

Development of Underutilized Species

**An Analysis of Best Practices based on Case
Studies for Devil's Claw, Quinoa and Physic Nut**

For

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Introduction

In this paper case studies for 3 crops are analyzed to formulate 'best practices' in developing the potential of promising species. The cases concern studies commissioned by the Global Facilitation Unit (GFU) on *Harpagophytum procumbens* (Devil's claw)¹, *Chenopodium quinoa* (Quinoa)² and *Jatropha curcas* (Physic nut)^{3, 4}. The development of promising species is a very challenging activity. Often entire marketing and production systems have to be designed or re-aligned to serve the market place. There is fierce competition from established products and engrained consumer preferences to overcome. Nevertheless, if the effort pays off the rewards can be significant in terms of economic, social and environmental benefits.

The 3 case studies concern very different crops with very different production characteristics and market opportunities. The studies on *Jatropha* include cases from Central America, Africa and S.E. Asia. It illustrates that different locations require different scenarios. Even for the same species. Implementation requires a thorough analysis of local opportunities and threats. The current analysis will describe the reasons behind the promotion of these species, the approaches used, the particular areas of the intervention and the stakeholders involved.

Devil's claw (*Harpagophytum procumbens* DC & *H. zeyheri* Decne.)

Introduction to species and its use

Devil's claw is the common name for 2 species, *Harpagophytum procumbens* and *H. zeyheri*, that are native to the Kalahari desert in Southern Africa. *H. procumbens* is recognized for its medicinal properties (arthritic and musculoskeletal pain relief) and predominantly found in Namibia, Botswana and South Africa. *H. zeyheri* is also found in Angola, Zambia and Mozambique. It is thought to have similar but much less potent medicinal properties than *H. procumbens*. In addition to a small, established domestic market for Devil's claw there is a much larger international demand. International demand is increasing. From 28 metric tons in 1973, the global market is currently estimated to be between 600 and 700 metric tons of raw material each year^{5, 6}. The increased international demand originates from the European Union and the US markets. In Germany alone the market value increased from €8 million in 1999 to €31 million in 2002⁷.

¹ Grote, K. (2003). The Increased Harvest and Trade of Devil's Claw (*Harpagophytum procumbens*) and Its Impacts on the Peoples and Environment of Namibia, Botswana and South Africa. GFU.

² Rojas, W. , J.L.Soto and E.Carrasco. (2004). Study on the Social, Environmental and Economic Impacts of Quinoa Promotion in Bolivia. GFU.

³ Euler, H. and D. Gorriz. (2004). Case study "Jatropha curcas". GFU.

⁴ Henning, R.K., (2003?). *Jatropha curcas* L. in Africa. GFU.

⁵ Raimondo, D. (2002). *Devil's Claw and Cites*. CITES World, issue 9, July.

⁶ Cole, D (2001). *Devil's claw in Namibia*. Brochure prepared by the Sustainably Harvested Devil's Claw Project, Namibia. CRIAA SA-DC, Windhoek, Namibia.

⁷ <http://www.nutraingredients.com>

Enhancement of use

The market prospects for Devil's Claw are good. There is an increasing demand from herbal medicine markets internationally. The potential of the species to develop and generate income is substantial. The area where *Harpagophytum* can be grown, and commercial utilization is viable, is restricted to parts of Southern Africa. Competition from elsewhere is therefore not an immediate threat although attempts are made to grow the species commercially in Morocco. In principle strict control over the supply side of the production could dictate the market and optimize revenues.

There are several areas where the use of *Harpagophytum* could be enhanced. These include the implementation of sustainable use, optimized income generation for collectors and a more predictable and high quality production to suit the international markets.

Approach used

Sustainable use

The roots that contain the active ingredient, harpagoside, are traditionally harvested from the wild. Rough estimates indicate that there are something 10,000 people involved in the harvesting of Devil's Claw in Namibia and another 4,000 in Botswana and South Africa⁸. Many of the collectors are impoverished people. They often depend entirely on the harvesting of Devil's claw for their livelihoods. The increased international demand has put the natural plant populations of Devil's Claw under stress. Concern about the sustainability of the harvesting practices has been raised. This culminated in a, hitherto unsuccessful, proposal to list Devil's Claw on Annex II of CITES. Several initiatives are aiming to make the use more sustainable:

- Legal instruments

Most of the governments involved have legislation in place that requires collectors and traders to register. In principle this would provide a control over the amount of plant material that is collected and traded.

- Train collectors

The collecting of roots is a labor intensive activity. The root system has to be dug out from the soil before the secondary roots can be cut loose from the taproot. Improper harvesting techniques can damage the plant with a total loss as result. Devil's Claw is a relatively slow growing plant that takes an average 4 years before it can be harvested again. Premature harvesting leads to sub-optimal yields. Programmes have been set up to train collectors in seeking out mature specimens for harvesting and proper harvesting techniques. A "quadrant" cultivation technique (a sector is only harvested once every 4 years) has been developed that allows the plants to recuperate.

⁸ <http://www.resourceafrica.org/programs/dc/>

Income generation

Although the market value of *Harpagophytum* products is substantial, the marketing channel is long and includes many intermediaries. The collectors of Devil's Claw roots fetch very low prices. These vary between N\$1-8 per kg of dried roots. Collectors are often in a weak position to negotiate a good price with a trader. They lack sufficient market intelligence that allows them to assess whether the price offered is fair. Besides, the sale is often forced at unfavorable conditions to settle existing financial debts.

Several projects involving NGO's are working together with collectors to organize the collecting and sales. Collectors organized in groups generally obtain better yields and are able to sell their produce at higher prices. In the case of the Sustainable Harvesting of Devil's Claw (SHDC) project, collectors are paid a guaranteed price. Some groups have been able to bypass a large part of the intermediaries. This resulted in substantially better markups for the sold produce. These projects work on the hypothesis that if better yields are obtained, local communities will be much more inclined to take care of the basic resource and implement sustainable harvesting methods.

Supplying international markets

International markets demand high quality source materials and a reliable supply. The collected material of *Harpagophytum* from the wild is very variable in terms of quality and yield. The cultivation of *Harpagophytum* on farms has so far been regarded as not commercially viable. The slow growth of the plant is mentioned as one of the main reasons. However recently trials with cultivated *Harpagophytum* yield promising results. Growing conditions can be better controlled on the farm and yields, quality and quantity, are high compared to material harvested from the wild. A German herbal medicine company is in the process of up-scaling their production. Some additional trials are underway to test alternative cultivation methods, which, if successful, would put commercial farming on a better footing. In principle commercial farming would be an instrument to serve the growing international markets with high quality source material and a dependable supply. It would also relieve some of the pressure on the natural populations and thus help to implement a sustainable use of the species.

Areas of intervention

The table below lists a number of intervention areas and indicates which ones are being applied in the case of Devil's Claw.

Intervention Area	Applied	Description
Access, conservation and improvement	✓	<ul style="list-style-type: none">▪ Development of sustainable harvesting practices for natural stands▪ Development of new cultivation techniques (commercial cult.)
Post-harvest handling and processing	✓	<ul style="list-style-type: none">▪ Processing harvested material (milling) by harvesters (not popular with exporters because

		of lack of quality control)
Policy and legislation	✓	<ul style="list-style-type: none"> ▪ Permit system for collecting and trade
Awareness creation and lobbying		
Marketing	✓	<ul style="list-style-type: none"> ▪ Promote producer associations ▪ Assure more equitable sharing of benefits ▪ Certification of organic produce
Capacity building	✓	<ul style="list-style-type: none"> ▪ Train harvesters in sustainable techniques
Information generation and management		<ul style="list-style-type: none"> ▪ Documentation and dissemination of local knowledge on harvesting
Inter-sectoral interventions	✓	<ul style="list-style-type: none"> ▪ Involve private industry in the development of cultivation methods ▪ Government and NGO's to promote sustainable use

Strategic partners

There is a very broad mix of stakeholders actively involved in the commercialization of Devil's Claw. Local harvesters are working with NGO's to implement sustainable harvesting practices, obtain fair prices and optimize income. Commercial farmers and herbal medicine companies are involved in developing cultivated farming of Devil's Claw. At the national level, the respective governments have put legislation in place to regulate the trade in Devil's Claw. The approach developed is fairly well integrated at the various levels and includes the key stakeholders. National policies and local activities all work towards a sustainable use of Devil's Claw based on financial incentives for the harvesters.

Quinoa (*Chenopodium quinoa* Willd.)

Introduction to species and its use

Quinoa has been cultivated in the Andean region since 3,000 BC (Tapia 1982). It is less well known that *Chenopodium* was a common component of farming systems in the hilly and mountainous regions of Asia, particularly the Himalayas (Partap 1998). Its adaptation to cold, dry climates and excellent nutritional qualities make Quinoa a crop of considerable value to highland areas. Cultivation in Asia is diminishing as subsistence farmers have switched to better yielding mono-cultures. In South America the production is for the most part used for home consumption (77% in Bolivia and 60% in Peru). Production in Bolivia varied between 16- 28,000 MT for the period 1990-2001 (MAGDER). Bolivia is the major producer worldwide (46%), closely followed by Peru (42%).

Enhancement of use

Besides a significant consumption by subsistence farmers themselves, there exists a limited domestic market. Many potential consumers are aware of Quinoa's high nutritional value, but increasingly rule it out of their diet in favor of imported alternatives such as rice or wheat based food stuffs. These are often cheaper, easier to prepare and have a more urbane image. These factors largely suppress a spontaneous surge in domestic demand. There is an emerging international health-food market, in which organic Quinoa has earned itself a place. However international market demands are difficult to meet considering that by far the largest proportion of Quinoa is grown as a subsistence crop. This means that supplies are very unpredictable and the produce is not homogeneous. The crops grown have much inherent variation to cope with ardent and variable atmospheric conditions. Enhancement of use should come from better serving national and international markets. Production, especially for international markets is currently too intensive and threatens to exhaust the soil. Sustainability of this type of cultivation is becoming an issue affecting yields.

Production chain

The production of Quinoa is typified by a dispersed production of small farmers in often remote areas. It is estimated that 75,000 producers are involved. Intermediaries play an important role in stockpiling the produce and making it available to industrial processors. In Bolivia there are only few industrial processors. They mainly produce for the domestic market. In general, the product quality does not meet international market standards.

Agricultural production

In Bolivia there are 2 different agricultural production systems. In the north most Quinoa is produced on small farms by subsistence farmers, while in the south farms produce more for the national and international markets. In general they cultivate more uniform varieties and cultivation is more intensive

and mechanized. There is no permanent seed improvement programme that would help to increase yields in a consistent manner. Soil degradation as a result of improper mechanized cultivation and a lack of a pest management strategy result in declining yields (especially in South Bolivia). Post harvesting losses (24%) further compound yield problems. Although education and training programmes have been implemented to introduce better suited cultivation methods, they failed to result in the wide spread implementation of more suitable agricultural practices as results fell short of the farmer's expectations.

Institutional issues

In Bolivia it is felt that demand, both nationally and internationally, could be stimulated with more active Government involvement. Diplomatic missions could promote this fairly unique crop abroad. At the national level Governments could do more to promote the consumption. That this could be very effective is demonstrated in Peru where some Governmental Food Aid programmes procure quinoa. This is thought to have been the main reason that cultivation has increased from 18,000 to 30,000 metric tons in just 4 years. Similar preferential buyer programmes could be implemented more widely to support domestic production and reduce often subsidized food stuff imports from abroad.

Many farmers do not have sufficient access to financial services that will allow them to invest in their businesses. This makes it difficult for them to respond to new market demands, e.g. export market. Communal farmer cooperations often have no firm legal status, limiting their access to services, and often have a decision making process that is not suitable to respond to commercial opportunities.

Approach used

On many of the areas that pose limitations, as listed above, activities have been going on. The interactions in the market chain are studied. Stakeholders, such as producers and industrial processors, are brought together to agree on production.

Agronomical research is focusing on building up germplasm collections, selecting higher yielding varieties, new cultivation techniques that will lead to less soil degradation. An integrated pest management system is also under development.

Most of these activities are not new. They were started in the 1960's, when the first attempt was made to integrate Government Quinoa research activities, but have recently been revitalized as government services in Bolivia have been reorganized.

At the end of the '90's the Bolivian Government developed a new strategy for agricultural development in which NGO's have a much more important role to play at the sub-national level. This has undoubtedly led to a more participation oriented development in which farmers are given a more active role. The NGO's in general help producers to get organized and optimize their income generation opportunities. They aim to provide fairer prices for farmers. Several mechanisms are applied. Some organizations provide price guarantees above average trading prices. This way additional income is

generated and income becomes more predictable. By accumulating the small harvests of individual farmers into larger lots, they are able to trade these directly with large industrial processors and exporters. This results in better prices for the farmers since intermediaries are cut out of the loop. By pooling farmer's resources NGO's can help primary producers to make joint investments that would not be attainable by individuals.

Areas of intervention

The table below lists a number of intervention areas and indicates which ones are being applied in the case of Quinoa.

Intervention Area	Applied	Description
Access, conservation and improvement	✓	<ul style="list-style-type: none"> ▪ Crop and cultivation improvement programmes ▪ Building up germplasm collections
Post-harvest handling and processing	✓	<ul style="list-style-type: none"> ▪ Seed cleaning to improve product quality
Policy and legislation	✓	<ul style="list-style-type: none"> ▪ Government preferential buying schemes (Peru) ▪ Legislation to protect traditional knowledge (Bolivia)
Awareness creation and lobbying	✓	<ul style="list-style-type: none"> ▪ Promote nutritional qualities of Quinoa (not enough)
Marketing	✓	<ul style="list-style-type: none"> ▪ Product diversification ▪ Product certification (organic) ▪ Promote producer associations ▪ Promote linkages between actors within production chain
Capacity building	✓	<ul style="list-style-type: none"> ▪ Training and education programmes for farmers (but ineffective) ▪ Participative research
Information generation and management		
Inter-sectoral interventions	✓	<ul style="list-style-type: none"> ▪ Activities to improve alignment of producers and processors ▪ Linkage to State Food Aid Agency

Strategic partners

The production chain seems very loosely organized. The fact that much of the production takes place on small farms in very remote areas must have contributed to this. The NGO's are playing an important role by linking primary producers with industrial processors. They actively establish the linkages and coordinate actions and try to achieve a better adjustment of the various actors in the production chain. They facilitate the farmer's access to the national and international markets, provide technical assistance, access to processing facilities and implement quality control principles. The role of government is

vital. It is one of the few institutions that has enough weight to influence the direction of developments. In Bolivia the Government has diminished its direct involvement in agricultural development. Responsibilities for there have been decentralized to sub-national levels. As a result government agencies play a minor role. In Peru Government programmes have been used much more actively. The state run food assistance programme has started to substitute imported cereals with Quinoa. This has had a definite effect on demand. As such there seems still quite some scope to improve linkages between producers, research, the industry, the government and consumers.

Physic Nut (*Jatropha curcas* L.)

Introduction to species and its use

Physic nut is a drought resistant shrub native to the Caribbean, but has been introduced in various parts of the tropics. Used as life fence and in reforestation projects. The species is grown for medicinal purposes and for its oil. Waste products (seed press cake) are good green fertilizers, while cultivation of the plant improves the quality of the soil.

Enhancement of the use

Physic nut has multiple uses across the tropical and subtropical areas around the globe. These range from use by local farmers as life fences to large bio-energy and re-forestation projects driven by national development programmes. The so called “*Jatropha*-system” describes how the species can be used in erosion control, income generation from derivatives and provide a source of renewable energy. This potential makes the species, especially in marginal conditions and on waste land, a very interesting crop. This large potential has a danger that its capabilities can easily be overestimated. In Belize, a reforestation project run by an NGO made the harvesting of *Jatropha* fruits for oil production part of its strategy for sustainable use. Only to find out later that labor costs would be far too high to make this in any way feasible. In 1991 a government project in Nicaragua attempted a large scale monoculture of *Jatropha*. The project was considered an answer fill the void that resulted from the collapse of the cotton cultivation due to low world market prices. The project objectives were to address national energy concerns (substitute fossil for bio-diesel), create rural employment, reclaim degraded land and produce useful spin-off raw materials such as fodder concentrates etc. Although the government provided substantial support the project failed. The management of the project was inadequate and expectations in terms of expected yields far exceeding realistic values. The introduction of *Jatropha* in monoculture was also a very risky strategy since farmers were made financially completely dependant on the performance of this crop. Disappointment with yields, unresolved land owner issues, short-term donor support and various other matters eroded support from the farmers involved and the project collapsed in 1998.

***Jatropha curcas* in India**

In India there is quite some experience with *Jatropha*. Earlier efforts have met with limited success. Experience indicated that production under marginal conditions seemed to survive a lot better than on plantations. Nevertheless there is a lot of experience and political backing for reintroduction is very strong. The discussion prior to the selection of *Jatropha* as a spearhead species for development has been long and extensive with broad participation. Besides strong political and government support, involvement of other actors is extensive. NGO's, Universities, oil processors and large institutional fuel consumers are all buying in. Farmers will be provided with free or near free plant material and will benefit from investment incentives and

buy-back agreements that provide a secure market and limits their risks. Private projects such as the Daimler Chrysler Project demonstrate the concept and provide much publicity in favor of *Jatropha*.

The approach to use *Jatropha*, and to a smaller extent *Pongamia*, in a National Programme that jointly addresses energy concerns, poverty alleviation and environmental issues (erosion/deforestation) is very ambitious. It involves the planned production of 13 million tones of bio-diesel by 2013 (>>1000 times present global *Jatropha* production). It will involve a massive introduction of *Jatropha* on currently un-used land. Some of the production estimates underlying the plan seem overly optimistic and there are still quite some factors requiring more research. Phase I of the project will be used to yield more solid data that will allow a realistic cost evaluation.

Jatropha curcas in Africa

In Africa the cultivation of *Jatropha curcas* goes back quite some time. During the 1940's Benin and Madagascar were cultivating *Jatropha* and exported the fruits/oil to France for soap production. In many countries throughout Africa *Jatropha* can be found in hedges to protect crops from animal grazing. Sometimes no additional use of the plant is made, while elsewhere the seeds are collected and used to produce oil and press residues, which is used as a natural fertilizer. The oil is successfully used in small cottage industries to produce soap. This provides additional income. Use as substitute fuel for internal combustion engines, cooking or lighting have proved economically viable only in very remote areas where distribution of fossil fuel is restricted and consequent costs are higher. *Jatropha* has been successful in combating soil erosion and in the rehabilitation of soil. In some cases (Tanzania) the oil obtained from *Jatropha* is used for cooking fuel and resulted in less fuel wood being harvested from other species. Some projects, often linked to private enterprise, are underway in Egypt, South Africa and Ghana to establish large *Jatropha* plantations. These plantations are receiving initial financing from the Trade of Emission Certificates as the plantations function as 'carbon sinks'. However it is assumed that their economic viability depend on a rise in cost of conventional fuel prices. This would make bio-diesel more competitive with fossil fuel.

Approach used

The versatility of *Jatropha* is mirrored in the variety of manners it is used. This ranges from small to large scale developments. Its ability to be used on marginal or waste land, and actually improve these soils, is a very strong point in its favour. It allows it to avoid direct competition with established productive crops.

The examples from Africa show that small scale deployment can be very successful especially in providing income opportunities for smallholder farmers. The examples of large scale deployment in several countries in Africa and India illustrate that such an approach requires substantial financial support from either private or public sources. These projects very much anticipate global trends, such as the rise of fossil fuel prices, stricter pollution normatives etc. In this sense they are more strategic in nature and short-term profitability is subordinate to longer-term viability. Despite its potential, there are also examples of failed implementation. In the case of Nicaragua the

attempt to use *Jatropha* on relatively high quality agricultural land was risky as competition with established production crops would be fierce. As yield predictions were over optimistic, support from farmers evaporated fast and the project as a whole was marooned before it could prove its real potential. Likewise the project in Belize could not deliver what it set out to do.

Areas of intervention

The table below lists a number of intervention areas and indicates which ones are being applied in the case of *Jatropha*.

Intervention Area	Applied	Description
Access, conservation and improvement	✓	<ul style="list-style-type: none"> ▪ Crop improvement programme (India) ▪ Plant material distribution programme (India)
Post-harvest handling and processing	✓	<ul style="list-style-type: none"> ▪ Research into efficient processing techniques (India) ▪ Industrial trial facilities (India) ▪ Cottage industries (Africa)
Policy and legislation	✓	<ul style="list-style-type: none"> ▪ Part of National development agenda (India) ▪ Links to Int. Treaties on Pollution and Climatic Change (Crop acts as 'carbon sink') (Africa, India)
Awareness creation and lobbying	✓	<ul style="list-style-type: none"> ▪ Promotion through National Programme (India) ▪ Promotion by NGO's as subsistence crop (Africa)
Marketing	✓	<ul style="list-style-type: none"> ▪ Development cottage industries (Africa) ▪ Heavy government involvement provides high level of security for investors (India) ▪ Investment incentives and buy-back agreements (India)
Capacity building	✓	<ul style="list-style-type: none"> ▪ Training participants (India)
Information generation and management	✓	<ul style="list-style-type: none"> ▪ Store relevant information and make these available to participants (India)
Inter-sectoral interventions	✓	<ul style="list-style-type: none"> ▪ Involvement from Universities, NGO's, processors and consumers etc. (India)

Strategic partners

The production chain for *Jatropha* includes a wide variety of stakeholders ranging from farmers, Universities, NGO's, private enterprise, industrial processors, governments to end-users.

Depending on approach (small vs. large scale) the relative weight of stakeholders changes. The African model is very much driven without heavy Government involvement. The Indian model is exactly the opposite. However in both cases the communication between the various stakeholders is vital to have a clear insight in what can be expected and what the risks are.

Best practices: analysis

This analysis on best practices is based on 3 quite different species:

- Devils Claw, a species native to Southern Africa which is used for medicinal purposes
- Quinoa a pseudo-cereal food plant native to the Andes in South America
- Physic nut a species native to the Caribbean but grown widely in the tropics and subtropics. It is used for medicinal purposes and more importantly its ability to produce oil, which could serve as an alternative, renewable source of energy fuel.

There are many reasons to develop the potential of promising species. These include food security, sustainable agriculture, health, consumer appetite for novelties etc. The bottom line is that key stakeholders such as farmers and private industry will only be committed to such developments if they have a reasonable chance to generate profits. Especially in the context of improving the livelihood of subsistence farmers, development of promising species needs to be geared towards achieving a secure and/or positive income effect that matures in the short run and is at the same time viable at the long term. Most subsistence farmers will simply lack means to tie their resources up in long-term investments. They definitely lack the resources to invest in high-risk developments that, upon failure, immediately threaten their livelihoods.

If we accept the idea that financial gain is the motor driving the process of promising species development we should consider different ways to generate more income.

Let's first consider the case of Devil's claw. It concerns a medicinal species with an established domestic market and an emerging high-value international market. The production area is limited to parts of southern Africa and number of people involved in the harvesting is relatively small (estimated 14,000). The increased demand has put the natural plant population under stress and without regulation the harvesting would have become unsustainable. The approach taken shows a good integration at the various levels. National governments have moved to provide a legal framework to regulate the harvesting and trade through a permit system. At the local level NGO's have taken the initiative to organize collectors. This has had a direct positive income effect for the collectors. NGO's collect the produce from individual harvesters. Since the collective yield represents a much larger volume, they can reduce dependency on intermediaries that would normally collect, stock and transport the material, and deal directly with industrial processors. Compared to individual smallholder farmers, an organization such as an NGO is in a much better position to acquire proper market information. This is critical to find appropriate markets and maximize income. As a result of the NGO's mediation, the harvesters are able to increase their individual income. The direct income effect has made it possible for the NGO's to sensitize the harvesters to the value of the natural *Harpagophytum* populations and address additional concerns. The training of harvesters in more sustainable harvesting methods has put the use of *Harpagophytum* on a much more

sustainable footing. Besides the positive income effect there is another potential spin-off from shortening of the production chain. The number of stakeholders is reduced which would, in principle, makes it easier to align supply and demand. This creates possibilities to exploit market opportunities to their fullest and optimize income for all stakeholders involved. In addition to the harvesting of natural products, trials are conducted to bring *Harpagophytum* under cultivation. Much of the research in this direction is privately funded as the potential market value returns are high. If successful, the cultivated yield would complement naturally harvested material and be able to respond to an increasing international demand. The fact that the species grows in a well defined area, at least so far, opens a further opportunity for the producers involved have at least some control over the market price by controlling the supply side. This however will require close collaboration between the governments involved.

In the case of *Quinoa* we see that NGO's have played a similar important role. By organizing the, in large part, isolated smallholder farmers and mediate in the selling of their joint produce, a positive income effect can be achieved. The extra income, if retained locally, leads to investments in other local structures and services, e.g. seed cleaning machinery, which improves the product quality and ultimately selling price. Over time such additive local investments will have a significant impact on rural development. The case of *Quinoa* shows another important marketing tool: product diversification. In Bolivia there is an established rural market and a more urban and international health-food market. For the urban and international market a special variety is grown "Royal Quinoa" which is visually more attractive (big, white seeds). In addition derived products like Quinoa flour, flakes, toasted and expanded grains are marketed. The more urbane and international markets are growing slightly, but can not always be served well. These markets demand a predictable and high quality supply, which is often difficult to realise with a crop such as Quinoa which is grown under very marginal conditions. There are cases where exporters have abandoned the highly affluent North-American and European markets and now focus on markets in the more immediate region.

Compared to *Harpagophytum*, the market for *Quinoa* is much larger in volume (not in value) and more people are involved in the production (75,000 vs 14,000). This obviously would justify a more active government involvement. How effective this can be is shown in Peru. Government food aid programmes have switched from using imported cereals such as wheat to using *Quinoa*. The increase in *Quinoa* production in Peru has been notable as the government programmes provide a very reliable source of income for farmers. The move makes sense from an economic perspective. The funds remain inside the country and provide employment and purchasing power for the local population. The role of governments is very important since they are able to create supportive legal frameworks, and are often the only key stakeholder that can make long-term and sustained investments. Especially in the case of newly introduced crops this is a requisite during the initial adaptation and development phases.

This brings us directly to the third case study of *Jatropha* in India. The Indian government has launched a very ambitious, multi-species bio-energy programme of which the massive introduction of *Jatropha* is an important part. The species will be introduced on marginal lands. All key players are thoroughly involved in the programme from producers, research, processors to end consumers. The full endorsement of the Government means that the programme has ensured a high degree of sustainability and security which is very important to win the commitment from private investors big and small. These range from subsistence farmers, industrial (oil-mills) investors to industrial consumers. The financial incentives for subsistence farmers are created because the Government Programme will mean a guaranteed demand and thus income stability. Industrial investors also benefit from such a situation as it takes a lot of the risk out of the equation. The plan is very daring and, if successful, will achieve a multitude of very strategic goals. The same species is successfully used in Africa in a completely different scenario. There low-maintenance *Jatropha* hedges earn their keep as life fences protecting valuable cash crops from damage by animals. The oil that can be derived from *Jatropha* seeds has become the basis for a “cottage industry” producing soap. It provides extra income and other useful waste such as green-fertilizer (seed press cake).

The 2 cases of failed introduction of *Jatropha* in Belize and Nicaragua started out right, by linking sustainable cultivation to positive income effects. However in Belize important costs factors were overlooked (cost of labor) which totally cancelled any hope on a sustainable programme. The failure of the Nicaraguan initiative can be attributed to several fatal miscalculations. Heavy dependency on foreign aid to sustain the programme’s core activities, projected harvests that were not realized in time, unresolved land owner issues that eroded confidence of key stakeholders etc.

Concluding remarks

The premise of this analysis on best practices has been that profitability expectations drive the actions of private stakeholders. Monetary and livelihood issues are very much interdependent. Production chains in the agricultural sector, more often than not, include private enterprises at vital sections of the chain. This starts with the individual farmer who produces the primary source materials!

Link to financial incentives

Programmes to introduce or develop promising species need to take this into account from the very start. Project objectives need to be linked to financial incentives for private stakeholders or one cannot expect full stakeholder commitment. Financial incentives come in many flavors. Most often they are aimed at achieving a direct positive income effect (more effective income) or an increase in income predictability (income security). How these financial incentives are created depends very much on the local situation. The case studies highlight a number of approaches on how to achieve income effects e.g. by making a better use of existing market mechanisms.

Improve position of primary producers

The organization of primary producers in cooperative structures is one way to strengthen the position of this group in the market. As a group they will have more possibilities to obtain relevant market information and a better negotiating position to sell their produce. Although there might be a natural tendency to look at affluent international markets to sell more produce, domestic markets might actually offer better opportunities. These markets are usually better accessible for local producers, less demanding and more dependable.

Product diversification and cottage industries

Other approaches such as product diversification and the development of “cottage” industries, which is a way to add value to locally produced materials, have also proven valuable to retain more income in the region where the primary production takes place.

Government intervention

Governments play an important role in creating the environment for local development. Government intervention could be merely enabling e.g. legal frameworks for collecting and trade, which allows others, such as NGO's and private investors, to develop local initiatives. Governments can also take on a lead role as major investor. This provides an environment with longer-term security and less risk for private investors to join and participate. Although income effects can be generated in various ways, invariably it requires good interaction between key stakeholders in the production column. This ensures that their activities are well aligned so that opportunities provided by the marketplace can be exploited to their fullest.

Sustainability

Any development or introduction of promising underutilized species will have to address sustainability issues. Especially in the context of rural development, sustainable income effects are much more important than short-term gains that often cause irreversible damage to traditional agricultural production systems. Any surge in demand as a result of a successful introduction will affect the primary production. In many cases traditional systems will not be able to cope with the increased demand. The development of complementary production systems is necessary. These sometimes will have to be built from scratch. The examples of Devil's Claw and Quinoa illustrate this point. Traditional cultivation complemented with a more high input cultivation provides a 2-tier production system to serve the markets. The cases reviewed also illustrate that income generation and addressing sustainability issues can very well go hand in hand. If these two work together and strengthen each other, a powerful model for development is created.

Socio-economics

Despite the fact that income generation is an important prerequisite to develop underutilized species, the additional income will not always translate in more (rural) development. If additional income is spent on purely consumptive articles (electro domestics, alcoholic beverages etc.) it will have little positive effect on local development. In cases where the extra income is invested in better food, education, health care and productive activities the extra income will strengthen local development. The spending pattern depends on which social groups control the extra income. E.g. in many cases men and women have different spending patterns. In designing a development project for promising species, these socio-economic factors need to be taken into consideration since they clearly influence how income generation will affect local development.

If anything, the case studies reviewed indicate that “best practices” come in many flavors. To a certain extent one could argue that this is caused by the very diverse nature of the cases reviewed in this study. But even for a single species such as *Jatropha*, we see very different implementation scenarios (Africa vs. India). This indicates that solutions need to be customized to a great extent to fit the specific production and market systems that are being targeted despite the fact that there will be recurrent issues in every assessment.

This study suggests that best practices will at least have to consider:

- 1) links to financial incentives
- 2) strengthening the position of primary producers
- 3) product diversification options
- 4) “cottage industry” development
- 5) potential for Government interventions
- 6) potential for NGO involvement as mediators
- 7) private sector investments
- 8) longer-term sustainability issues
- 9) socio-economic factors

Finding the right mix of these components will determine whether the development of an underutilized species will succeed and whether the benefits derived from this will translate into real (rural) development.