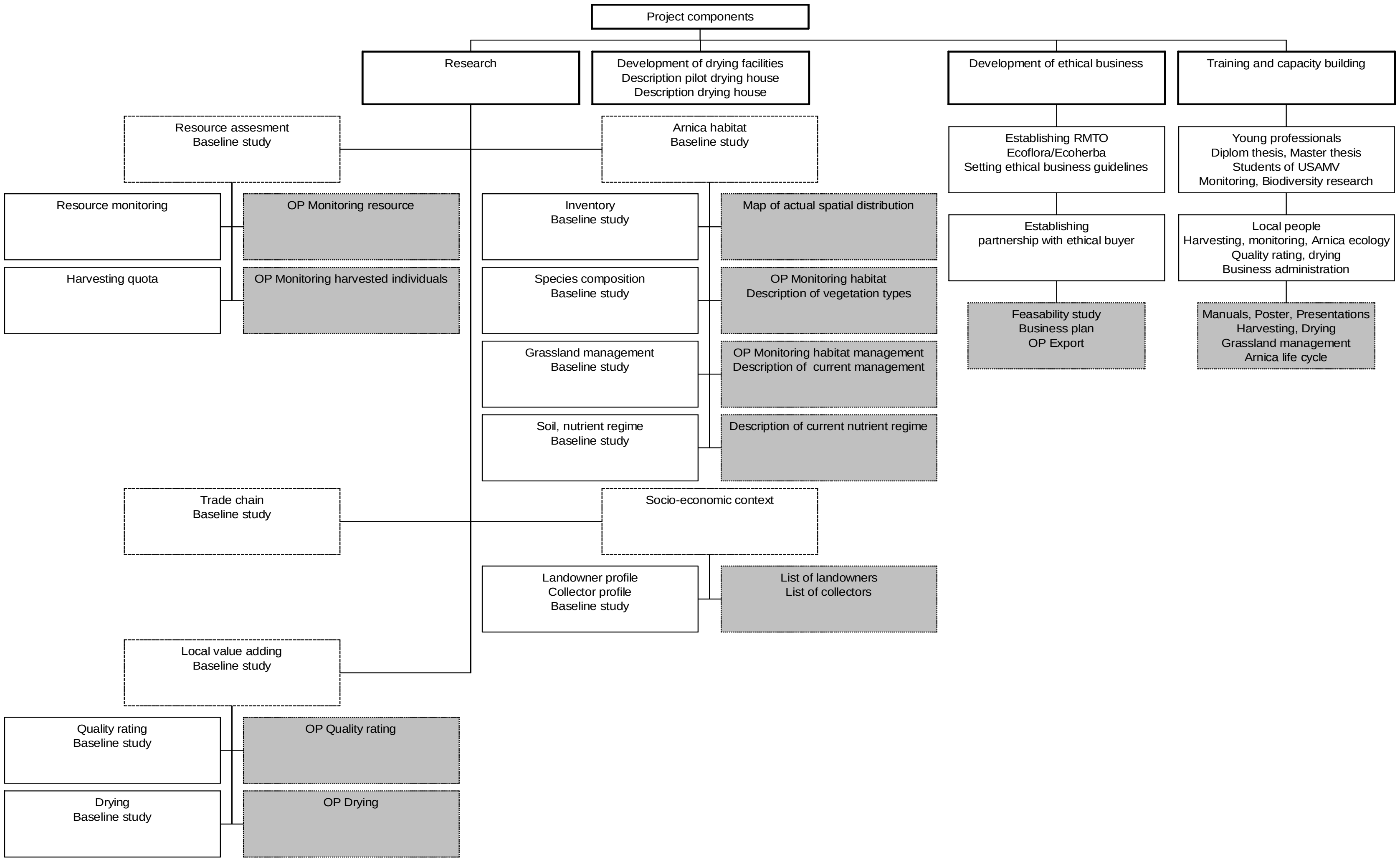


Figure 1: Relationship of project components (white boxes) and management plan components (grey boxes) and documentation of results and operational procedures (OP) in the management plan

5. General descriptions

5.1. Morphology of *Arnica montana*

Scientific Name: *Arnica montana* L. Sp. Pl.: 884 (1753), *Asteraceae*

Common Names: European *Arnica***,** Leopard's Bane, Mountain Snuff, Mountain Tobacco, Wolf's Bane

Arnica montana of the family *Asteraceae* is a perennial herb. Stems 20-60 cm, leaves simple, 2-4 cm wide, obviate or elliptical to oblanceolate, cauline, opposite, crowded near base of stem. Leaves densely glandular pubescent or puberulent on the upper surface. Florets yellow 1-3 up to 7 flower heads per stem, size 6-7 cm (diameter) Receptacle convex, hairy, ligulate florets female, tubular florets hermaphrodite. Achenes ribbed. Pappus hairy, about as long as corolla. It thrives in meadows, pastures and heaths.

Figure 2 *Arnica montana*, source: Koehler's Medicinal-Plants

5.2. Distribution of *Arnica montana*

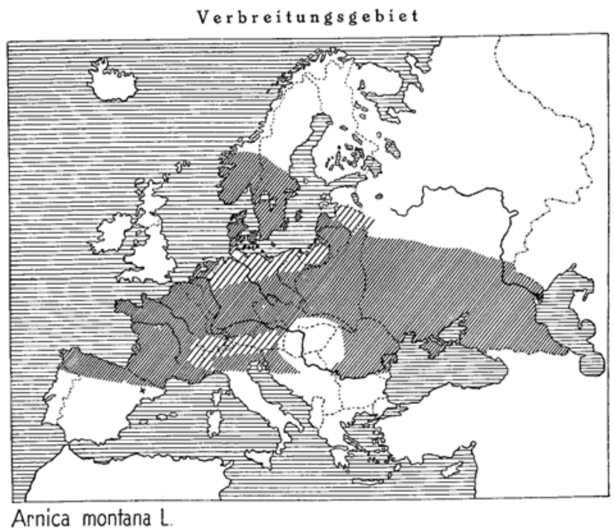


Figure 3 Distribution of *Arnica montana* in Europe (Meusel et al. 1965)

The species is endemic to Europe and can be found in Au Be Da Ga Ge He Ho Hs Hu It Ju Lu No Po Rm Rs (B,C,W) Su (Maguire 1943; Tutin *et al.* 1984). *Arnica* occurs according to Hegi (1929) in humus, sandy soils in unfertilised meadows, heathlands, in drying up bogs and in light coniferous forests. *Arnica* is a characteristic species of *Nardus stricta* grassland (Oberdorfer *et al.* 1994). The habitat type occurs from the lowlands to alpine-altitude belt.

5.3. Conservation status of *Arnica montana*

Arnica montana is a threaten species[2]. The species is listed in Annex V of the EU-FFH-directive (Council directive 92/43/EEC).

In mountainous regions, *Arnica montana* mainly occurs in the habitat types *Nardus stricta* grasslands and in mountain hay meadows. Both habitat types are listed in Annex I of the EU-FFH-directive:

- Habitat type 6230*: *Nardus stricta* grasslands*
- Habitat type 6520: Mountain hay meadows

Due to changes in agriculture practice, the species declined within the last decades in Europe. Extensive grazing and extensive meadow management practices have been typically for subsistence-based or small-scale farming systems in areas of low agriculture productivity especially in mountainous regions and in heath lands. These systems have been replaced by intensive management regimes, or the land was abandoned or reforested. Nowadays, National and EU payments subsidise farmers to be able to manage the remaining oligotrophe grasslands. However, the total amount that is spent for these conservation efforts is limited and in consequence the number of farmers respectively areas that profit from these subsidies is limited.

The UNEP site http://enrin.grida.no/biodiv/biodiv/national/romania/index.htm provides general information about biodiversity in Romania (Species, habitats, threats, legal and institutional framework**,** National Strategy and Action Plan). http://www.plant-talk.org/country/romania.html offers information on nature conservation in Romania. Donita *et al.* (2005) gave an overview on habitat types in Romania. A number of 357 habitats belonging to 7 classes and 24 subclasses of PALAEARCTIC HABITATS classifying system have been listed. Sarbu (2005) presented an overview on IPA in Romania. 276 IPA have been identified. Coldea *et al.* (2003) published lists on the national and international conservation status of species occurring in Romania.

In Romania *Arnica montana* is not listed in:

- BOŞCAIU N., COLDEA G., HOREANU C, 1994, Lista roşie a plantelor vasculare dispărute, periclitate, vulnerabile şi rare din flora României, Ocrot. Nat. med înconj., t. 38, nr 1, Bucureşti, p.45-56.*Arnica montana* is listed as vulnerable in:

- Oltean M., Negrean G., Popescu A., Roman N., Dihoru G., Sanda V., Mihăilescu S., 1994: Lista Roşie a plantelor superioare din România. Inst. De biologie – Studii, Sinteze, documentații de ecologie, 1, Bucureşti, p1-52.

Arnica montana is attributed to category „Aii", european threaten, in:

- COLDEA G., SÂRBU I., CRISTEA V., SÂRBU A., NEGREAN G., OPREA A., CRISTUREAN I., POPESCU G., 2003, Ghid pentru identificarea importantelor arii de protecție şi conservare a plantelor din România, Ed. Alo, Bucureşti, 113p. **Aii**

[2] For details on conservation status see http://www.traffic.org/plants/species-3.html, http://www.wwf.de/fileadmin/fm-wwf/pdf-alt/arten/medizin/*Arnica*_montana.pdf. http://www.wwf.org.uk/filelibrary/pdf/amontana.pdf

5.4. Herbal *Arnica*, *Arnicae Flos*

Arnica (*Arnica montana)* is a very popular medicinal plant. Mostly dried flowers are used (*Arnicae Flos*) to manufacture phytomedicines. Tincture and oil macerate are the basic to prepare ointment, cream or gel. In Central Europe it is used since the middle age as medicinal plant. Mayer and Cygan (2000) gave an overview of the historical use of *Arnica montana*. In folk medicine *Arnica* appears to have been used since the middle ages for menstrual pains and as an abortifacient agent. In the course of the 16th century, it became an outstanding »wound-remedy« for external injuries.

Wichtl (2004) summarized the present situation. *Arnica* preparations are restricted to external use in the treatment of post-traumatic and post operative conditions such as haematomas, sprains, bruises, contusions, fracture-related oedema and rheumatic ailments of the muscles and joint complaints. Others are inflammation of the oral and pharyngeal mucosa, furunculosis and inflammations caused by insect bites and surface phlebitis[3]. Beside this volatile oil is extracted from the flower heads (*Arnicae aetheroleum*) and add on cosmetics e.g. hair tonic, shampoo and cream (Merfort 1992).

5.5. Study area and people

Figure 4: Location of the study area

Very beautiful traditional landscapes characterise the investigation area in the northern Apuseni mountains (www.proiect-apuseni.org, www.*Arnica*-montana.ro, http://www.parcapuseni.ro/).

[3] http://www.herbalgram.org/iherb/commissione/Monographs/Monograph_0007.html

The case study area was the community Gârda de Sus, County Alba in the Apuseni mountains (46°29'27.29''Northern latitude; 22°48'50.78''Eastern latitude). The surface of the community Gârda covers 87.4 km^2. This refers to 8741 ha.

1861 people are registered in the community of Gârda de Sus, of which 932 are women, and 929 are men. Declining birth rate and strong migration trend in the last decades resulted in a decreasing human population. From year 1966 to 1977 the number of the population decrease from 3228 to 2703, meaning an average reduction of 48 people/year. In the next decade a reduction from 2666 in the year 1979 to 2336 in the year 1989 was recorded (decline of 33 people/year average). Since 1989, the population decreased by 475 people, an average of approximately 43 people/year (Jordan and Frasineanu 2005, Zinke 2006).

The altitude ranges from 700m in the valley to 1350m. The climate is a typical mountainous climate. The mean annual temperature reaches 3.9°C to 4.4°C. The annual precipitation is estimated 1358-1631mm with a maximum from July to September. Snow is falling from the end of October to the end of March (Povara *et al.* 2005).

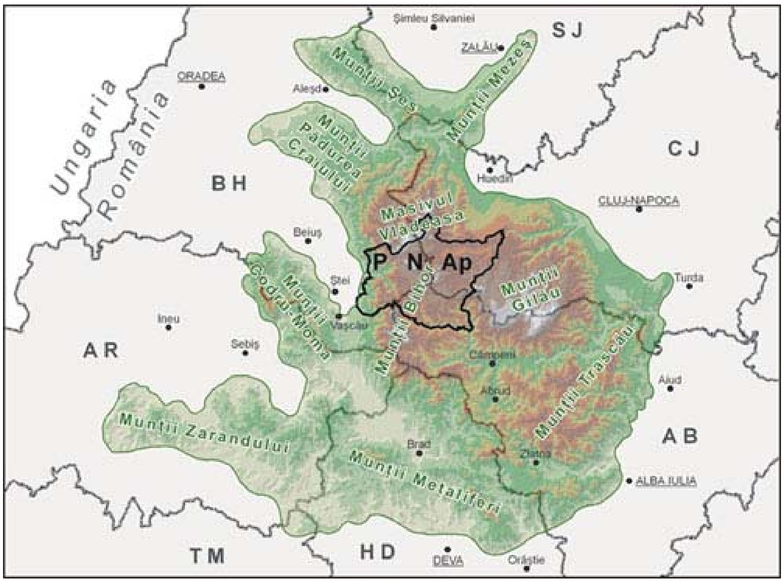
Figure 5: Activities of local farms; source: Auch (2006)

Traditional land-use shapes the landscape (Reif *et al.* 2005 a, b, c). The inhabitants, so-called "Motsi" have up to now had a very traditional life style (Goia and Borlan 2005). The livelihood strategy consisted of a highly diverse activities portfolio (Auch 2006).

The farmers' livelihood is based on grassland management, dairy farming, and animal husbandry (subsistence production). Forests are used for fuel wood, forest pasture and timber extraction. Traditionally wooden vessels were produced and traded. However, after the end of socialism this market ceased. Instead of this timber for construction is processed now. Due to the climatic conditions agriculture and vegetable gardening is limited (Povara *et al.* 2005). Local people use the technique of shifting cultivation to cultivate gardens, small fields of potatoes, and cabbage for personal consumption. Rarely cereals like oats (grain for the horses) and rye (straw production) are grown. Small fields are cultivated for crops for several years, followed by a conversion to grassland. The locals use only organic fertilizer produced by themselves and their animals. Herbicides are not applied. Many weeds are present in the fields and gardens.

Currently the locals make their income in the forest. "Lack of governmental control, breakdown of social welfare system, increased incorporation in European and global markets, new technology like electricity and use of circular and motor chains, and increased competition for resources has resulted in an overexploitation of forest resources" (Brinkmann and Reif 2006). It is obvious that timber resources will be exhausted in a few years (Auch 2006). This underlines the critical social and financial situation of the locals. The maintenance of the *Arnica* sites is closely linked to the economic survival of the local people in the region. Regional development strategies that focus on both nature and people are necessary to maintain the beautiful cultural landscape of the region and the culture of the "Motsi". Sustainable tourism development and value adding to local resources like MAPs can contribute to this.

5.6. Apuseni Natural Park (ANP)



The park has been set up to conserve karst phenomena and to promote tourism and scientific research in medium altitude ecosystems (Munteanu *et al.* 2003). The ANP http://www.parcapuseni.ro/ has a surface of 76.786 hectares. It includes restrictive zones (IUCN: I) and permissive ones (IUCN 5). To protect, maintain and restore the mountain grasslands is one of the main objectives of the ANP. 64.75% (5354 of 8761 hectares) of the area of the community of Gârda de Sus is included in ANP. This refers to 5.53% of the ANP surface. 1948 hectares of the park area in the community is agriculture land. This consists of 200 hectares arable land, 1145 hectares pastures, and 603 hectares hay meadows (Zinke 2006).

6. Baseline studies

6.1. Inventory of *Arnica* sites

Purpose: The inventory of *Arnica* sites provides information on the spatial distribution of different sized *Arnica* sites and to calculate the total area of *Arnica* sites in the community. The inventory provides the basis for the random selection of sites for resource assessment and for monitoring. Moreover, it is the basis for the identification of the landowners.

Arnica sites are often located along the edge of forest, or on top of stony hills in fluent transition to more intensively managed grassland. The farmers carry the dung with horse charts from the houses to the meadows and distribute it manually. Generally, more intensively managed grassland is located close to the houses with access to roads, whereas extensively managed grassland is situated far from houses and roads. In addition, extensive grassland occurs on stony soils with low nutrient and water capacity or on the edge of fens, however the later are rare.

The surface of the community Gârda covers 87.4 km^2 (8741 ha). In this area, 597 polygons (sites were *Arnica* occurs) have been identified[4]. The total of all polygons add up to 550 ha, which is 6% of the surface of the community of Gârda.

Table 2 shows the descriptive statistics of *Arnica* sites sizes. The mean size of the sites is 0.92 hectare (9243 m^2). The standard deviation is 2.7667. The later reflects a high variability of the size of the sites. The median size of the sites is 0.26 hectare (2588 m^2). The smallest site covers 0.01 hectare (82 m^2), the largest one 41.92 hectares (419230 m^2). Half of the sites is smaller than 0.25 hectare (2588 m^2), 95% of the sites are smaller than 3.37 hectares (337000 m^2), 5% this refers to 29 sites are larger than 3.37 hectares (Table 3).

Table 2: Summary statistics of size of *Arnica* polygons

[ha]: hectare

	Size of polygons [ha]
Mean	.9243
Median	.2588
Std.dev.	2.7667
Minimum	0.01
Maximum	41.92

Table 3: Percentiles of distribution of size of polygons

[ha]: hectare

	Percentile						
	5	10	25	50	75	90	95
size [ha]	.0293	.0462	.1043	.2588	.7363	2.0021	3.3724

[4] Half of the surface has been mapped during “Proiect Apuseni”.

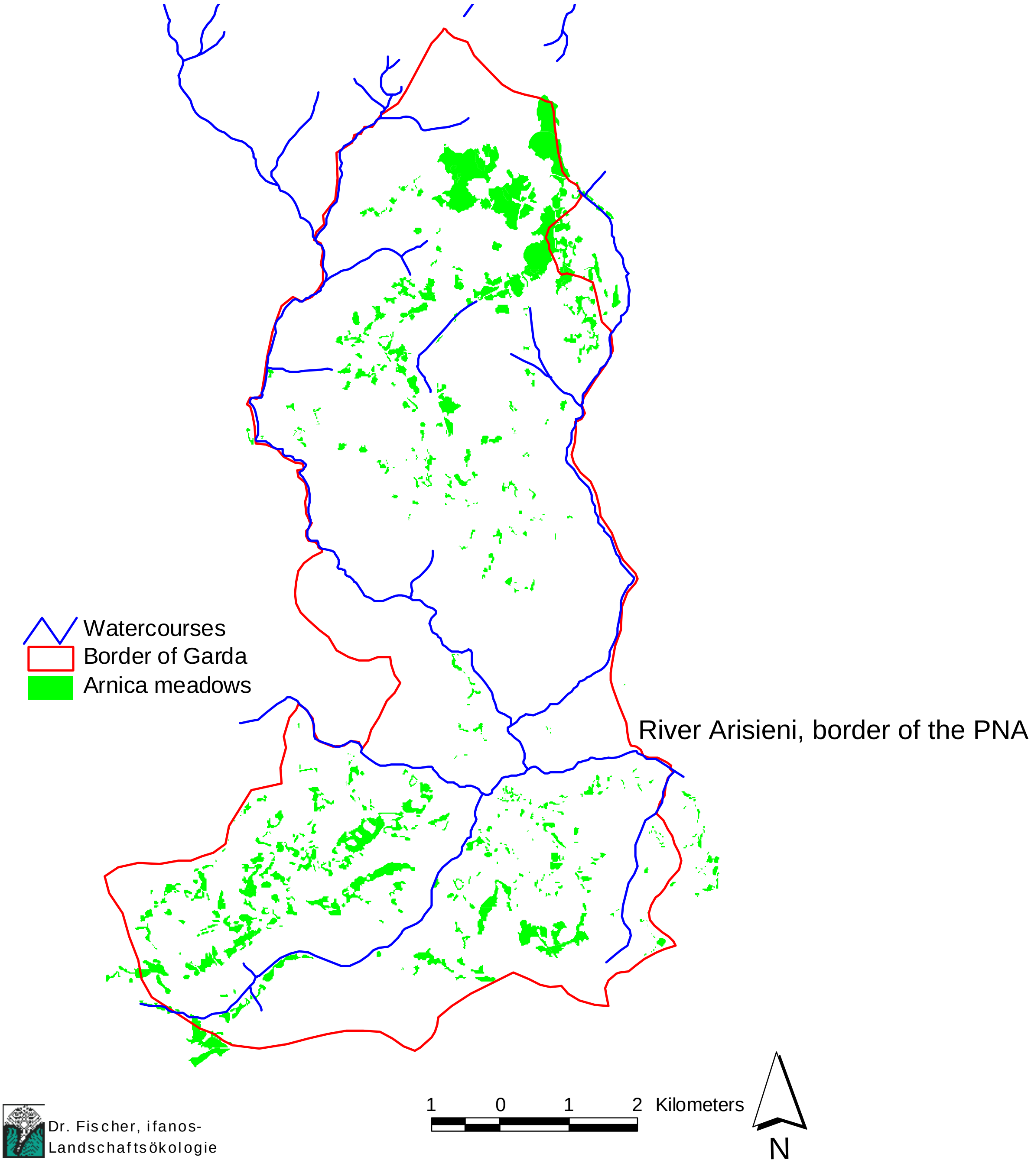


Figure 6: Distribution of the polygons

6.2. Key species of *Arnica* habitats

Data collection: Barbara Michler in 2001, Andrei Stoie in 2005, 2006; Data analyses: Barbara Michler, Hagen Fischer

For details and OP please see

> ***Appendix 4: Species composition of Arnica sites; key species for habitat mapping and monitoring***
>
> ***Appendix 5: Monitoring habitat***

Purpose: The species composition of the *Arnica* sites was recorded and analysed statistically to describe the vegetation type, determine the conservation status and to identify key species to map and monitor the habitat. Key species indicate whether the habitat is still managed traditionally or whether it is fertilised, overgrazed or abandoned. Key species helps in the development of OPs to monitor the maintenance of *Arnica* habitat.

Reif, Coldea and Harth (2005) gave an overview of the vegetation of the northern part of the community Gârda de Sus. Michler and Reif (2002) recorded 50 sites and Andrei Stoie (PhD in prep.) recorded the species composition of *Arnica* sites in 58 random selected sites and in the 48 largest *Arnica* sites. The Braun–Blanquet approach (Braun-Blanquet 1964) was used to record species, abundances and cover values. The output of the statistical analyses (Table 4) is a vegetation table that can be used by specialists and a condensed list of key species that can be used for mapping and monitoring by local people or to get a first impression of habitat quality. As reforestation may well be a future threat, using the reduced table for habitat indication may help those to make a decision which sites should not be afforested. Comparing the species composition of *Arnica* sites with the species composition of grassland sites without *Arnica*, key species indicating *Arnica* sites and key species indicating degradation of the habitats through fertilisation, intensive grazing, or abandonment can be identified (Table 5). The *Arnica* data were analysed statistically and a total of 245 species and 146 samples were analysed. A standard procedure similar to WILDI (1989) was applied (Table 4). The analysis consists of classification procedures, ordination and variance analyses. Results are documented in ***Appendix 4: Species composition of Arnica sites, key species for habitat mapping and monitoring.*** In rows the species are listed, in columns the samples can be found. The species and sample groups are taken from the classification procedure. The table in Appendix 4 reflects a management gradient. On the left-hand side meadows, on the right-hand side pastures are arranged. Applying the classification of the habitat directive, releve group 1, 2, 3, 4 represent different types of mountain hay meadows (Habitat type 6520), releve group 5 is transitional whereas 6, 7, 8. 9 represent *Nardus stricta* grassland (Habitat type 6230). For details on species composition see appendix 4. Species group 1, 2, 3, 5, 6 are pre-dominant in hay meadows, whereas 7 pre-dominate in *Nardus stricta* grassland. Species group 8 consists of species, frequently occurring, in *Arnica* habitats. The species composition reflects various soil properties and various management activities. In general, the mountain hay meadows are richer in species and the Shannon-Weaver diversity in higher than in *Nardus stricta* grassland. However, differences are obvious within both types (Table 6).

Key species representing *Arnica* habitats are listed in Table 8. The species are ranked from the highest to the lowest value of correlation coefficient. A rough evaluation to set the emphasis of the species in hay meadows or in pasture is added. For details please have a look at ***Appendix 4: Species composition of Arnica sites; key species for habitat mapping and monitoring.***

Key species negatively correlated with *Arnica* sites, indicate fertilisation. They are listed in Table 9. At present, these species are rarely found (if present low abundance) in hay meadows and *Nardus stricta* grassland. However, if meadows and grassland will be fertilized, the abundance of these species will increase[5]. Fertilisation will increase the abundance of species listed in Table 9 and decrease the abundance of species from Table 8. Finally, key species of *Arnica* habitats will be replaced by key species of more fertilised grassland. Pacurar and Rotar (2004), Brinkmann and Reif (2006) presented the results of an ongoing fertilisation experiment in the area. Species richness decreased, whereas productivity increased. After 3 years of moderate fertilisation, an *Arnica* site (hay meadow) was replaced by another meadow type. *Arnica* disappeared within the three years, as well as *Gymnadenia conopsea, Gentianella austriaca, Polygala vulgaris, Potentilla erecta* and others.

If the farmers give up mowing and maintain moderate grazing, the species composition in the hay meadows will change like it is described in ***Appendix 4: Species composition of Arnica sites, Key species for habitat mapping and monitoring.*** If both mowing and grazing should

[5] Please note that heavily fertilized grassland as is typical for huge areas in central Europe currently does not occur in the study area. Species like *Rumex obtussifolius*, *Stellaria media* or *Heracleum sphondyleum* indicating highly fertilized meadows in central Europe, are currently rarely found in meadows of the project area. These species currently are only growing around places where manure is stored.

cease a new situation will occur in the project area. From other regions it is known, that the abundance of woody plants like *Chamaespartium saggitale*, *Vaccinium myrtillus*, *Vaccinium vitis-idaea* or of species having an efficient vegetative reproduction like *Deschampsia flexuosa* will increase. Quite quickly tree seedlings of the surrounding forests will grow, eg. *Picea abies*, *Salix caprea, Acer pseudoplatanus,* or invasive species like *Pteridium aquilinum* will invade the habitats. The vegetation will soon shade out all light demanding species such as *Arnica*.

During "Proiect Apuseni" a modeling of potential versus actual existing *Arnica* sites was performed. A habitat model (Fischer 1994) based on site maps (soil type, aspect, slope, land use) that simulates the potential distribution of *Arnica* habitat types showed, that large areas of potential *Arnica* meadows are already lost due to fertilisation and overgrazing. The communal pasture "Calineasa" was assigned to be a typical *Arnica* habitat. However, it is overgrazed and dominated by a few grass species: *Nardus stricta* (32%), *Agrostis capillaris* (23%), *Festuca rubra* (20%) and a few other herb species (25%) (Kölling and Reif 2005). *Arnica* is not growing there at all.

In ***Appendix 5: Monitoring habitat*** an OP for habitat monitoring is given.

Table 4: Analyses of the species composition of the *Arnica* habitats

Data source: Michler and Reif (2002), Reif *et al.* (2005), Stoie (PhD in prep.) Statistical analyses similiar to: Wildi (1989), Software: ***MULVA 5 http://www.wsl.ch/land/products/mulva/*** (Wildi & Orlóci 1996).

- Correspondence analysis was applied to identify outliers. 2 Samples were omitted. They represent the only ferns.
- Sample classification: Histogram transformation (scalar transformation) was applied to the cover values to transform the extreme right skewed distribution to an equal distribution. Releves were normalised (vector transformation) The sites were classified with minimum variance classification based on Jacquard index.
- Species classification: Presence absence transformation (scalar transformation) was applied to the cover values. The sites were classified with minimum variance classification based on Ochiai index.
- ANOVA with Monte Carlo significance test was applied to distinguish between characteristic and indifferent species. 1% significance level.
- Concentration analysis was applied to determine order of groups in one dimension.
- Correspondence analysis was used to determine a meaning order of species and releves within the species and releves groups.

Table 5: Analyses of the grassland data set

Data source: Michler and Reif (2002), Reif et al. (2005), Stoie (PhD in prep.)

- The data were presence/absence transformed. After the correlation between *Arnica* and all other species was calculated (Pearson's Phi). The species with the highest correlations are the best indicators for *Arnica* habitats and consequently the species with the lowest correlation are the best indicators for non- *Arnica* habitats.

Table 6: Vegetation types, diversity and eveness

Vegetation types numbered from 1 to 9; number of samples recorded per vegetation type, mean number of species per site, mean diversity, mean evenness; HM: mountain hay meadow (6520); T: transition hay meadow/*Nardus stricta* grassland; N: *Nardus stricta* grassland (6230). For details regarding statistical methods see Wildi 1989, Wildi and Orloci 1996, for details regarding the vegetation types see appendix 4.

	HM	HM	HM	HM	T	N	N	N	N
Vegetation type	1	2	3	4	5	6	7	8	9
Number of samples	23	29	15	23	10	17	34	16	5
Mean number of species per site	40	44	40	32	42	38	26	22	13
Mean diversity (Shannon-Weaver)	1.07	1.23	1.12	.93	1.09	1.06	.89	.76	.68
Mean evenness	67	75	70	62	68	67	63	57	61

Table 7: Key species indicating overgrazing

Overgrazed grassland is indicated by a few dominant grass species: *Nardus stricta*, *Agrostis capillaris, Festuca rubra*. In total, grass covers 75% of the surface. The vegetation is species poor. Soil erosion is obvious.

Table 8: Key species representing *Arnica* habitats, emphasis of occurrence

+: present, (+): rare; *: emphasis

Habitat type(FFH- directive)	**6520 Mountain hay meadows**	**6230 *Nardus stricta* grassland**
Potentilla erecta	+	+
Nardus stricta	+	+*
Polygala vulgaris	+	+
Vaccinium myrtillus	(+)	+*
Luzula campestris	+	+
Deschampsia flexuosa		+
Melampyrum sylvaticum		+
Achillea distans	+*	+
Gentiana austriaca	+	
Scorzonera rosea		+
Veronica officinalis	+	+*
Vaccinium vitis idaea		+
Luzula luzuloides		+
Veratrum album	+*	+
Campanula patula, ssp abietina	+*	+
Gnaphalium sylvaticum	+*	+
Hieracium aurantiacum	+*	+
Viola declinata	+*	+
Chamaespartium sagittalis		+
Crocus heufelianus	+	+
Dantonia decumbens		
Gymnadenia conopsea	+*	+
Antenaria dioica	+	+*
Rhinanthus glaber	+*	+
Campanula serratula	+	+*
Ajuga genevensis	+	+
Pseudorchis albida		+
Centaurea montana	+	
Festuca rubra	+	+
Hypericum maculatum	+	+
Euphorbia carniolica	+	
Laserpitium krapfii		+
Agrostis capillaris	+	+
Viola canina		+
Traunsteinera globosa	+	

Table 9: Key species indicating fertilization

Taraxacum officinalis agg.

***Achillea millefolium* agg.**

Trisetum flavescens

Leontodon hispidus

Festuca pratensis

Colchicum autumnale

Carum carvi

Vicia cracca

Tragopogon pratensis

Medicago lupulina

Galium album

Alchemilla vulgaris

Crepis biennis

Rumex acetosa

Trifolium pratensis

Poa trivalis

6.3. Habitat type and *Arnica* density

Purpose: Creating samples to test whether management and soil influence the *Arnica* density.

The distribution of *Arnica* is scattered within the sites. There are flowering and non-flowering rosettes. There is huge variability in the number of flowering and non-flowering rosettes among sites and between years. In some sites, numerous flowering, and non-flowering rosettes occur, in others only a few can be found. Additionally the density may differ in the same site from year to year. The variability maybe random or it is caused by different management activities, nutrient regime, soil and climate conditions. E.g. the density of flowering rosettes in hay meadows may differ from the density of flowering rosettes in *Nardus stricta* grassland.

The species composition of a site represents a specific combination of environmental conditions e.g. management, soil properties, aspect, slope. Classifying sites according to the species composition leads to habitat types, representing a specific combination of environmental conditions. In the statistical sense, a set of sites of the same habitat type can be regarded as a sample of the "universe" (parent population). Only repeated observations of the same universe lead to confidential statements and conclusions.

The number of flowering rosettes was counted in transects of 30m*2m (60m^2) to estimate the density of the flower heads in the sites. The transects were placed randomly in the sites. In average 4 transects per hectare were counted. For each site, the mean flowering density was calculated and for easier understanding converted from 60m^2 to 1m^2.

At the same time, the number of flowering rosettes and the number of non-flowering rosettes was counted in quadrates of one square meter only. It is too time consuming to count within 60m^2. The quadrates have been randomly placed in the sites only where *Arnica* occurs. The flowering rate was calculated:

$$flowering\_rate = \frac{number\_of\_flowering\_rosettes}{number\_of\_all\_rosettes}$$

Based on data from 2006 (large and random data set) a sample size of n=78 was obtained. U-test was calculated to check whether hay meadows (n=24) and *Nardus stricta* grassland (n=54) differ significantly in their number of flowering rosettes (transects), number of flowering rosettes (quadrates), number of non flowering rosettes (quadrates) and flowering rate (quadrates).

At the 0.1% significance level ($p<0.000$) hay meadows and *Nardus stricta* grassland differ in the number of flowering rosettes per m^2 in transects. At the 1% significance level ($p=0.014$) the number of flowering rosettes (quadrates) and the number of non-flowering rosettes (quadrates) differ between hay meadows and *Nardus stricta* grassland. The difference in the flowering rate is not significant ($p=0.576$).

Table 10 provides descriptive statistics of *Arnica* density in hay meadows and *Nardus stricta* grassland. In transects the density (median) of flowering rosettes in hay meadows was estimated 1.21 per m^2 whereas in *Nardus stricta* grassland 0.46 per m^2 were estimated. As well, the number of flowering and non-flowering rosettes in quadrates is higher in hay meadows than in *Nardus stricta* grassland.

Managing meadows is more time consuming, than managing pastures. It maybe interesting for the future to find a balanced management system that focuses on reduced management activities, but avoids as much as possible a decline of flowering rosettes.

The number of flowering rosettes per m^2 in transects is lower than the one that is calculate from the quadrates. The transects were randomly distributed in the sites, whereas the quadrates were randomly distributed only where *Arnica* occurs in the sites. The estimates derived from the 60 m^2 transect represents the mean density of flowering rosettes per site, whereas the quadrates are used only to calculate the flowering rate. The later cannot be used to calculate the density of flowering rosettes of the site, because it is not representative for the site.

Table 10: Descriptive statistics of *Arnica* density in hay meadows and *Nardus stricta* grassland

	Flowering rosettes (transects)	Non-flowering rosettes (quadrates)	Flowering rosettes (quadrates)	Flowering rate (quadrates)
Mountain hay meadow				
N (sites)	24	24	24	24
Mean	1.86	38.26	6.72	.17
Median	1.21	32.59	5.60	.15
Minimum	.17	4.50	1.17	.05
Maximum	4.69	118.50	14.12	.49
Nardus stricta grassland				
N (sites)	55	55	55	55
Mean	.69	24.42	4.30	.18
Median	.46	19.19	3.41	.17
Minimum	.03	1.75	1.25	.06
Maximum	3.93	76.93	9.93	.55

6.4. Grassland[6] management

Photo: ©Florin Pacurar

Florin Pacurar, Ioan Rotar, Barbara Michler

For OPs please also see:

> ***Appendix 15: Arnica meadows management manual***
>
> ***Appendix 16: Poster meadow management***

Purpose: Management activities of the farmers influence the species composition of the habitats and the abundance of *Arnica*. It is necessary to identify key activities to establish good management practices to maintain the habitat and flowering *Arnica*.

Long-term traditional management of pastures and meadows, has generated a diverse landscape, deeply marked by the seasonal activities and by the living colours of the numerous plant species. The rich plant diversity is the result of extensive management activities by local people. The grassland management system is influenced in a characteristic way by the seasonal migrations of the local people (transhumance) to the communal, high-altitude pasture of Călineasa and by diverse management activities. Even within the communal area of Gârda, the management system differs from the northern region to the southern one. All management activities are performed manually and by using horses. In order to maintain the *Arnica* habitats the

[6] Please not: The term "grassland" is the umbrella term for meadows and pastures. In general, meadows are mown, whereas pastures are used for grazing. However, often a mixed management is practiced.

maintenances of traditional grassland management is required. Otherwise, the grassland will be encroached by forest, actively reforested or used in a more intensive way. In the end, the species *Arnica montana* will disappear.

Arnica grasslands are generally far away from the farmhouses. They are located on slopes or on top of the hills. The access is exhausting and mowing difficult due to the rocky terrain. The soils are of a reduced fertility and the productivity of the grassland is low (Michler *et al.* 2004) Comparing the management activities in *Arnica* sites with more productive grasslands around the houses, the activities in *Arnica* sites are of lower intensity. The fertilization of *Arnica* grassland is done only with manure obtained from people's own households. It is applied in spring, in autumn and sometimes in winter. The grassland is used in a mixed way: a mixture of mowing and grazing is the most common management type, less common is to only graze the grassland and hardly ever is the grassland mown but not grazed. The mixed management, mowing the grassland in summer and grazing in autumn, is the most frequent one. Grazing only is realised especially in the southern part of Gârda village (Biharia). The grass is dried on the surface.

In 2005/2006 the land owners were interviewed on *Arnica* habitat management. In total 83 interviews were performed. The data are composed of several subsets with different sample size. E.g. 76 out of 83 manage the land active in terms of fertilising and/or controlling ants and/or wood growth and use the land for mowing or grazing whereas 7 use the land for grazing and mowing only. However they put no efforts in active management. 60 out of 83 fertilise the land, whereas the others do not apply manure. The result is summarized and documented as a seasonal work plan (Table 11) and as meadow management manual (see Appendix 15).

Table 11: Seasonal work plan for *Arnica* habitats. Based on interviews with 83 landowners and field observations

	Month	Activity	Execution	Observations
Spring	March (the end)	Fertilising	For transport horse carts are used. Spreading is performed manually. The manure quantity applied on *Arnica* meadows is smaller than the one that is applied on meadows that are more productive.	The fertilizer quantities differ very much. The majority of landowners fertilize in spring (38 answers out of 60 possible ones, the others do not fertilize the land). In general, the manure is from cattle and horses. It is 6 months old and mixed with saw dust from wood processing and dried beech leaves which are used as litter in the stables. The manure is spread manually from small piles deposited by horse and cart.
	April	Gathering rocks	Manually	The rocks are frequently deposited in piles at the margin of the site.
	April	Controlling ants	Manually	
	April	Controlling wood growth	Manually	Mostly *Salix caprea, Sorbus aucuparia* and *Prunus spinosa* are eliminated.
	April	Crushing applied manure	A horse drags a branch, on which rocks are fixed to make it heavier.	This work is performed generally one week after the manure has been applied (valid for the ones that fertilize in spring). The crushing of manure applied in autumn is performed in spring. Rain determines when work starts.
	April	Gathering uncrushed remaninigs and beech leaves	Manually by rake	The gathering of un-crushed remaining is generally performed until one month after crushing. The uncrushed remainings are deposed in a pile on the area on which they have been gathered. Simultaneous with remainings, the dried beech leaves are gathered.
	May	Controlling weeds	Manually with scythe, reaping hock and knife	In general, the following species are eliminated: *Colchicum autumnale, Veratrum album, Pteridium aquilinum* and *Arctium lapa*. This work done regularly by only a quarter of the respondents (21 out of 83).
	May	Repairing damages caused by wild boars	Manually by hock or rake	The biggest damage is done on meadows. This work is done along the entire year as many times as necessary.

	Month	Activity	Execution	Observations
	May	Grazing		Some grassland is grazed only in spring and in autumn (22 of 78 answers) others are grazed from spring to autumn (10 of 78 answers)) and others only in autumn (38 out of 78 answers). The grazing is generally done by cattle and horses. The beginning of grazing is, in most cases, random.
Summer	June-July	Harvesting *Arnica* flower heads	Manually	
	July-August	Mowing of meadows	Manually	The *Arnica* meadows are mown a maximum of once a year at the end of the mowing period. First the locals cut productive meadows without *Arnica*, after the less productive ones with *Arnica* are cut. The mowing height is very low (2-3 cm from surface). The grassland remains sometimes unmown. Reasons for this are: ➢ The grass is not needed because the locals have already enough from sites that are more productive. ➢ The productivity of the grassland is too low to take the effort to cut it. ➢ The owners didn't manage to cut the grass in time. ➢ The owners are too old to do the exhausting job.
	July-August	Drying grass	Manually	The grass is dried on the surface. This method has a great disadvantage; the nutritional value of hay is quickly lost. However, this may be an advantage for *Arnica* as the seeds are well distributed in this way. The drying time of grass depends very much on the climatic conditions. It is very different from one area to another and less productive meadows have shorter drying times than more productive meadows.

	Month	Activity	Execution	Observations
Autumn	September-October	Grazing	-	The grazing is generally performed in autumn, when animals return from the communal pasture (38 out of 78 answers). The grazing is generally done by cattle and horses. The starting point is random. The grass's is about 5 and 10 cm high (estimated by owners). When winter (snow) comes, the grazing stops.
	October	Hay transport	By horse carts	After returning from the communal pasture, the hay is transported and deposited either in sheds, or in large hay stacks.
	October-November	Fertilization	The manure is transported by horse carts and spread manually. *Arnica* meadows are typically less fertilised than meadows without *Arnica*.	The quantities of fertilizer differ a lot. Some grassland owners apply the manure in autumn (31 out of 60 possible ones). After the transport, the manure is spread or deposited into piles. In spring, it is distributed on the surface and crushed later.

6.5. Mowing status: Past and present - future?

Photos: © Florin Pacurar

Florin Pacurar, Barbara Michler;

Purpose: Traditionally the meadows were mown once a year the end of July the beginning of August, after the *Arnica* flowering period. Mowing influences the species composition of the habitats. E.g. it represses woody species and encourages species with rosettes close to the surface like *Arnica*. The mowing date influence the reproduction by seeds. The locals dry the grass on site. This way a part of the seeds remain in the sites and were dispersed in the sites. The past and present mowing status is described to have a baseline for future habitat management.

Past

Up to 2005 the locals did the mowing per hand with scythes (Reif *et al.* 2005). In 2005/2006 we performed interviews to get information about meadow management. Some questions regarded the frequency of mowing and the mowing techniques in the past (up to 2005). This is the baseline study and reflects the situation in the past.

From a total of 83 landowners interviewed, 20 farmers used the land as pasture only. Of the remaining landowners, 62 out of 63 cut the meadows per hand. Only one person had a cutting machine. In future, only an additional 4 farmers thought they might use a cutting machine. Asking them what are the reasons why they will continue to cut the meadows by hand, most of them answered that the terrain is not suitable or they cannot afford a machine. When asked for the reasons why some meadows had not been mown in previous years, they answered that in case of too much hay production in other meadows, they do not mow the *Arnica* meadows. This generally happens 2-3 times in 10 years.

Present (2006)

During a field stay in October 2006, we noticed that many meadows were not or only partly mown. The mowing season in 2006 was quite different from the previous years. In 2006, the agriculture ministry offered farmers to buy cutting machines. These were co-financed by 60% by the state. Prices ranged from 2000€ to 2200€ (total amount). 14 farmers in the project area took up this offer. For the first time some locals used cutting machines. The machines can be used on flatter surface. Steep terrain and stones cause problems, the meadows are mown only partly.

Interviews 2006

To find out about the reasons for this development and attitudes towards mowing in the future, we designed a questionnaire for semi-structured interviews. Forty interviews were conducted with the help of USAMV students for the Occoale and Ghetar area only (northern plateau).

The following questions were asked:

- Name, age, gender, place of living
- What do you think are the reasons that meadows (general) have not been cut this year?
- Did this happen already in the past?
- Specify when.
- Do you own unmown *Arnica* meadows?
- Why did you not mow them this year?
- What will you do in the future?
- If you got subsidies, would you mow the *Arnica* meadows?

The average age of the people interviewed after the mowing season 2006 was 54±16 years, 18 male 22 female. 81.6% (31) stated that in general it had not happen in the past that meadows were not cut. 18.4% (9), gave one date within the last 5 years. Asking them for reasons why the *Arnica* meadows were not mown, 37.5% (15) mentioned that they had enough hay that year, in consequence they did not mow the less productive meadows. 30% (12) answered that the owners are too old to do the exhausting job. Next, the people were asked whether they own *Arnica* meadows themselves and whether they had mown them. 30% (12) own meadows. Half of them mentioned that they had no manpower to do it, i.e., that they are too old for mowing. 3 persons had problems with pigs who destroyed the meadows, 3 persons had no need of hay. When asked whether they would cut the meadows if subsidies were provided, 94.9% (37) answered yes.

Field observations 2006

In October/November 2006, an additional rough survey was performed in the field to find out the actual mowing status. 137 *Arnica* sites were checked visually. It was noted whether the polygon was managed. The percentage area mown was estimated. It was also recorded whether the unmown part of the meadow was used as pasture.

63.5% (87 out of 137) of meadows checked in field were mown completely. 5.1% (7 out of 137 were neither mown nor used as pasture. 14.5% (20 out of 137) of the sites were used as pasture only. 16.8% (23 out of 137) were partly mown.

Conclusion

Previously relatives and men specialised in mowing joint the farmer to help during the mowing season. However, nowadays Romanians prefer to work outside the country. It is, e.g., more profitable to work in agriculture in Spain, Italy or Germany than to do the hard job in the mountains. The machines, the farmers bought can be used on flatter surfaces. Steep terrain and stones cause problems. Some of the *Arnica* sites are likely not be mown at all in future. As long as the meadows continue to be used for extensive grazing, the situation is not too serious. However, the cattle spend only the day at the pasture and are herded back to their stables at night (fear of wolves and bears). As a result, only, sites close to the houses are likely to be used as pastures whereas sites further away from the house are more likely to become abandoned or suffer from forest encroachment. The situation is getting worse because of out migration of young people.

6.6. Biodiversity and biomass production of *Arnica* sites

Purpose: The information is necessary to develop a compensation scheme that is based on conservation value and productivity of the grassland.

Michler *et al.* (2005) investigated the species composition and the biomass production of the *Arnica* habitats. In 2004, 53 plots of one square metre were studied intensively. The species present were identified and the cover was measured precisely using a frame of one square metre subdivided into 100 squares of 10 by 10 centimetres. Within the frame, the total biomass of grass and herbs was cut, dried and the dry matter per ha was calculated.

The Shannon-Weaver-diversity index and the evenness (Pielou, 1975) were calculated for each plot. Regressions were calculated between diversity and total biomass.

The studies show that Shannon-Weaver diversity in the sites ranges from 0.55 to 1.37. The median is 0.97. However, the grass production is low. Dry matter ranges from 0.4 to 2.8 t/ha. The median is 1.1 t/ha. This is typical for extensive mountain meadows.

Dry matter is positive correlated with diversity ($y = 0.29 + 1.04x$, $r^2 = 0.33$, $n = 45$). The very nutrient poor sites are of low diversity. Under these circumstances, a moderate application of fertilizer can increase biodiversity. *Arnica* cover is negatively correlated with diversity ($y = 43 - 31x$, $r^2 = 0.19$, $n = 53$). Only a few specialists like *Arnica,* whose roots form symbiotic associations (mycorrhizae) with fungous are adapted to very poor nutrient conditions. If the nutrient availability is increasing, other species can compete and increase diversity of the sites.

6.7. Soil, nutrient regime

Data collection: Ing. T. Lechnitan, USAMV; Translation: Horatiu Popa; Data analyses: Barbara Michler

Purpose: Beside management, soil and nutrient regime influence species composition and *Arnica* density. The soil survey provides basic information of these important environment factors in the *Arnica* sites.

6.7.1. General characterization of *Arnica* soils

Mr. Lechnitan soil scientist from USAMV performed a soil survey in *Arnica* sites. Soil samples of the random selected plots have been analysed at a laboratory of the Technical University Munich (http://www.bioanalytik.wzw.tum.de/index.php?bo_anal). In detail: the soil type, ph, plant available phosphorus, potassium, magnesium, carbon to nitrogen ratio have been determined to get information about the nutrient status of the *Arnica* sites. The methods used to perform the analyses are standard methods and widely used in the EU to determine the nutrient content of meadows and pastures in agriculture. The nutrient regime can be directly related to the flowering rate and to the amount of *Arnica* in the habitats.

Poor to very poor nutrient conditions and acid to extremely acid pH characterise the *Arnica* sites. Organic matter content of the soil samples lies mostly below 25% organic matter. Mostly mineral soils have been observed (Figure 7). The ph varies between 3.5 – 4.5 (Figure 8) and can be classified as extremely acid to very acid (AG Boden 1996). The assessment of the nutrient regime follows (Table 12). Phosphate content (Figure 9) is regarded as very poor, potassium content (Figure 10) as very poor to medium. The content of magnesium in the soil is (Figure 11) poor to very poor. A C/N ratio from 8 up to 17 was determined, which means that the type of humus varies from mull to moder.

A slight positive linear correlation is visible between density of *Arnica* flower heads per square meter and phosphate content of the soil (Figure 13).

Table 12: Assessment of nutrient content in mineral soil[7]

Content class	**P_20_5 (mg/100g soil)**	**K_20 (mg/100g soil)**	**Mg (mg/100g soil)**
Very poor	**<6**	<7	<6
Poor	6-12	7-15	6-10
Medium	13-25	15-25	10-15
Rich	25-35	25-35	15-25
Very rich	>35	>35	>25

[7] Staatliche Lehr- und Versuchsanstalt für Viehhaltung und Grünlandwirtschaft Aulendorf (2005) Düngung von Wiesen und Weiden. Merkblätter für die umweltgerechte Landbewirtschaftung Nr. 13.

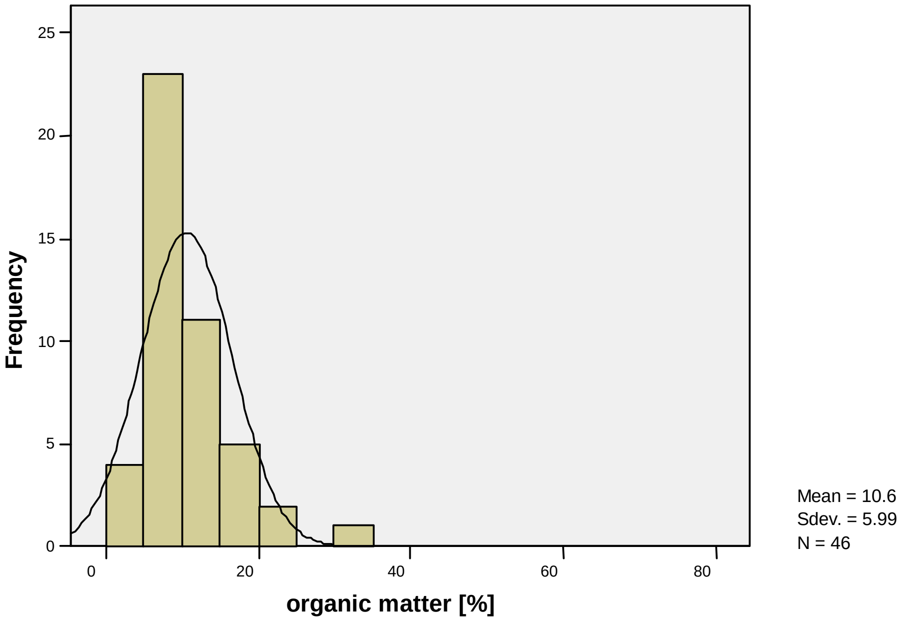


Figure 7: Organic matter content of *Arnica* sites

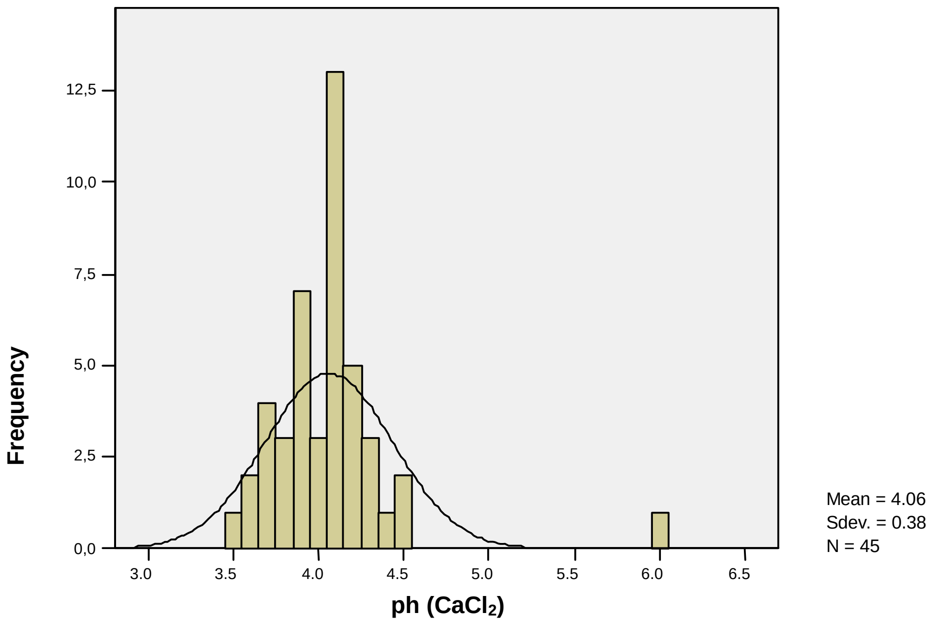


Figure 8: ph ($CaCl_2$) of *Arnica* sites

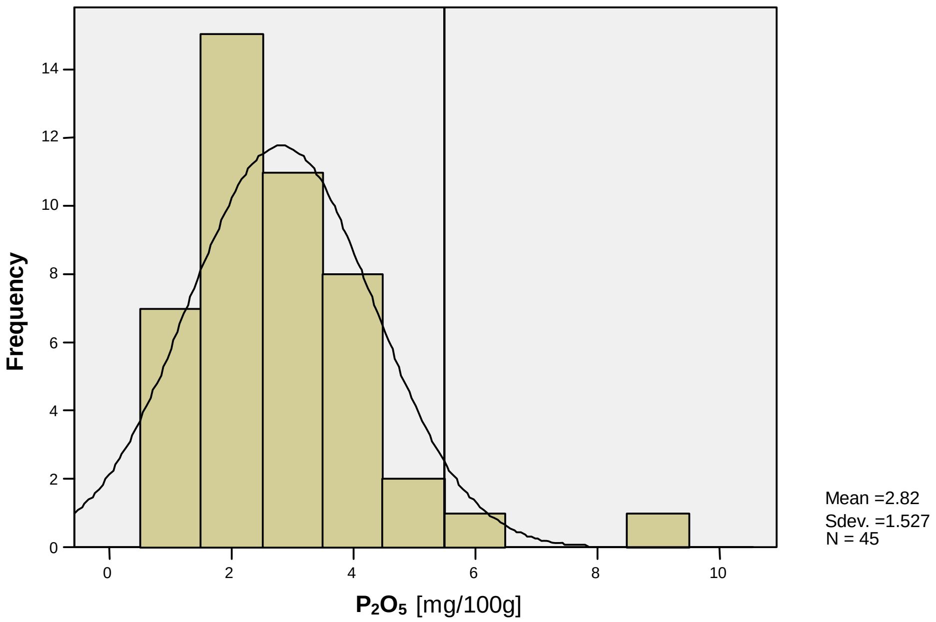


Figure 9: Phosphate (P_2O_5) of *Arnica* sites, vertical lines refer to assessment classes from very poor to poor (Table 12)

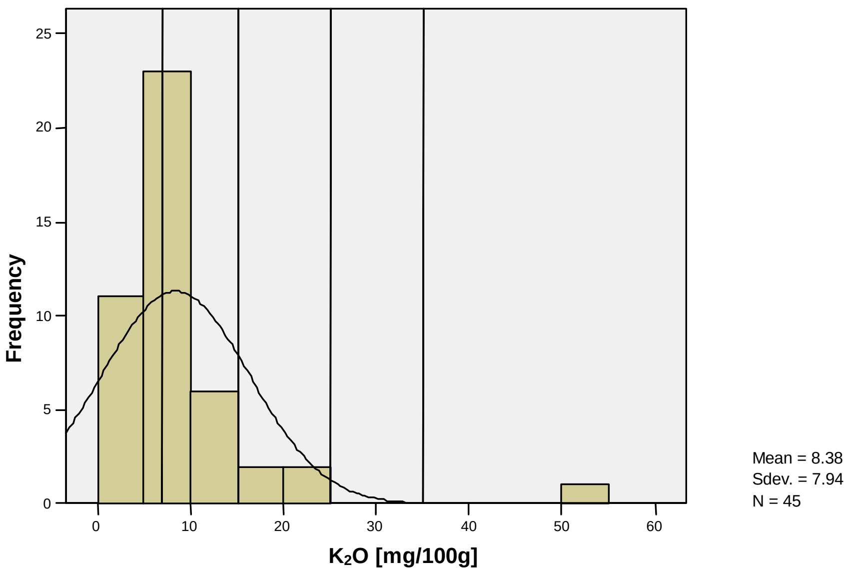


Figure 10: Potassium (K_2O) content of *Arnica* sites, vertical lines refer to assessment classes from very poor to very rich (Table 12)

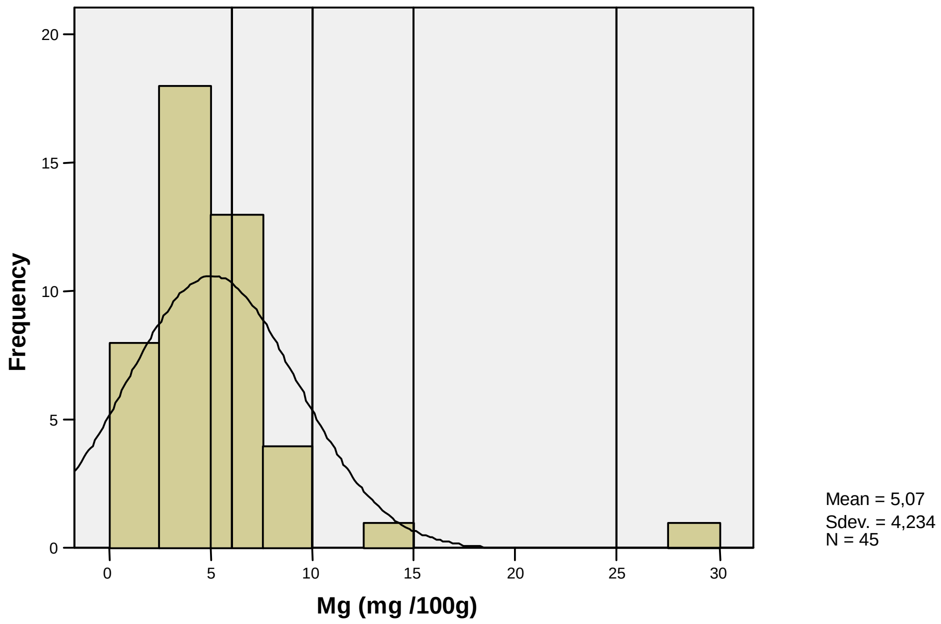


Figure 11: Magnesium content of *Arnica* sites, vertical lines refer to assessment classes from very poor to very rich (Table 12)

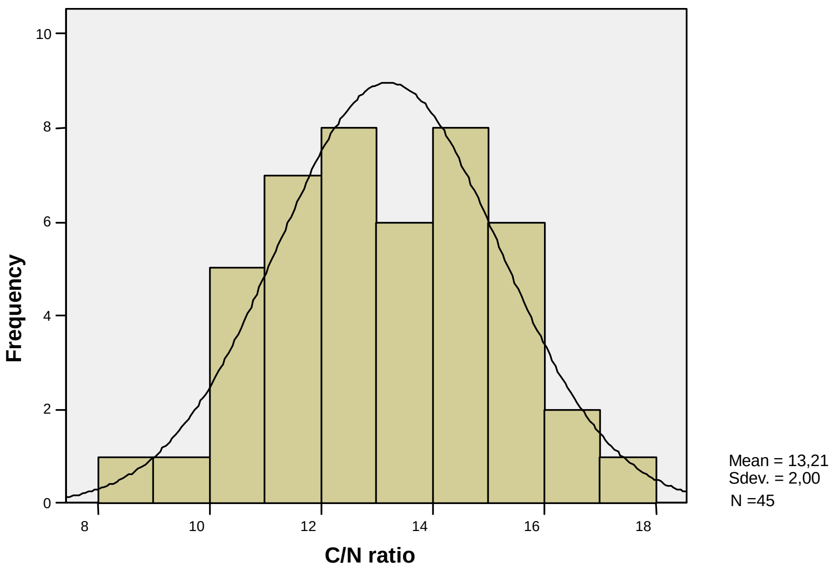


Figure 12: C/N ratio of *Arnica* sites

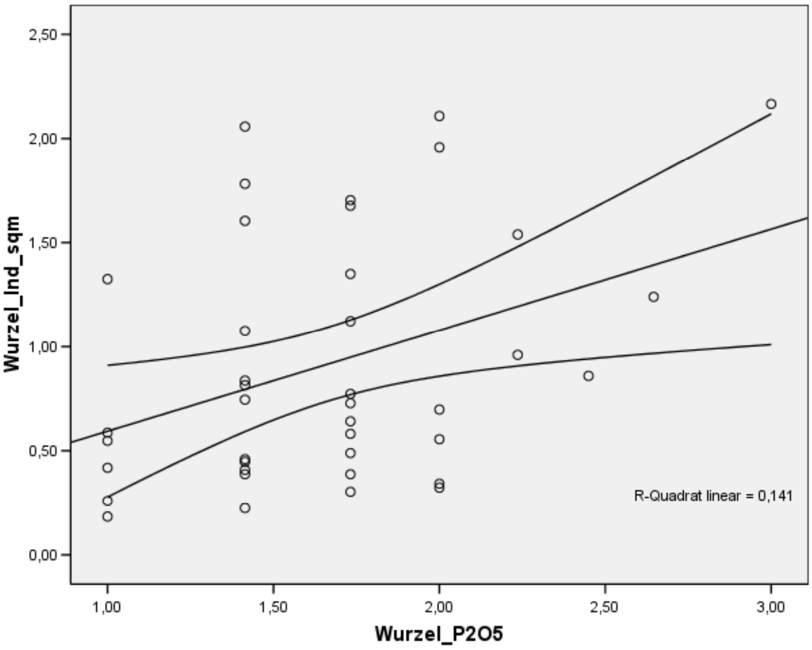


Figure 13: Relation between Phosphate and *Arnica* density

(“Wurzel_P2O5”= $\sqrt{P_2O_5}$; “Wurzel_Ind_sqm”= $\sqrt{Indiv./sqm}$)

6.7.2. Differentiation between Hay meadows and *Nardus stricta* grassland

The mountain hay meadows (6520) show a slight tendency to prefer soil textures with higher clay content whereas the *Nardus* grassland (6230) shows a slight preference of sandy soils (Figure 14). *Arnica* occurs on various Cambisol (dystric, eutric, reddish eutric), Rendzina and Lithosol soil types. The frequencies of the soil types do not differ evident. There is only a slight tendency to more eutric and rendzinic soil types under hay meadows and more dystric and podsolic, i.e. more acid soil types under *Nardus stricta* grassland (Table 13). However no difference can be observed in soil pH($CaCl_2$) (Figure 15). The more acid conditions are probably due to a lower supply of bases, which coincides with the lower clay content of the soils. The nutrient regime of both *Arnica* habitat types is very poor. There is a slight tendency to higher contents of nutrients in soils of mountain hay meadows than in the *Nardus stricta* grassland (Figure 16), whereas organic carbon content is higher under *Nardus stricta* grassland (Figure 17), indicating reduced decomposition of litter and in consequence reduced availability of nutrients.

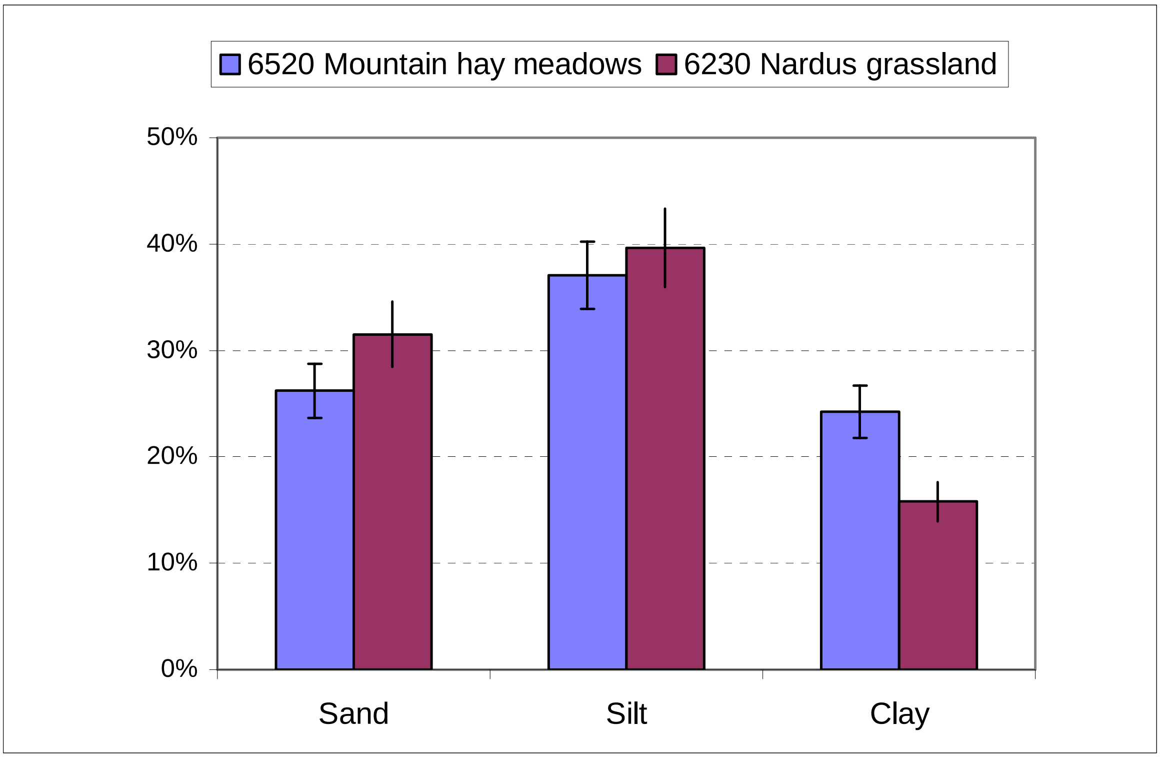


Figure 14: Mean and standard errors of soil texture grain sizes

Table 13: Frequency of soil types in hay meadows (6520) and *Nardus stricta* grassland (6230)

Soil type	Hay	Nard.	total	Hay	Nard.
	observed			Deviation from expectation	
CAMBIC RENDZINA	1	0	1	0.5	-0.5
DYSTRIC CAMBISOL	3	11	14	-4.1	4.1
ERODISOL	1	0	1	0.5	-0.5
EUTRIC CAMBISOL	5	2	7	1.4	-1.4
HUMIC UMBRISOL	1	0	1	0.5	-0.5
LITHIC RENDZINA	3	0	3	1.5	-1.5
LITHOSOL	3	4	7	-0.6	0.6
LUVOSOL	1	0	1	0.5	-0.5
NIGROSOL	0	1	1	-0.5	0.5
PREPODSOL	0	3	3	-1.5	1.5
REDDISH EUTRIC CAMBISOL (TERRA ROSSA)	3	1	4	1.0	-1.0
RENDZINIC CAMBISOL	3	0	3	1.5	-1.5
TURBOSOL	0	1	1	-0.5	0.5
Total (sample size)	24	23	47		

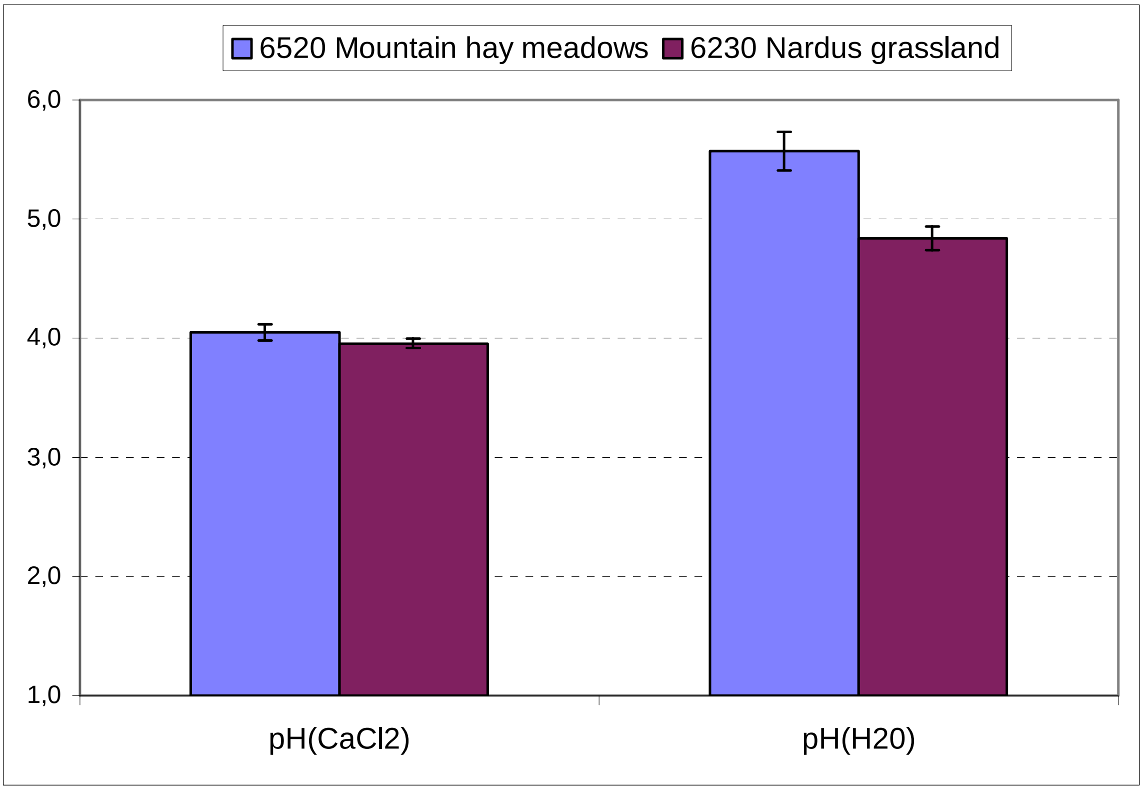


Figure 15: Mean and standard error of soil acidity: pH($CaCl_2$); pH(H_20)

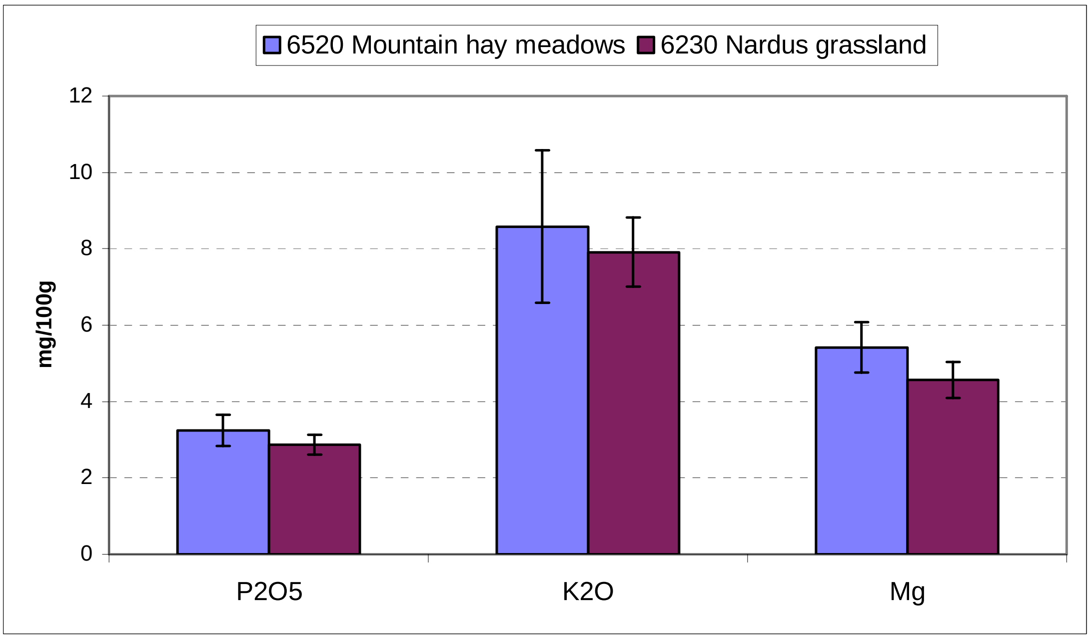


Figure 16: Main nutrients (P_20_5, K_20, Mg, means and standard errors)

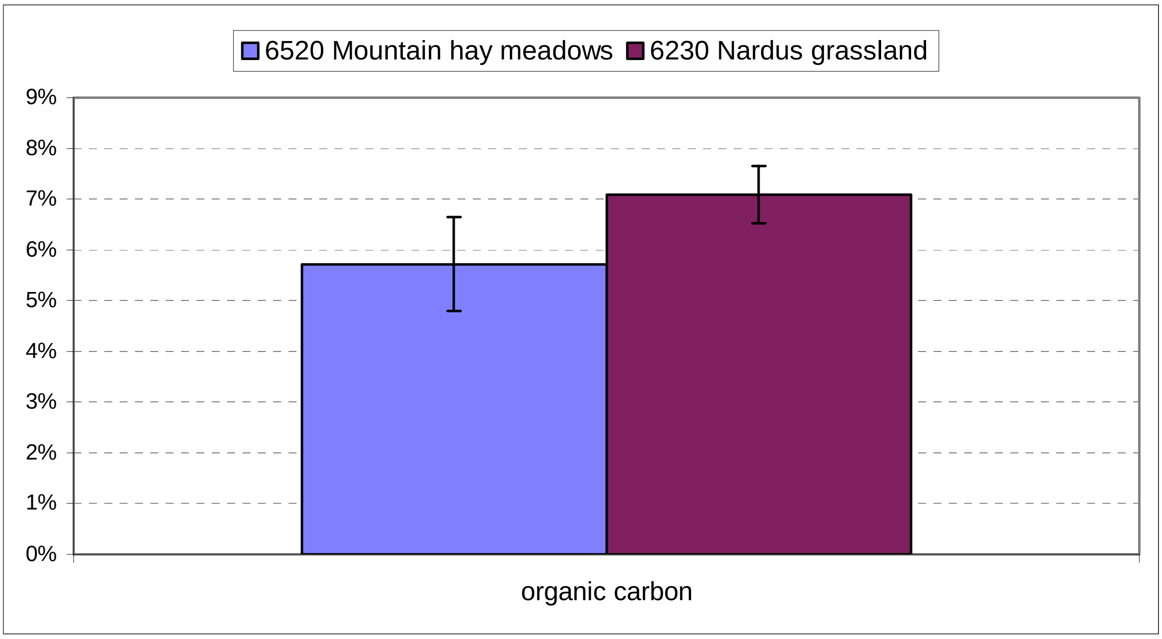


Figure 17: Organic carbon (means and standard errors)

6.8. Resource assessment

Purpose: Resource assessment provides basic information to establish harvesting quotas. Resource assessment is based on a landscape approach. A sample is monitored, the results are extrapolated to the spatial distribution of the sites.

The occurrence of *Arnica* sites in the landscape depends on the parent rock, soil conditions, relief, local climatic features and management activities. These parameters are highly variable themselves and occur in various combinations. Observations of the last years show that the numbers of flowering rosettes per site vary from site to site and from year to year. The procedure of resource assessment is described below. Table 14 summarizes the steps.

In 2001, a rough field survey was performed to get information about the flowering rate of *Arnica* and the distribution and species composition of its habitats and to find out what is limiting occurrence of *Arnica* and its preferred habitat types. It was very helpful to join the collectors to identify *Arnica* sites in the field. In this way a quick assessment especially of the huge sites can be performed. However, the success is hardly depending on a good relationship with the collectors and in common the collectors know only about the places they prefer to collect. Based on the species composition of the *Arnica* sites and non-*Arnica* sites a simple key to map the habitat was developed. It is reduced to the presence of *Arnica montana*, *Gymnadenia conopsea*, *Traunsteinera globosa*, *Vaccinium myrtillus*, *Vaccinium vitis idae, Nardus stricta* and the absence of *Tragopogon pratense*. These species are easy to identify by lay people and mismatches are unlikely. To get an overview, the distribution of the *Arnica* habitats were mapped in the field in the scale 1:5000 respectively 1:7000 and digitized (Popa H. in prep.).

The *Arnica* sites are numerous (597 sites), of various size and spread over 80km^2 in a mountainous region. Only a few unpaved tracks exist. The access to the sites is on food. Due to differences in altitude, aspect, slope and soil the *Arnica* flowering period lasts one month. The monitoring can start only if the stems were already developed. Mowing terminates monitoring. The experience of the last years shows that one team (3-4 persons) can manage 50 polygons within one flowering period.

Table 15 provides descriptive statistics of the assessment of flowering rosettes (transects) in the sites within the last years. There are huge differences between years. This reflects different sampling strategies and random variation. In the first year, a random set in the sense that all polygons that could be identified, have been selected. In 2002, the interest was to find large plots together with the collectors. At the same time, the spatial distribution of *Arnica* sites was mapped. The area covered by *Arnica* sites was calculated (Michler 2005a). In 2004, the interest was to monitor as many plots as possible in the northern part and to get as much information as possible about the southern part of Gârda where no information had yet been available about the distribution of *Arnica* habitats and the density of flowering rosettes. The team concentrated on large polygons. In 2005, a random set was selected from the sites mapped in 2002, 2003 and 2004 and polygons situated close to the random selected plots were monitored.

The sites of the random set monitored in 2005 were monitored in 2006 again. In Figure 18 the variation among sites in 2005 and 2006 is illustrated. Moreover the figure shows -regarding the whole sample- a general linear trend. Sites with small numbers in flowering rosettes in 2005 tend to small numbers in 2006. Sites with high numbers in 2005 tend to high numbers in 2006. Regarding single observations a huge variance is obvious. In some sites the number of flowering rosettes in 2006 is higher in some it is lower than in 2005. Linear regression was calculated to find out whether it is possible to estimate the number of flowering rosettes in 2006 from the data of 2005. The regression coefficient is significant (p = 0.001), a R^2 of 0.416 was calculated. The following regression equation obtained:

sqrt (flowering rosettes per m^2 2006) = 0,332 +0,715x sqrt (flowering rosettes per m^2 2005).

A paired t-test was calculated to test whether the samples differ. No significant differences in the number of flowering rosettes in the samples between the years (paired t-test: p = 0.18). This result support a sampling design based on a landscape approach and monitoring samples. Predictions regarding single observations e.g. for a specific site does not make much sense (Figure 18). In 2006, the random set from 2005 and additionally the largest polygons were monitored. In Table 16 descriptive statistics are presented. In random selected plots 0.54 flowering rosettes per m^2, whereas in large plots 1.4 flowering rosettes can be found. The difference is significant (U-test; p<0.001).

There is a slight linear tendency between number of flowering rosettes (stems) and size of the polygons. The size of polygons is known. The density of flowering rosettes, stems per m^2, per polygon is calculated, applying the regression model below to all polygons:

$$\sqrt{Stems/sqm} = 1.092 + 0.113 \cdot \ln(ha)$$

$$Stems/sqm = (1.092 + 0.113 \cdot \ln(ha))^2$$

Multiplying the density of flowering rosettes in the polygon by the size of the polygon (area) results in the number of flowering rosettes per polygon. The estimations are summarized for all polygons and result in the total number of flowering rosettes (total stems) in all polygons (n=597):

$$TotalStems = \sum_1^n (Stems / sqm \cdot Area)$$

In 2001 and 2005 the number of flower heads per stem was determined. In total the number of flower heads of 10208 flowering rosettes were count (Table 17)**.** In average 1.92 flower heads per stem were found. The total amount of flower heads is calculated:

$$TotalFlowerheads = TotalStems * 1.9$$

In 2006, 18 batches of *Arnica* flower heads were dried. The drying processes of each batch were monitored measuring a sample of 600g on a test surface of $0.25m^2$. This simulates the conditions in the drying shed were 2.4 kg were spread per m^2 and is easy to handle. The number of flower heads of these samples was counted at the beginning of the drying process. Afterwards the samples were dried and weighted again. Fresh weight and the dry weight of flower heads are parameters to estimate the weight of the resource. In Table 18 descriptive statistics characterize the variable. One kilo of fresh *Arnica* consists of 1008 (median) flower heads, one kilo of dried *Arnica* consists of 5797 (median) flower heads. A slight positive relation with time can be observed. Towards the end of the flowering period, the flower heads are lighter.

The calculations above result in 8,4 Mio stems and in 16 Mio. flower heads, 15.8 t of fresh weight and 2.7 t of dry weight of *Arnica montana* flower heads in all mapped polygons of the community Gârda.

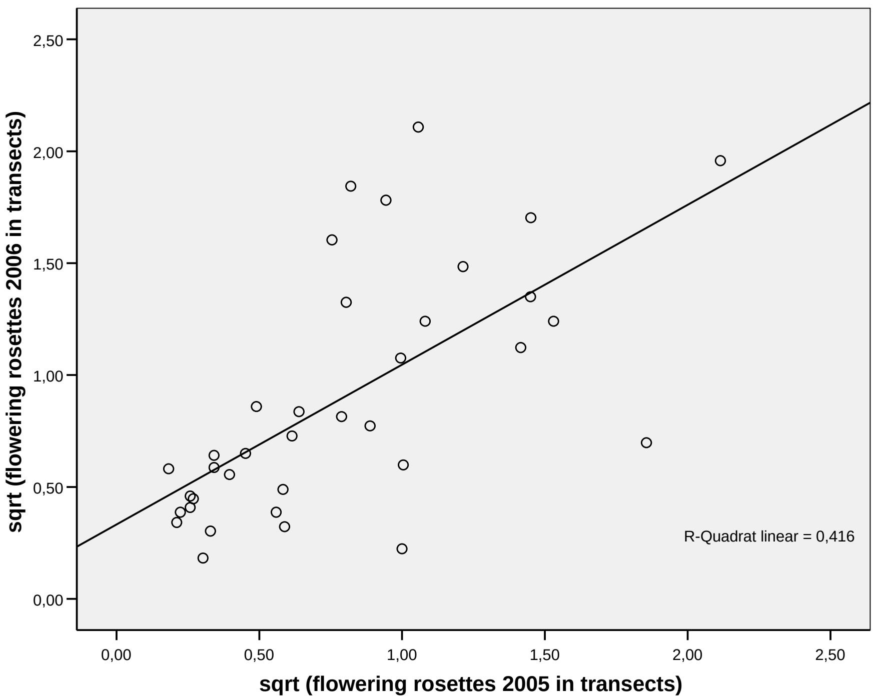


Figure 18: Flowering rosettes in transects, variation among sites and between years (2005, 2006)

Table 14: Resource assessment of *Arnica* flower heads

Resource assessment (Michler and Reif 2002, Michler 2005)	
Parameter	Result
➢ Rough field survey of *Arnica* habitats	➢ Information on species composition of habitats, limits of habitat distribution
➢ Generating mapping key of *Arnica* habitats	➢ Key species for mapping
➢ Mapping *Arnica* habitats (inventory)	➢ 597 sites ➢ 550.9 ha
➢ Calculating size of the sites	➢ Size of each site is calculated
➢ Random selection of a subset of sites	➢ 58 random sites ➢ 54.1 ha
➢ Selection of largest sites	➢50 largest sites ➢327.5 hectares = 60% of total mapped area
➢ Counting the flowering rosettes (stems) in selected sites in transects of 30*2m, number of transects in relation to the size of the site, 4 transects per hectares are recommended.	➢ Flowering rosettes per m^2 per polygon
➢ Calculating (estimating) density of flowering rosettes estimation for all polygons	➢ $\sqrt{Stems / sqm} = 1.092 + 0.113 \cdot \ln(ha)$
➢ Counting flower heads per stem (very large sample)	➢ Average number of flower heads: 1.9; sample size = 10208
➢ Counting flower heads per kg fresh weight	➢ 1008 flower heads per kg
➢ Drying samples	➢ fresh weight : dry weight = 1:5.8
➢ Calculating flower heads per kg dry weight	➢ 5797 flower heads per kg
➢ Calculating resource of flower heads	➢ 15.8 fresh weight; 2.8 t dry weight

Table 15: Descriptive statistics of flowering rosettes per m^2 in transects (total)

Year	Number of (transects)	Number of sites	Mean	Median	Minimum	Maximum	Skewness	S.e of skewness.
2001	223	50	.983	.367	.0	11.4	4.296	.337
2002	181	38	1.341	.783	.1	8.0	2.559	.383
2004	1103	39	1.654	.817	.0	7.1	1.482	.378
2005	1139	130	.996	.317	.0	15.5	4.824	.212
2006	837	94	1.030	.475	.0	8.1	2.512	.249
total	3483	351	1.114	.467	.0	15.5	3.808	.130

Table 16: Descriptive statistics of flowering rosettes per m^2 (transects) in random selected and large plots

Year	Number of sites	Mean	Std.dev.	**Median**	Minimum	Maximum	Skewness	S.e. skewkness
Random 2005	37	.8629	1.00149	**.5694**	.03	4.47	1.948	.388
Random 2006	37	1.0723	1.19401	**.5298**	.03	4.44	1.401	.388
Large 2006	46	1.7736	1.22090	**1.4115**	.18	5.33	.932	.350

Table 17: Number of flower heads per stem, resource, harvesting scheme

Number of flower heads	Number of flowering rosettes	Percent	Resource flower heads	Harvested flower heads "leave one"	Harvested flower heads "take one"
1	4866	0,48	4866	0	4866
2	1668	0,16	3336	1668	1668
3	2978	0,29	8934	5956	2978
4	494	0,05	1976	1482	494
5	192	0,02	960	384	192
6	8	<0.1	48	0	0
7	1	<0.1	7	0	0
8	1	<0.1	8	0	0
Total	10208	400	20135	9490	10198

Table 18: Flower heads, descriptive statistics of weight

	Number of flower heads	Fresh weight	Dry weight	Flower heads per kilo fresh	Flower heads per kilo dry	Fresh to dry weight ratio
N	18	18	18	18	18	18
Mean	603.89	600.22	102.83	1006.15	5884.53	5.850
Std. dev	76.456	.943	4.985	127.723	783.603	.2860
Median	605.00	600.00	102.00	**1008.33**	**5797.19**	5.882
Minimum	427	600	91	712	4186	5.3
Maximum	736	604	113	1227	7000	6.6

6.9. Harvesting quota

For OPs please see

Appendix 6: Monitoring the Arnica resource

Appendix 7: Monitoring harvested flower heads

Appendix 8: Monitoring flowering rate

Purpose: Establishing sustainable use through setting harvesting quota. Setting of the harvesting quota is based on the resource assessment, monitoring of the resource and monitoring of the flowering rate.

The flowering rate has been monitored since 2000 (Table 20). In each polygon that has been monitored the flowering rate was determined in random plots of $1m^2$. The number of flowering and the number of non-flowering rosettes was counted. The flowering rate is determined as the number of flowering rosettes divided by the total number of rosettes (sum of flowering and non flowering rosettes). A mean per site was calculated and from this descriptive statistics per year and an overall average for all years was calculated. There is variation among sites and between years, however the variables show no significant trend over the years. A linear regression was calculated the slope is not differing significantly from zero (Figure 20) The median of the total is

0.11, this mean on average (median) 11% of the rosettes are flowering. The interquartil ranges between 7 and 18%.

As long as the flowering rate shows no significant decrease (should be tested statistically), a solution is recommended that could be easily applied by the collectors and monitored by the local company and controlled by an external audit. It is suggested to pick a **maximum of half of the flower heads** per site and to leave the second part for seed production (Table 17). It does not make a huge difference in the total amount whether collectors take one flower head from each stem or whether they leave one flower head on each stem. Both cases lead to approximately half of the resource.

Table 19: Harvesting quota

Harvesting Quota
Take half of the resource and **leave half** of the resource for seed production (Figure 19)
Pick only 1 flower head per stem

The guideline to leave half of all flower heads is followed can be easily monitored after the collecting season and, before mowing starts. It is similar to determining the number of flower heads per stem. The number of stems without flower heads, with one flower head, two flower heads etc. have to be recorded in the random selected and the large sites (OP: ***Appendix 7: Monitoring harvested flower heads***).

Figure 19: *Arnica* life cycle
Leave flower heads for seed production;
©: Florin Pacurar, Valentin Dumitrescu

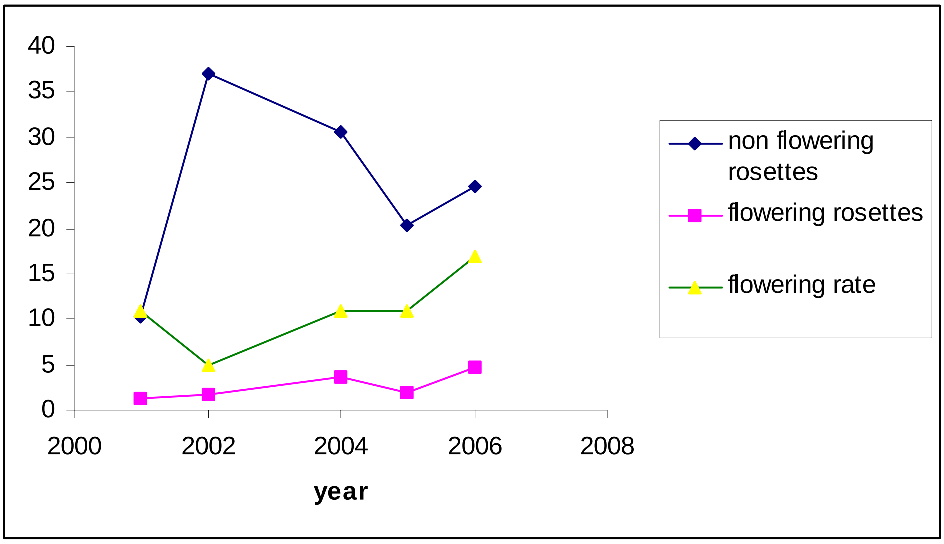


Figure 20: Non flowering rosettes, flowering rosettes, flowering rate (2001 to 2006)

Table 20: Descriptive statistics of mean of non flowering rosettes per m^2, mean of flowering rosettes per m^2 and mean of flowering rate per m^2 (quadrates).

Year	Parameter	Non flowering rosettes per m^2	Flowering rosettes per m^2	Flowering rate per m^2
2001	N (number of quadrates)	243	243	243
	N (number of sites)	48	48	48
	Mean	19.1325	2.3458	.1271
	Median	**10.3125**	**1.3667**	**.1138**
	Minimum	1.08	.00	.00
	Maximum	103.13	14.38	.35
	Skewness	2.003	2.616	.947
	S.e skewness	.343	.343	.343
2002	N (number of quadrates)	400	400	400
	N (number of sites)	38	38	38
	Mean	39.8169	2.3591	.0679
	Median	**36.9118**	**1.7750**	**.0526**
	Minimum	3.00	.00	.00
	Maximum	92.13	6.00	.24
	Skewness	.469	.892	1.456
	S.e skewness	.383	.383	.383
2004	N (number of quadrates)	1002	1002	1002
	N (number of sites)	38	38	38
	Mean	33.8417	4.4537	.1270

Year	Parameter	Non flowering rosettes per m^2	Flowering rosettes per m^2	Flowering rate per m^2
	Median	**30.6048**	**3.5952**	**.1145**
	Minimum	10.10	1.83	.05
	Maximum	84.40	11.10	.26
	Skewness	1.152	1.156	.626
	S.e skewness	.383	.383	.383
2005	N (number of quadrates)	1321	1321	1321
	N (number of sites)	132	132	132
	Mean	23.7399	3.0764	.1344
	Median	**20.3333**	**2.0227**	**.1074**
	Minimum	.67	.20	.01
	Maximum	93.00	26.63	.67
	Skewness	1.054	3.598	2.184
	s.e skewness	.211	.211	.211
2006	N (number of quadrates)	1632	1632	1632
	N (number of sites)	94	94	94
	Mean	28.9918	5.2744	.1776
	Median	**24.5667**	**4.6237**	**.1658**
	Minimum	1.75	.67	.05
	Maximum	118.50	14.50	.55
	Skewness	1.412	.930	1.692
	S.e skewness	.249	.249	.249
2000-2006	N (number of quadrates)	4598	4598	4598
	N (number of sites)	350	350	350
	Mean	27.3608	3.6382	.1370
	Median	**23.8102**	**2.5000**	**.1164**
	Minimum	.67	.00	.00
	Maximum	118.50	26.63	.67
	Skewness	1.160	2.340	1.830
	S.e skewness	.130	.130	.130

6.10.Landowner and collector

Data collection: Florin Pacurar, Adriana Morea, Dana Bîte, Students of USAMV; Data analyses: Barbara Michler

Purpose: Characterising landowners and collectors and their relationship to each other. Preparing a list of landowners to make contracts for sustainable management activities and a list of collectors for organic wildcrafting certification requirements.

Only local people collect *Arnica* flower heads. 83 landowner were asked whether *Arnica* flower heads are collected on their land, 81 answered yes. In only a few cases landowners restrict collection and only harvest their own (6%) sites. Mostly the landowner and their neighbours (57.8%) or only the neighbours (33.7%) are harvesting the *Arnica* flower heads. *Arnica* is flowering together with the grass species and collecting the flower heads tramples the grass. Thus, the farmers tolerate collection only among their own family members and neighbours (probably relatives).

6.10.1. Landowner profile

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It was difficult to identify landowners of *Arnica* grassland. There are several reasons for this: During “Project Apuseni” we already learned that the local people do not classify their land in “grassland with *Arnica*” and “grassland without *Arnica*”. The meadow classification of the people follows the locality. The local name of *Arnica montana* is “yellow flower”. This causes additional problems, because there are a few similar species like *Doronicum austriacum* or *Tragopogon pratense* and other yellow flowering species.

In 2001 I accompanied the collectors to identify sites and land owners. The next step was to involve collectors in the monitoring team. This way we got first-hand information about the collecting places and the landowners. At the same time we had exhibitions in the local churches about the *Arnica* component of the previous "Project Apuseni". This way many people learned about the project and it was easier to get in contact local people. Also landowners started to observe whether *Arnica* occur on their land.

In 2002, mapping of the *Arnica* sites started. The inventory was necessary on the one hand for resource assessment on the other hand it is necessary to identify the landowners and to find out how they manage the land. However, one major problem remained: No up-to-date land registry exists. The most recent dates back to 1870!!!. Figure 21 illustrates the situation. In the map from 1870, polygons mark some meadows and the rest (largest part) is forest. The remote sensing image shows quite a different situation. The area covered by forest decreased whereas the one covered by grassland increased. The yellow spots indicate actual *Arnica* habitats. In the official map, some of the spots are located in forests. The owners registered 1870 time are the ancestors of the current owners, but they rarely have official title deeds. No border markings exist. We needed to rely on the help of local people (Dana Bîte and others) to identify the landowners of the *Arnica* sites (polygons). We also collected information about the age of the landowners and how many generations live at the farm. A senior, a junior, and a young generation were distinguished to find out whether there will be a future generation to manage the farm. During the last 30 years, many people left the villages to live in the cities. Outmigration especially of the young is a major problem of the region.

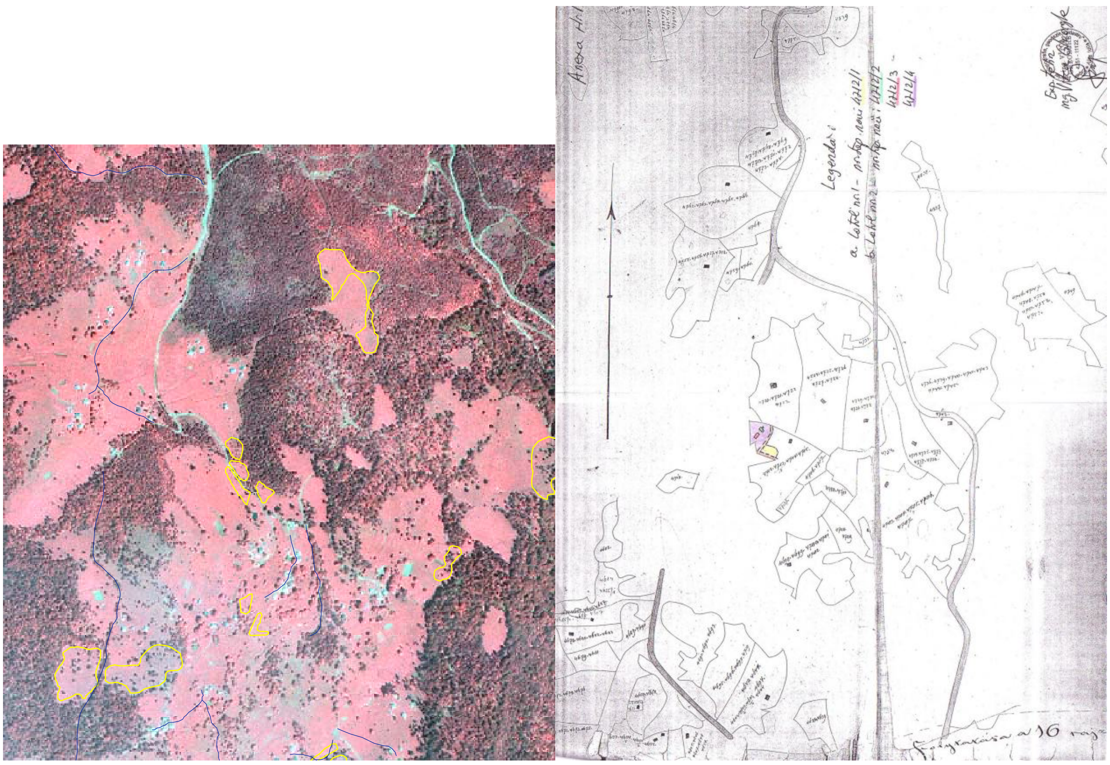

Figure 21: Left satellite image from 2001, right "actual" map from 1870 of the same site

The landowners of 231 polygons out of 597 polygons were identified. Altogether, they own 407.7 ha, which is 39% of the polygons or 74% of the total area of identified *Arnica* sites. In total 195 landowners were identified, and the age of the landowners was estimated by locals. Some of the landowners own several polygons. However, it is also possible that one polygon has several landowners. In 44.6% (n=141) of the households 3 generations are living together. In 15.8% (n=50), a senior and a junior generation is present. In 14.9% (n=47) of the households only a senior generation is present. A junior and a young generation is present in 19.6% (n=62). Only a junior generation is present in 5.1% (n=16) of the households. The median age of the senior generation is 67.5 years, the median age of the junior generation is 38 and the one of the young generation is 12.5 years. Only a senior generation live in nearly 15% of the households. The median age is 67.5 years.

The management of the *Arnica* habitats is quite exhausting and one of the key risks is that in future the landowners will not be able to manage the meadows.

6.10.2. *Arnica* collector profile

The profile is based on statistics of the 2006 field season. Ecoflora/Ecoherba, the local resource and trade organisation that have been founded during the project, bought 3076 kg of fresh *Arnica* flower heads. A specially design form (***Appendix 10 Sourcing and quality rating of Arnica flower heads***) was filled in for each delivery of *Arnica* to get information about age and gender of the collectors and to determine the time they need for collection. The latter was necessary to calculate an average wage per hour and to find out how much they can deliver daily. Please keep in mind that local people collect *Arnica* as an additional activity apart from their daily work on the farm.

People between 18 and 50 years collected 1324.1 kg of *Arnica*: (43%). Children collected 666.3 kg (21.7%) and older people 1086.5 (35.3%). Thus, children and older people collected 1752.8 kg of *Arnica*, which is more than half of the total *Arnica* bought by Ecoflora/Ecoherba.

The collectors delivered a median amount of 6.5 kg of *Arnica* per day, which equates to 6.5 hours for collection per day per family. Most of the *Arnica* was collected by women and girls (262 lots, 2286 kg, 74, 3% of fresh weight). Male collectors delivered 116 lots, which is 790 kg or 25.7% of total fresh weight. Most of the *Arnica* harvesters collect alone (48.3%, 1487.5kg) followed by collection with family (43.9%, 1350.3kg). Only a few collect with friends (7.8%, 239.1kg).

A linear regression was calculated to determine the relation between working time and quantity that has been collected. A coefficient of 1.0 obtained (y (fresh weight) = 1*x (hour); R^2=0.816). Per hour, one kilo of fresh *Arnica* is collected.

6.11.Revenues of the collectors

Data collection: Mona Cosma[1], master student at USAMV, Michael Klemens[2], Florin Pacurar[3]

From Gârda de Sus data are available from 2001 to 2005. Students of USAMV from the Apuseni area were asked whether *Arnica* is collected in their villages. This way other collecting places in

Apuseni were identified. In 2005, s a rough field survey of prices was performed in these villages. Table 21 reflects the situation.

Table 21: Revenues from *Arnica* collecting

Location	2004[ROL per Kg]	40613 ROL=1€	2005[ROL per Kg]	36 129ROL=1€
Matisesti[1, 3]	12 000-15 000	0.29-0.36	10 000	0.27
Rachitele[1, 3]	Not transparent	Not transparent	10 000	0.27
Balcesti[1, 3]	Not transparent	Not transparent	No collecting	No collecting
Rasca[1, 3]	10 000- 28 000	0.24-0.68	10 000	0.27
Sacuieu[1, 3]	10 000	0.24	10 000	0.27
Maguri[1, 3]	No collecting	No collecting	10 000	0.27
Poiana Horii[1, 3]	Not transparent	Not transparent	10 000	0.27
Giurcuta de Sus[1, 3]	10 000	0.24	15 000	0.41
Marisel[1, 3]	8 000	0.19	10 000	0.27
Rogojel[1, 3]	10 000	0.24	10 000	0.27
Margau[1, 3]	Not transparent	Not transparent	10 000	0.27
Gârda[2,]	9000-15000	0.22-0.36	10 000	0.27

In 2002, the collectors in Gârda received 15 000 ROL, this equates to 0.47 €, (Exchange rate 2002: 31801 ROL = 1 €) (Michler 2005).

In 2003, collectors received on average 18 000 ROL, this results again in 0.47€ (Exchange rate 2003: 38255 ROL = 1€) whereas in 2004 they received 0.24 € (Exchange rate 2004: 40 613ROL = 1€), in 2005: (Exchange rate 2005: 36 129 ROL = 1€) they received 10000 ROL which equals 0.27€. These calculations show that the prices decreased the last 2 years.

As shown above, the collection of one kilogram of *Arnica* flower heads per hour, means that the price per kg reflects the hourly wage of the collector. According to web-site of the German foreign office http://www.auswaertiges-amt.de/diplo/de/Laender/Rumaenien.html the average net monthly income in 2005 was 734.5 RON (ca. 183 €), the average gross income in 2005 was: 819.5 RON (ca. 202 €). According to http://www.boeckler.de/pdf/pm_wsi_2006_03_14.pdf the minimum wage rate per hour is 0.50€. Assuming 40 working hours per week, the prices paid to the collectors are below the gross income and below the minimum wage rate. The *Arnica* was sold to intermediate traders, some of whom export directly (Figure 24).

Even if the costs for drying, storing, and exporting are the same, Ecoflora/Ecoherba, Ecoflora/Ecoherba cannot continue to exist and make profit unless a premium price is paid by the manufacturer/buyer. To encourage sustainable-use and give an incentive to continue managing *Arnica* meadows it is important to pay a better price for *Arnica* flower heads. This is only possible if more value can be captured locally, e.g., through drying locally and then trading *Arnica* directly. Ecoflora/Ecoherba has been tasked with that. As a result, in 2006, the collectors received 3 RON or 0.82 € (3, 66 RON = 1€) per kg of fresh *Arnica* from Ecoflora/Ecoherba. This is a significantly higher price than the one offered by intermediate traders or other companies.

6.12. Value adding


For details and OPs please see

Appendix 10: Sourcing and Quality rating of Arnica flower heads

Appendix 11: Pilot Drying house and Pilot Drying

Appendix 12: Description of the Drying house

Appendix 13: Drying of Arnica flower heads

Appendix 14: Drying poster

Appendix 17: Harvester poster

Purpose: Documentation of the sourcing and rating process is part of the value adding. It is generally required by buyers and an essential and initial step to make the sourcing of the raw material transparent. Quality, level of processing and price of the *Arnica* material are close related issues. Drying is a value adding and improves both the quality of the product and revenues from its sale.

6.12.1. Sourcing and Quality rating of *Arnica* flower heads

A good price depends on good quality and proper market access. This section focuses on the quality of the raw material delivered by the collectors and on methods to improve the quality. Training of the collectors, sourcing and rating of the collected materials are basic tools to achieve this aim. According to the monograph of ESCOP[8], the European Scientific Cooperative on Phytotherapy, the herbal drug consists of the whole or partially broken, dried flower heads, *Flores Arnicae,* or of dried flowers or ligulate and tubular florets, which are separated from receptacle and bracts, *Flores Arnica sine calycibus,* (Wichtl 2004, Merfort 1992). The foreign matter is restricted to 5% (European Pharmacopoea 2002). Foreign matter means parts of the

[8] http://www.escop.com/

plants that are not included in the monograph e.g. stems, leaves, buds, roots, or parts of foreign plants. The flower heads should be harvested at the stage of full bloom.

The situation before 2004 can be described as follows: the collectors used plastic bags for collection, which are used for other purposes as well. The *Arnica* flower heads were stored in these plastic bags until the collectors had time to go to the local trader. The temperature in the bags was more than hand warm. Due to the climatic situation, the flower heads were often collected wet. A visual screening of the harvested *Arnica* flower heads obtained the following: no adulteration with other species could be determined. The collectors were harvesting the flowering head at the top and the nearby-situated closed buds too. The collectors pick the flower heads and a part of the stem too.

It is not hygienic to use plastic bags. They are not air permeable and as a result microbiological contamination is encouraged. Harvesting wet material exacerbates the contamination process, apart from making it more costly to dry. Contaminated material cannot be sold. The storing reduces the quality of the flower heads, the composition of the chemical components changes. Buds, stems, and Achenes (fruit containing the seeds) from faded flower heads increase the foreign matter content of the herbal drug. Faded flower heads and buds are better left for seed production.

In 2004 and 2005, sourcing and harvesting methods were developed. Textile bags were handed over to the collector only if the weather conditions were suitable and were accepted only the same day. The collectors were trained to pick better quality of *Arnica* flower heads. The training focussed on:

- Picking flower heads only at dry weather conditions
- Using the textile bags they get from the sourcing team
- Picking only the full blooming flower heads
- Picking flower heads without stem
- Leaving buds
- Leaving flower heads for seed production
- Delivering the flower heads in textile bags immediately after picking

In cases were collectors brought sub-optimal material the sourcing team sorted through the material with the collector, and if the quality of material was too bad the team refused to buy it. Based on this experience a harvester manual was developed. The collectors were trained again when they got the textile bags for collection. The training was effective and the collectors adapted to the new system. However, it is necessary to honour their efforts with a higher price. It is much more time consuming for them to collect good quality than bad one and to follow the harvesting guidelines. The sourcing/rating team trained the local buyers in rating the collected *Arnica* and to buy only good quality.

Documentation of the sourcing and rating process is part of the value adding. It is generally required by buyers and an essential and initial step to make the sourcing of the raw material transparent. For each lot delivered, a form was filled-in together with the collector (***Appendix 10: Sourcing and Quality rating of Arnica flower heads***). The origin of the *Arnica* flower heads needs to be fully traceable if organic wild harvesting certification[9] or compliance with the new Standard for Sustainable Wild Collection ISSC-MAP[10] is desired. Both processes were trialed during the project period and *Arnica* was certified under both. In absence of further financial support the cost of these processes need to be covered by Ecoflora/Ecoherba or the buyer of *Arnica*. Ecoflora/Ecoherba is in not in the position to cover such costs unless the price of *Arnica* is increased.

6.12.2. Drying

Quality, level of processing and price of the *Arnica* material are closely related issues. Drying is a form of value-adding and improves both the quality of the product and revenues from its sale. When the project started, harvesters and the local traders depended on intermediate traders who picked up the flower heads with a van. The local population was not informed about the market situation and the demand for *Arnica* flower heads.

Advantages of on-site drying of *Arnica* flower heads are:

- Drying of flower heads is a step in value-adding.
- Drying is required for storing.
- Storing is beneficial if waiting to sell the raw material may result in a better market price.
- A good market price depends on the level of product quality.
- High quality raw material is dried immediately after picking in hygienic circumstances, thus preventing microbiological contamination.
- No *Arnica* flower heads are wasted.

On site drying requires facilities that can be managed by local people under local conditions. The infrastructure of the region is still under-developed. The most frequent vehicle is a horse cart. Electrical power is available, but -during the summer- thunderstorms are usually accompanied by power black-outs. The abrupt fall of voltage affects electronic devices negatively and limits the application of electronic controlling systems. A literature survey on drying technologies was carried by Michler in 2003. It is based on: Heeger (1989), Heindl (2003) Herold, Dubiel, Pank (1990), Laxhuber (1998), Marquard, Kroth (2001), VEB Pharmazeutisches Werk (Hrsg.) 1986.

There was no local experience in drying methods. The project started in 2004 with a small pilot drying house to perform preliminary studies to get information about drying space and drying process with a special focus on the climatic conditions in the mountains. These details are necessary to calculate the dimension of the final drying facility and the total amount of flower heads that can be dried during the flowering period (dryer capacity). In this context, it is crucial to know the ratio between fresh and dry flower heads. Of course, it is also essential for any calculation related to the price of dried flower heads.

The pilot-drying house was built in 2004. It is a simple wooden construction. The equipment consists of sensors for monitoring the humidity and temperature, stove for heating, ventilation system, ventilation windows, electric lighting and plug, wooden tools for working with *Arnica*

[9] http://www.imo.ch/imo_services_wildcollection_organic_en,38864,998.html
[10] http://www.floraweb.de/map-pro/

raw material, devices for keeping windows open, fire extinguisher, posted working instructions, template for data recording, tools to clean the drying house (for details see Appendix 11). The data obtained from the drying experiments in 2005 were used to calculate the dimension of the final drying house, which was built in 2006.

Tamasz *et al.* (2006) analyzed one sample of on site dried according to the stipulations of the European Pharmacopoeia. He confirmed the high quality of the material sourced and dried in Gârda de Sus.

6.12.3. Drying process

In the field season 2005 about 334 kg of fresh *Arnica* flower heads have been ordered to be dried on site. The material was collected in the afternoon, only during sunny weather periods and brought into the dryer in the evening. 6 batches were processed. 2 kg of fresh flower heads were spread per m^2. Additionally, experimental shelves were filled with 500 g of flower heads per board.

Result

From Table 22 some statistics can be obtained. The average fresh/dry weight ratio per batch is 5.5±0.4. Minimum, 5 kg fresh flower heads, maximum 6.1 kg fresh flower heads are necessary to get 1 kg of dry flower heads. A drying period takes 4 days. During the fifth day no decrease is visible. This is illustrated in Figure 22. It shows the drying process of batch 1.

Table 22: Overview of drying in Ghetar 2005

Batch	Fresh weight [kg]	Dry weight [kg]	Ratio fresh/dry
1	62.500	12.424	5.0
2	62.500	12.560	5.0
3	62.500	11.653	5.4
4	62.500	10.687	5.8
5	62.500	11.089	5.6
6	21.000	3.468	6.1
Total	333.500	61.881	Mean 5.5
			Standard dev. 0.4

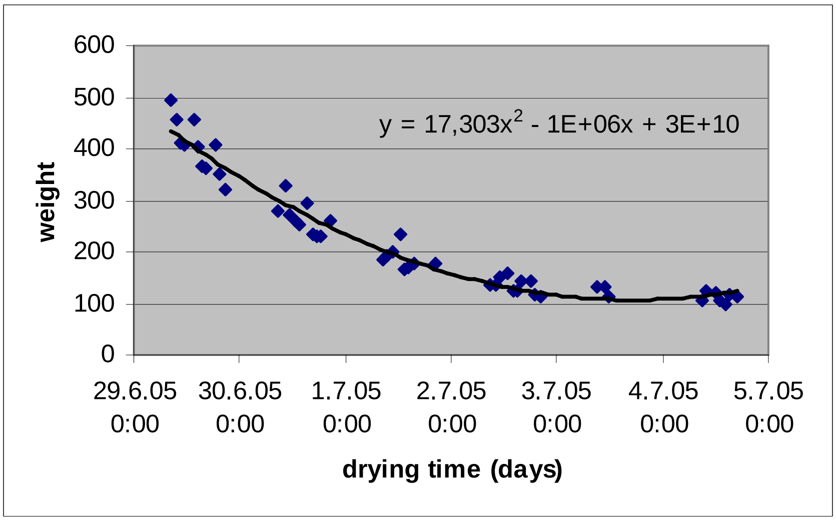

Figure 22: Relationship between weight and drying period

In Figure 1 the relation between temperature and dew point in the drying house (indoor) and outside the drying house (outdoor) is shown. The dew point of a given parcel of air is the temperature, to which the parcel must be cooled, at constant barometric pressure, for the water vapor component to condense into water, called dew. The precise determination of the dew point is possible only with complicated experimental means. However there is an approximation formula to estimate the dew point τ from vapour pressure (http://www.sf.tv/sfmeteo/diverses_wetterlexikon.php):

$$\tau = \frac{234{,}67 \cdot \log(e) - 184{,}2}{8{,}233 - \log(e)}$$

e is

$$e = \frac{r}{100} \cdot 6{,}06 \cdot 10^{\frac{7{,}5 \cdot t}{237{,}5 + t}}$$

r is the relative percental humidity and t the air temperature.

If there is a large positive difference between the actual air temperature and the dew point the evaporation process goes quickly. The more the air temperature approaches the dew point the longer takes the drying. Regarding the dew point and the temperature outside it is obvious that there is not a huge difference between those two. As a result this means that the *Arnica* outside the house under “open-air drying” conditions would not dry. At night, in the drying house, a distance between dew point and temperature can be observed. This means no water is condensing in the drying house at the night (Figure 23).

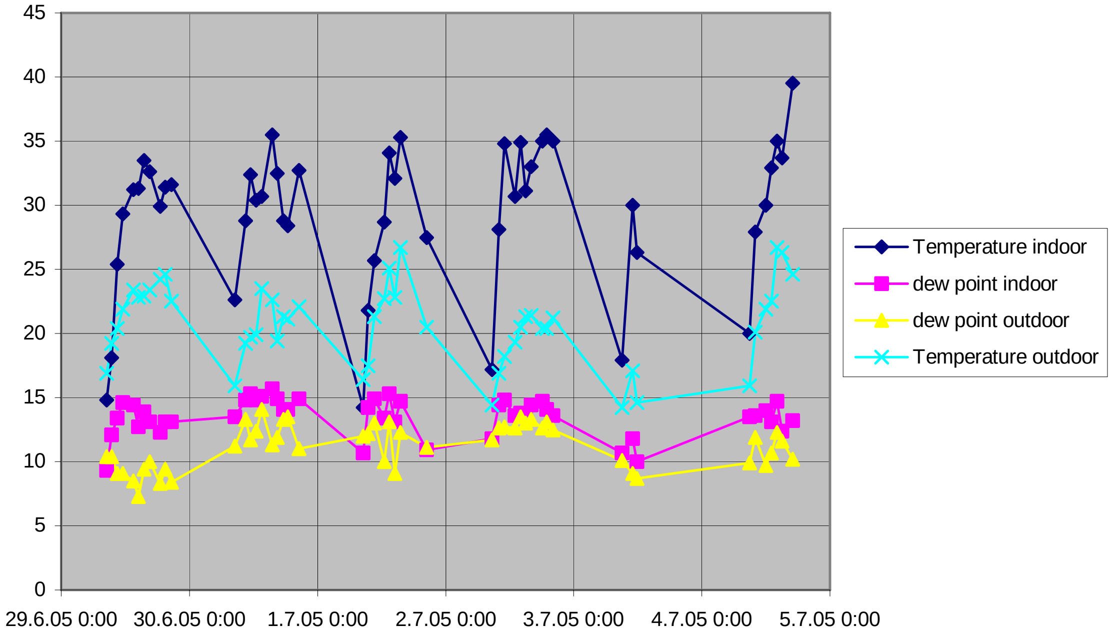

Figure 23: Relation between temperature and dew point

Conclusion

The weight of *Arnica* in natural habitats is influenced by the soil of the habitat, climate, the harvesting date and time and how long the *Arnica* is stored until the collectors deliver it. The longer it is stored, the more humidity is transpiring. However, only fresh material, processed immediately after collecting was used for the experiments. The ratio obtained in this experiment is within the range, that can be obtained in the literature (Table 23). Tamasz *et al.* (2006) determined the loss on drying of one on-site dried sample. It is below 10% and in accordance to the European Pharmacopoeia. For example, 550±50 kg of fresh flower heads are necessary to receive 100 kg of dried flower heads. It takes approximately 4 days to dry the flower heads.

Table 23: Fresh dry weight ratio

Fresh dry weight ratio	Reference
8:1	VEB Pharmazeutisches Werk (Hrsg.) (1986):
4-5:1	Dachler, Pelzmann (1999)
5.5-5.9 : 1	Galambosi *et al.* 1998
4-5:1	Heeger 1989
5.5 ±0.4 : 1	Michler, Morea 2005

It is recommended to Ecoflora/Ecoherba to start with a pilot drying experiment in the small drying house, if they extend their offer to other herbs or mushrooms. Especially if only small amounts (100 kg dried material) are necessary it is more efficient to do this in the small pilot dryer than in the huge one.

7. Ethical Business

For details on setting up the ethical business please, see

Appendix 21: Steps to establish the ethical business, main constraints and challenges

Setting up an organisation for the sustainable management and trade of *Arnica* and local natural resources was a core element of the project. It was successfully accomplished in the form of an ethical business (Ecoherba ltd.) and an association (Ecoflora) by team and community members. This is an innovative and piloting effort for Romania.

Sustainable use of natural resources is linked to local livelihoods and to economic viability. As one of the key elements of the project, a Resource Management and Trade Organisation(s) (RMTO) was established at Gârda-de-Sus. The mechanisms and procedures to set up the RMTO were developed by the local stakeholders in co-operation with the project team from Cluj. Out of this Ecoherba and Ecoflora were founded.

The project aimed at developing an effective management system to encourage positive social and environmental impacts. This was to be achieved through adding value to the local resource – *Arnica*, which would retain more value locally and thereby giving incentives for the sustainable use of the resource and the management of the habitat. The product created "*Arnicae Flos, sustainable, fair and transparent*" should be attractive to increasing ethical markets in Western Europe. It was understood that companies, such as Weleda, Germany actively seeking ethical, high quality and long-term *Arnica* supplies for marketing to ethical consumers.

Before the project started the benefits of collectors have been little. The prices have been as low as 30 cents/kg fresh weight and with high fluctuation between years. The collectors sold only fresh flower heads. The collectors were not organised and trained, had no power and no market info. The quality of *Arnica* was poor (e.g., collected and stored in plastic sacks up to 2-3 days; buds & stems collected, etc.) and a lot of the resource was wasted when local buyers did not turn up. In addition, landowners didn't receive benefit from trade and thus had no incentive to manage the habitats.An MBA student consultancy team (Joshua Hawn, Jessica Jackson, Johannah Dods Gertrude Makhaya, Martin Zdravkov) from Saïd Business School, Oxford University worked with the project team and developed a business plan and a feasibility study for the creation of a social enterprise engaged in the sustainable and fair trading of *Arnica montana*.

7.1. Value/supply chain before project started

Data collection: Michael Klemens

From this business plan the value/supply chain (Figure 24) before the project started and the value/supply chain after project intervention (Figure 25), showing potential social and environmental impact are taken. Michael Klemens (Klemens in prep.) studied the supply chain of *Arnica montana* flower heads in Romania and worked together with the MBA-team.

The *Arnica* montana supply chain is buyer-driven. The lead firm is the producer of the final consumer product. The bulk of the profit is captured in the design, marketing and sales of consumer products. It is typical in such buyer-driven supply chains that the profitability is greatest in the concentrated areas of the supply chain that have higher entry barriers.

This dynamic is evident in the value/supply chain operating before the project started. During that time local harvesters and collectors received €0.28 and €0.38 per kg of fresh *Arnica montana* respectively. Because *Arnica montana* flower heads shrink when they are dried, this purchase price translates to €1.68 per kg of dried *Arnica montana*. In contrast, traders currently receive around €10.00 per kg of dried *Arnica montana*, and Romanian-based wholesalers or manufacturers (operating in a position similar to the previously referenced German businesses) receive approximately €25.00. Thus, in this typical example 64.2% of the value is concentrated with the wholesaler/manufacturer, over 27.5% with the trader, about 2.14% with the intermediate local trader, 6% with the harvesters. Only 8.1% remains in the village with the intermediate local trader and the harvesters. This demonstrates the power imbalance in the chain due to the low availability of information and opacity of pricing from the perspective of the Gârda villagers. This supply chain highlights the potential to bring more value into the village by introducing value-added processes, such as improved collection techniques, *Arnica montana* drying, and production of oils and tinctures.

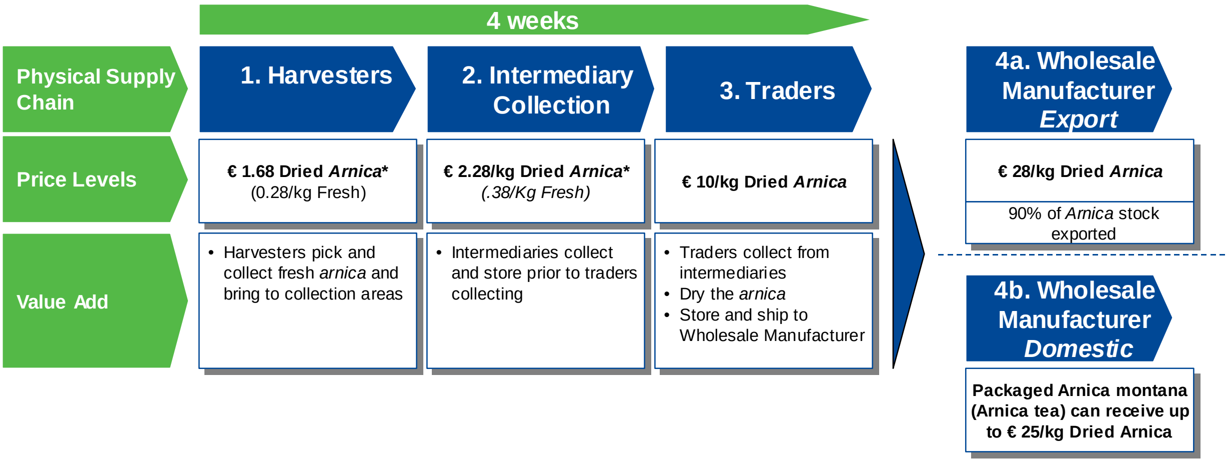

Figure 24: Value/supply chain before project start (source: MBA-business plan, 2006)

Figure 25 shows a simplified value/supply chain, which captures more value for the local community and generates positive social and environmental returns. The building of the drying house in the community has enable Ecoflora/Ecoherba to sell directly to European manufacturers such as Weleda, thereby removing an intermediary and earning €7 over the €10 per kg usually earned by traders. This is a result of producing a higher quality product due to on-site drying and the quality assurance measures taken (described in the previous section). To some extend the price also reflects the value placed by the manufacturer on sustainable and organic production. Harvesters receive a higher price for the crop; as a result, they should have more incentive to adopt sustainable harvesting practices and continue with traditional farming techniques.

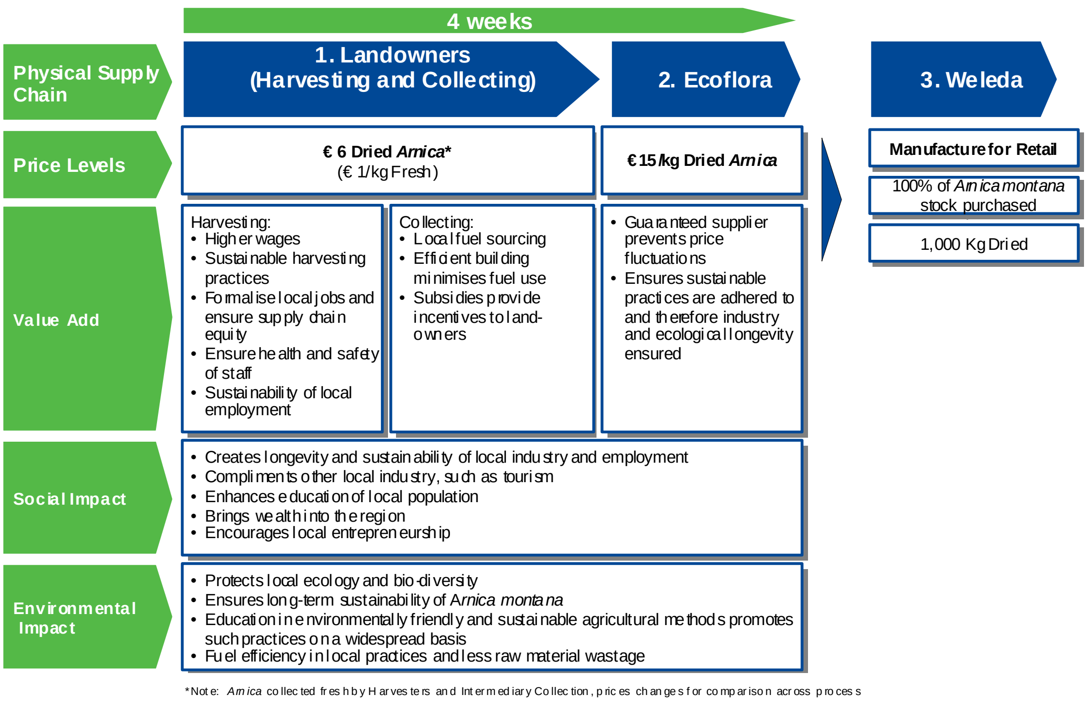

Figure 25: Value/supply chain after project intervention showing potential social and environmental impacts (source MBA-business plan, 2006)

The value proposition to consumers of high-end *Arnica montana* products includes a promise of high-quality, organic certification, and sustainable harvesting. This promise commands a higher market price than set for products made from low-quality, untraceable *Arnica montana* (a category that fits the historic GdS product). The value-adding processes listed above will allow GdS villagers to provide an inherently more valuable product to manufacturers, rather than selling low-quality products to an intermediary.

In designing the pricing and incentive structure, the following factors will have a significant impact on outcomes. The incentive structure must ensure that landowners are appropriately rewarded for maintaining the traditional management of the grasslands. This requires the pricing scheme to provide explicit and credible returns for *Arnica montana* production in the immediate future.

7.2. Value/supply chain established

Florin Pacurar, Dana Bîte and local advisory group

Ecoflora as a non-profit association and Ecoherba LTD were founded (Figure 26). Members of Ecoflora are are still few and are composed of landowners of *Arnica* sites, local official people and members of the project. The mission of Ecoflora is to protect the wild plants and their habitats in Gârda and to generate benefits for the local communities and for conservation. The objectives of Ecoflora are:

- Maintaining the populations of wild plant species.
- Maintaining the cultural and natural mountainous landscape.
- Supporting the local communities in sustainable use of the natural resources by traditional and modern methods.
- Maintaining and supporting the traditional management of the meadows, management that generated the large flora diversity and cultural landscape of the Gârda de Sus area.
- Awareness raising regarding the protection of nature etc. with a special focus on local communities

The company is called Ecoherba and is administrated by both, landowners of *Arnica montana* and a non-profit organisation, called Ecoflora. The main objective of the company is the *trade with wild flowers and plants (5122),* that is part of the codified system CAEN. Besides this main activity objective, Ecoherba has other secondary objectives, such as: collecting the forest products and other wooden products that come from the spontaneous flora, en-detail selling in specialized stores of other products, en-detail selling of fresh fruit and vegetables, making fruit and vegetable juice etc. Ecoflora and Ecoherba collaborate closely in the conservation of the species *Arnica montana* and its long-last exploitation. The association Ecoflora owns 40% of the business Ecoherba Ltd. Ecoflora also owns the drying house and Ecoherba has to rent it and pay Ecoflora. 40% of any profit made goes to Ecoflora to pay from it amongst other things the compensation payment to *Arnica* meadow owners. So far no legal basis exist on which to distribute compensation payment due to unclear landownership. Until landownership is established, any profit of Ecoherba is likely to be reinvested in, e.g., improvement of business and awareness raising.

The project established this system and trained the staff to activate in both entities Ecoflora and Ecoherba. In 2006 Ecoherba applied for collection permission and exported dried *Arnica* flower heads. The activities of Ecoherba are listed in ***Annex 18: Activities of Ecoflora/Ecoherba*** in ***Annex 19: How to obtain an export permit for MAP's in Romania*** the procedure to get collecting and export permissions can be obtained and in ***Annex 20: Exporting Arnica flower heads*** the Export procedure is described.

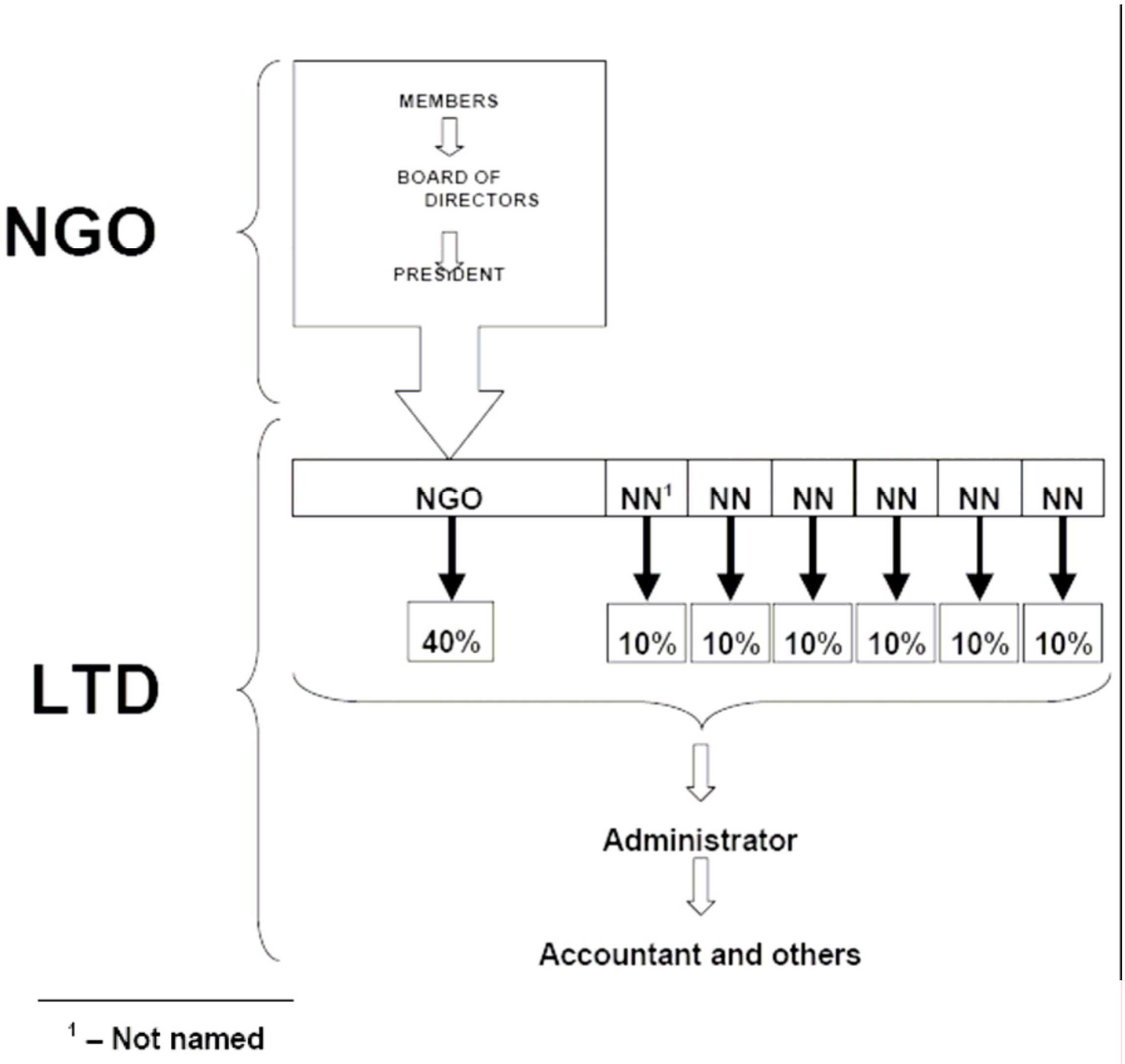

Figure 26: Structure and Governance of Ecoflora (NGO) and Ecoherba (LTD)

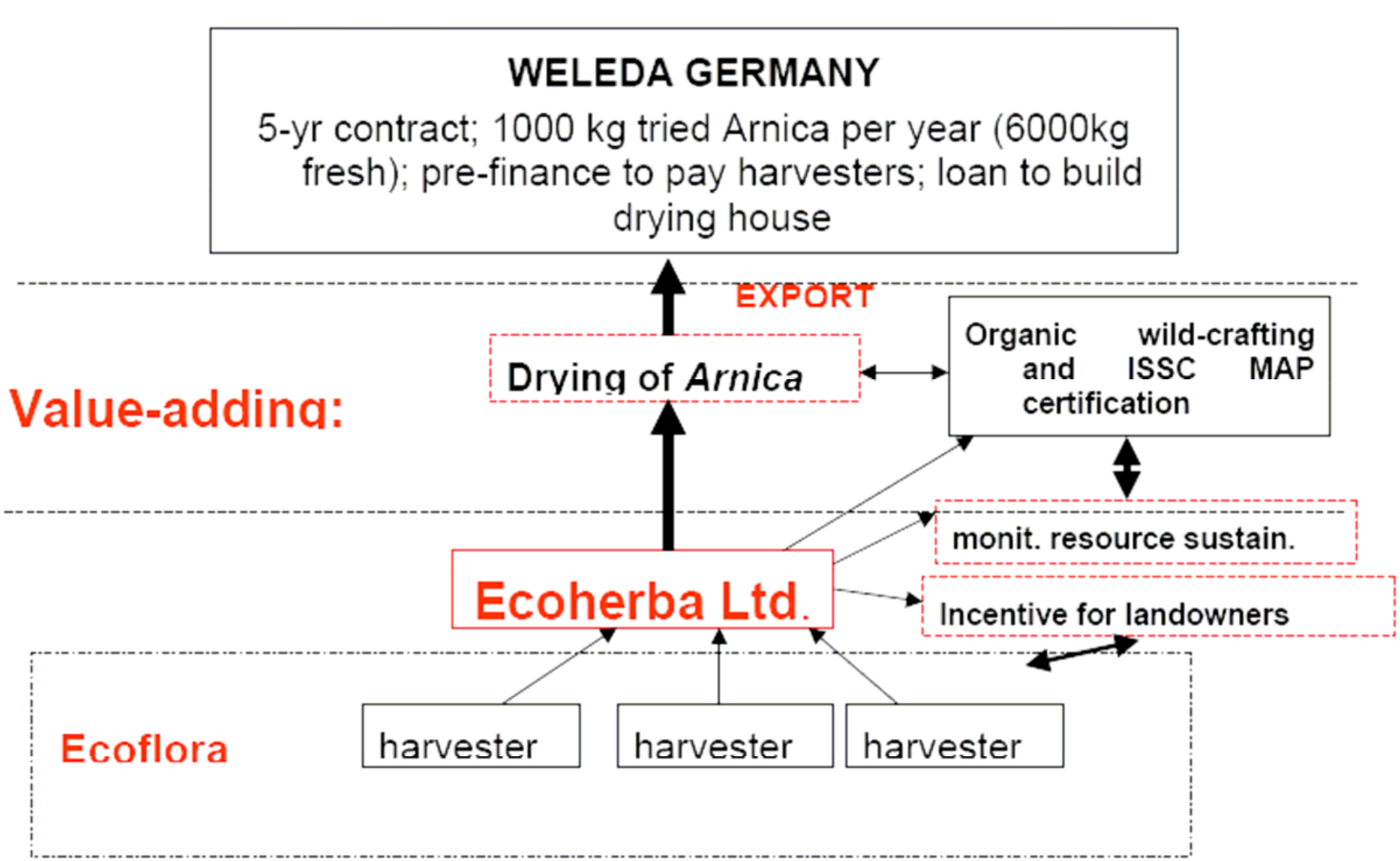

Figure: 27: Local management and trade structure and supply chain established by the project

(source: presentation Dr. Susanne Schmitt)

7.3. Key activities of Ecoflora/Ecoherba

Key activities of Ecoflora/Ecoherba are monitoring, value adding and business administration. The MBA business team developed key tasks for a three years action plan. In year 2 (2007) it is strictly recommended to expand into other products and to develop new partnerships.

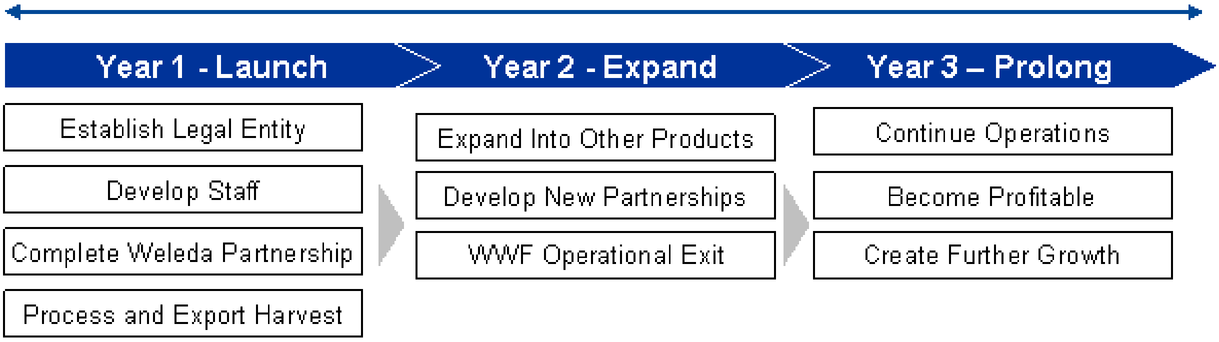

Figure 28: Key tasks for three years action plan (source: MBA-business plan, 2006)

7.3.1. Monitoring

Purpose: Over harvesting and habitat loss are serious threats to the *Arnica* populations in the area. The presence of *Arnica montana* and the resource of flower heads in a specific site is the result of a dynamic process. On the one hand growing conditions (e.g. soil, microclimate, water availability) and varying or abandonment management activities on the other hand influence the annual and long-term crop of flower heads and the maintenance of *Arnica montana*. At the landscape level 597 sites are spread over 80 km^2. Varying environmental conditions and management activities form a dynamic system. Monitoring activities focus on the landscape level and include monitoring of the resource and the habitat. Two sets of sites are monitored every year to evaluate the development in the area.

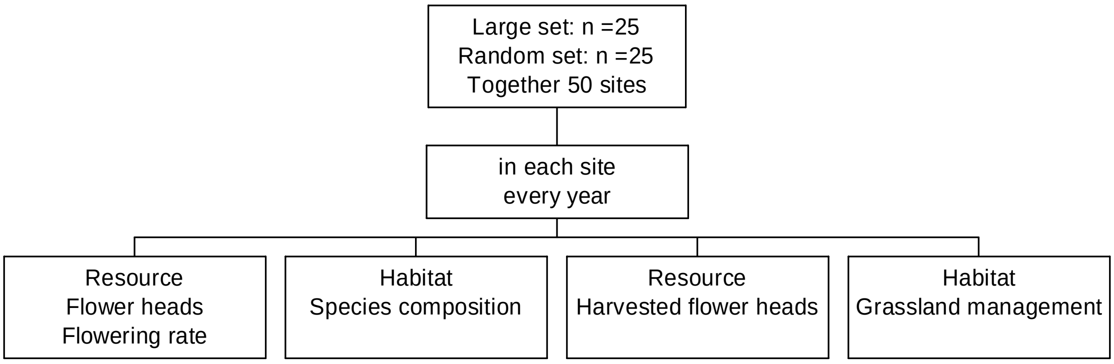

Figure 29: OP-Monitoring: Sample size, timeframe, activities

Monitoring of the resources provides basic information on density of *Arnica* flower heads and the population size in the landscape. Habitat monitoring is a tool to determine the conservation value of the sites and to monitor meadow management activities (Figure 29).

During the flowering season resource monitoring is performed to observe the population development and to adapt the annual harvesting quota. It includes monitoring of flowering rosettes (transects) and monitoring of the flowering rate an. At the same time habitat monitoring to evaluate management activities, especially fertilisation should be executed. After the collecting season, before the mowing season starts, the flower heads left behind by the collectors are recorded. This information serves as proof whether harvesting guidelines are kept and whether fruits (achenes) were evolved. Additionally in autumn the management status of the sites should be recorded to follow on whether the land is still under management or abandoned (Table 24).

From the conservation and the resource point of view, the large sites are of special interest for monitoring. At the landscape level monitoring a random set of sites represent the development of the *Arnica* population, the resource of flower heads, and the habitat. A sample size of 50 sites per year is recommended: The largest 25 sites of a total of 550 and 25 random selected sites. In each of the selected 50 sites, monitoring has to be performed. Whereas the sites of the large set should be monitored every year, the sites of the random set are selected new every year. In this way, the development of the large sites is monitored continuously and the development of the landscape is studied in a varying random set.

The selection of the large and the random set follows the procedure described in ***Appendix 2: Selection of polygons for monitoring.*** For OP on monitoring see:

Appendix 5: Monitoring Arnica habitat

Appendix 6: Monitoring the Arnica resource

Appendix 7: Monitoring harvested Arnica flower heads

Appendix 8: Monitoring Arnica flowering rate

Appendix 9: Monitoring management of Arnica habitats

The monitoring team has to visit the sites three times.

1. During the flowering season:
   - Monitoring resource.
   - Monitoring of flowering rate.
   - Monitoring of habitat (species composition).
2. After the flowering period, before the mowing period starts:
   - Monitoring of harvested flower heads
3. The end of September
   - Monitoring habitat (meadow management).

Table 24: Annual timetable, activities and OPs related to monitoring

Time:	Activity	OP
March	Selecting random and large set	***Appendix 2: Selection of polygons for monitoring***
March	Printing maps	***Appendix 1: Generating and printing maps***
June/July	Performing resource assessment	***Appendix 6: Monitoring Resource***

	Monitoring flowering rate	***Appendix 8: Monitoring flowering rate***
	Monitoring habitat	***Appendix 5: Monitoring habitat***
	Monitoring harvested rosettes	***Appendix 7: Monitoring harvested flower heads***
September	Monitoring habitat, meadow management	***Appendix 9: Monitoring habitat management***
October	Enter data in a database	
November	Analysing the data	

7.3.2. Further value adding and product diversification

Currently local value adding is performed on the level that *Arnica* flower heads are dried and exported. For details and OPS please see:

Appendix 10: Sourcing and Quality rating of Arnica flower heads

Appendix 11: Pilot drying house, pilot drying

Appendix 12: Description of the Drying house

Appendix 13: Drying of Arnica flower heads

Appendix 14: Drying poster

A further possibility is to sell dried flower heads, oil and tincture to tourists. On site, there is no way to manufacture oil or tincture. However, Ecoflora/Ecoherba can commission an external company to manufacture the products and sell it in the community to tourists. The ice cave located at the plateau is very famous. Every year thousands of tourists came to the region to visit the ice cave[11]. An information centre, located close to the ice cave and managed by a local tourist association already exists. During the last years, the local tourist association sold *Arnica* oil and tincture produced by the project. Klemens (2007 in prep) performed a survey to find out the attitude of the tourists to buy local products. It seems to be a realistic chance to expand the activities of Ecoflora/Ecoherba and create more products from herbs (Michler 2003).

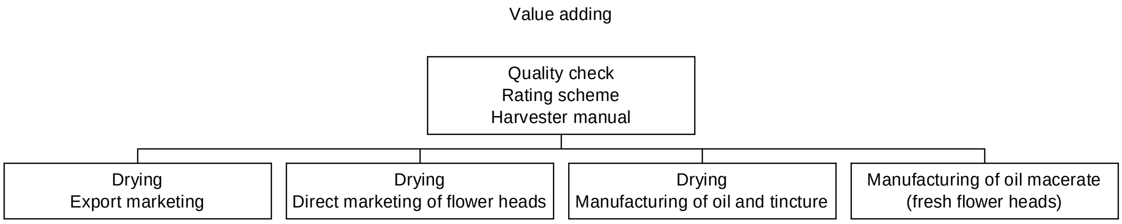

Figure 30: Further value adding scheme

[11] http://en.wikipedia.org/wiki/Scarisoara_Ice_Cave

8. Threats and opportunities

- No sufficient training in data management and statistical analyses

Currently the locals work under supervision of Florin Pacurar (monitoring) and Adriana Morea (drying). They are consultants of Ecoflora/Ecoherba. However, both of them are not trained in data management, statistical analyses, and interpretation.

- External audit to verify resource and trade management

The project set clear rules that determine the amount, timing, and technology for collection and drying of flower heads and to monitor the resource and the habitat. An external auditing should be established to verify in the field that the rules are kept. Moreover, the activities of Ecoherba should be transparent: E.g. price paid to the collectors, amount of money that is handed over to the landowners.

- Habitat loss

Arnica sites are a product of subsistence based grassland management. The habitat types are threatened by conversion. The management activities are quite time consuming and exhausting. A transparent calculation of habitat management costs should be performed and included in the operational costs of Ecoherba. It maybe interesting for the future to find a balanced management system that focus on reduced and less exhausting management activities and avoids declining of flowering rosettes.

- Resource exploitation

Monitoring the resource and the habitat can ensure the sustainability from the ecological point of view. It is not a problem to do it, the problem is who will pay for it. It is obvious that the price of sustainable sourced *Arnica* flower heads is higher than the price of *Arnica* sourced in a short time perspective. The maintenance of the business is clearly linked to the revenues of it. If the revenues of the *Arnica* business do not cover the costs and no profit is made with sustainable use of the resource, the locals will give up the resource and trade management and collect *Arnica* only. If due to habitat loss the resource is declining, the resource will be over exploited.

- Regional development strategies focus on intensification

Intensification of the agriculture systems to increase milk production or husbandry will lead to a loss of *Arnica* sites. The grassland is not profitable. The hay production is low. Either the sites will be fertilised or become fallow. Raising awareness of this problem is a major challenge to maintain unproductive grassland and ensure a future use of *Arnica* flower heads at all.

- Regional development strategies focus on reforestation of unproductive grassland

Reforestation of *Arnica* sites will lead to a loss of *Arnica* and a loss of the species rich habitat types. Raising awareness of this problem is a major challenge to maintain unproductive grassland and ensure a future use of *Arnica.*

- Compensation of landowners

At present, landowners do not hold official title deeds for their land. This makes it hard to distribute any money, because nobody can verify ownership of the land. However, land registry is under development. Based on this, on density of *Arnica* flower heads and on habitat quality an incentive scheme that takes into account the conservation value and the *Arnica* density in the sites can be developed and the landowners can receive revenues from Ecoflora/Ecoherba.

- Migration in general

The young leave the region to find a job anywhere else. In consequence, neither farmers managing the land nor collectors will be available. The maintenance of *Arnica* and is habitat is closely bounded to extensive farm management. Although the current *Arnica* price is a "premium price", it does not cover the habitat management and the monitoring costs and it is far a way to cover the livelihoods.

- Low local capacity in business administration

The price offered to collectors, the operational costs of drying and monitoring should be summarized and analysed the end of the *Arnica* harvesting period 2007. An annual work plan should reflect activities and estimate the working time. The locals need more training in business planning and business administration.

- Low revenues from *Arnica* collecting

Traditionally traders in Central Europe are accustomed to low prices of raw material collected in Eastern European countries. However, the economic situation and the land management in Eastern Europe changed. People are leavening the agriculture regions, where most of the botanical resources are found, either to work in the cities or outside the country. Especially since the access to European community it is for Romanians much more profitable to work seasonally in Central or South Europe than in Romania. Collecting medicinal plants is a small business; the average wage per hour is low. The locals will give up collecting in case they find a better-paid alternative.

- Competition from commercial traders

Resource assessment, monitoring, and costs of habitat management significantly increase the price of the dried *Arnica* flower heads. To be profitable Ecoflora/Ecoherba has to ask a higher price than other companies, which are selling dried *Arnica* flower heads. As such, Ecoflora/Ecoherba needs to communicate the benefits for livelihoods and biodiversity as value adding to their product.

- Ecoflora, Ecoherba is not profitable

Ecoflora/Ecoherba cannot exist from *Arnica* business only. There is a urgent need to diversify as profit from *Arnica* is not enough to make business viable. In the area occur many Maps, wild fruits and mushrooms. A concept of local sustainable resource and trade management of other local ressources and posibiltiesof value adding and marketing of it should be established.

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