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Marketing Underutilized Plant Species for the Benefit of the Poor: A Conceptual Framework

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ABSTRACT

Modern crop production is based on only a few plant species. Particularly in marginal environments of developing agricultural economies, many less well-known agricultural or non-timber forest species, continue to be grown, managed or collected, thus contributing to the livelihood of the poor and to agricultural biodiversity. Some of these species, called underutilized plant species, are characterized by the fact that they are locally in developing countries but globally rare, that scientific information and knowledge about them is scant, and that their current use is limited relative to their economic potential. In this paper, we first identify the economic factors that cause these plants to be 'underutilized'. Based on this analysis, we propose a classification of underutilized plant species based on the relationship of the observed to the potential economic value of the species, and the presence or absence of and constraints to output markets. Then, focusing on a subset of underutilized plant species with market potential, we identify three necessary conditions for the successful commercialization of underutilized plant species for the benefit of the poor: demand expansion, increased efficiency of supply and marketing channels, and a supply control mechanism. This conceptual framework is intended to provide a basis for an empirical assessment of marketing solutions for underutilized plant species among the rural poor in developing economies.

Keywords: underutilized species, agricultural biodiversity, agricultural marketing, agricultural development, niche markets

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Marketing Underutilized Plant Species for the Benefit of the Poor: A Conceptual Framework

Guillaume Gruère,[1] Alessandra Giuliani,[2] and Melinda Smale[3]

1. INTRODUCTION

Modern crop production is based on only a few plant species (Prescott-Allen and Prescott-Allen 1990). Particularly in marginal environments of developing agricultural economies, ethnobotanic surveys have documented that many less well-known species continue to be grown, managed and collected (IPGRI 2002). Numerous terms have been employed to characterize them, including "minor crops," "underutilized" species, "neglected species" or "orphan crops," "underexploited" and "underdeveloped" species.

These species persist because they are still useful to local people, occupying special niches in the agroecology and semi-subsistence production systems. Some demonstrate an agronomic advantage in terms of adaptability to low input agriculture and marginal lands (Padulosi et al. 2002), environmental services or restoration of degraded lands (De Groot and Haq 1995). Recent publications have underscored their importance in the livelihoods of the poor (Naylor et al. 2004), though their role in rural life has long been recognized by ethnobotanists and anthropologists. Some species are gathered as a source of food or cash, especially during "lean" periods in the agricultural cycle. Others supply diversity, essential nutrients, vitamins or minerals in diets that would otherwise consist primarily of carbohydrates (Johns 2004; Johns and Sthapit, 2004). Often, they reflect cultural values (Johns and Eyzaguirre 2002).

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Traditional knowledge is typically associated with the use of these species, while scientific knowledge is emerging, but limited. To cite some examples, palm fruits from Brazil are rich in beta-carotene. The bitter gourd and fenugreek grown in India contain compounds that can improve the body's ability to respond to insulin. The benefits of African leafy vegetables and other plants containing carotenoids such as lycopene and lutein are also well recognized. Thus, many of these plant species have a current, private use value for some of the world's more vulnerable populations, as well as a potential value, both public and private, that is to a large extent unknown.

Increased public awareness about underutilized species was prompted by the Convention on Biological Diversity (1992) and the Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture (FAO 1996). The Consultative Group on International Agricultural Research (CGIAR) recently expanded its research agenda to include underutilized species (CGIAR 2004).

Despite this recognition, there is no unique definition of underutilized plant species. Different reports define them based on various, broad characteristics. In general, the term "minor" refers to the fact that these species have a small commercial value of production and trade compared to major agricultural commodities. The term "underutilized" means that they were once grown more extensively, or might be more widely grown in the future, but for economic, agronomic, or genetic reasons, they are now cultivated in limited areas. These plant species are also described as "neglected" or "orphan" crops since they have received scant attention from research and development, and there is little scientific information about them (Eyzaguirre et al. 1999). Their potential economic value remains "underexploited" (Padulosi and Hoeschle-Zeledon 2004) or "underdeveloped."

In this paper, we have chosen to employ the term "underutilized" in order to focus on a set of economic characteristics. We define underutilized plant species as any agricultural or non-timber forest species, collected, managed, or cultivated, that has the following three characteristics.

- First, the species is locally as compared to globally abundant, meaning that it is collected or produced in a single area or numerous, but geographically restricted areas. Local abundance often implies a center of diversity for the crop and a significant contribution to agricultural biodiversity, which is a global public good. At least for cultivated species, local abundance also indicates that the crop is of high local use value to rural people as a food staple, source of diet quality, or source of occasional cash.

- Secondly, local users have a practical knowledge of the plant species, but there is a lack of scientific knowledge on the species both within and outside of the user circle. Not much is known about the physiology of these plant species, their agronomic and ecological properties, or the properties of the plant products (e.g., nutritional, medicinal or aromatic properties of the fruits, leaves, flowers). For many of these species, the lack of scientific knowledge is linked to the apparent lack of interest on the part of public or private research institutions. Little research leads to little knowledge, in turn providing little encouragement for research.

- Third, the current use of an underutilized plant species is limited relative to its economic potential. Although the species has a distinctive past, present or potential use value, as well as the potential to generate significant local income, it does not now occupy a significant share of national or international trade. Somehow, local abundance is not associated with major commercial value even at the local level, so that the full cash-generating potential of the species is unmet.

This compounds the problem of limited knowledge since there are few perceived benefits from research investment.

The uniqueness of underutilized plant species as we define them compared to other plant species comes from the fact that they possess these three characteristics simultaneously.

Minor millets (finger millet, kodo, barnyard, small millet) are examples of underutilized plant species that fit our definition. Relatively less scientific investment has been made in studying minor as compared to major millets, and they are locally abundant in specific geographical areas. They were more widely grown in the drylands of India before it was feasible to grow pearl millet hybrids and improved wheat under irrigated conditions; they were also more extensively grown in parts of Eastern Africa before maize become the dominant starchy staple during World Wars I and II. At a point of contrast, kiwifruits also fit our definition of underutilized plant species before the expansion of global demand for this commodity.

Why is the current use of these species limited relative to their economic potential? Despite a growing body of scientific literature on underutilized plant species, and an emerging set of case studies about their economic value or market potential, no overarching conceptual framework has been formulated to enable systematic economic and policy analysis. In this paper, we identify the economic factors that contribute to underutilization. Then, based on economics principles, we propose necessary conditions for the successful commercialization of underutilized plant species to benefit the poor. This paper is intended to serve as a basis for undertaking applied economics research to support the effective commercialization of underutilized plant species.

2. SEARCHING FOR AN ECONOMIC DEFINITION OF UNDERUTILIZED PLANT SPECIES

As we have defined them, underutilized plant species have a distinctive past, current, or potential use value, but their use is currently limited relative to their economic potential. Local abundance and the lack of scientific knowledge of the plant, the two other characteristics of our definition, also relate directly to underutilization, because they result from a restriction in use of these species compared to other plant species. ‘Underutilization’ translates into undervaluation in economic terms; these crops have a lower observed (or expressed) value relative to their economic potential. What explains why these crops have a positive economic value that surpasses their current value?

First, we need to characterize the sources of economic value associated with the species. Secondly, based on this characterization, we need to identify the economic factors that cause these plants to be underutilized. We divide this section into two subsections. The first subsection characterizes the sources of economic value. The second subsection focuses on the market imperfections and market failures that lead to underutilization. We close the section by proposing an economic classification of underutilized plant species based on these different factors.

SOURCES OF ECONOMIC VALUE IN UNDERUTILIZED PLANT SPECIES

Economics is anthropocentric; that is, all sources of value derive from human society as use values (market and non-market; direct and indirect) and non-use values. There are two ways in which the value of the species can be revealed. First, users value its provision of goods or services. The value of the plant species is revealed, at least locally, by its sustained use. Secondly, some of the non-users of the species may also value it. On the one hand, scientists may value its current or potential properties to produce some useful goods (medical drugs) or to provide some valuable services (basic research on genetic resources or selection for resistance to abiotic stresses). On the other hand, other non-users may value its existence (or value the fact that it is not extinct) and its contribution to agricultural biodiversity. In economic terms, the social benefit of producing or not destroying the species is equal to the private benefits of the users or primary producers and the positive externalities associated with this production or use.

It is important to distinguish the *potential* value of the species from the *observed* (or current or expressed) value of the species. By definition, the observed value of any underutilized plant species is inferior to its potential value. The observed and the potential value of underutilized plant species can then be characterized according to different criteria: public or private, the level of competition and existing knowledge gap, and spatial and temporal dimensions.

Private versus public value

According to our definition, underutilized plant species are important locally to the rural poor in specific geographical areas, while contributing to global agricultural biodiversity. Thus, the value of underutilized plant species can be divided into a private and a public component. The private value can be revealed by its propensity to generate income to the primary producers or collectors, by its ability to reduce risks of production shocks as a livelihood strategy, and by its value for household or subsistence consumers (nutritional, medicinal, participation to diet diversity). The public value[4] of the species is expressed by three main assets: first its contribution to agricultural biodiversity (such as

4 We define public value as the aggregate value of the species and all products derived from it that it is not private. Following this definition, the social value of the species will be equal to the sum of its private and public value.

the provision of ecosystem services), secondly, the opportunity it provides for future generations to generate income or be used for proper nutrition, and third, the maintenance of tradition and culture. The public value of the species can be generated by positive externalities of production, or may be linked with the existence (or non-disappearance) of the species itself.

In the context of the agricultural sector taken as a whole, the low observed private value of underutilized plant species may be the direct consequence of the fact that other crops (or other agricultural activities) with higher market values offer better income opportunities to a larger number of producers (more competitive from the producer's perspective). In this setting, primary producers have an incentive to prefer these other crops or agricultural activities because: 1) they are relatively profitable; 2) they attract government support, or 3) their marketing systems function better. In this situation, the existence of a public policy problem depends on whether the potential social value of the underutilized plant species exceeds its potential private value by a large magnitude. If it does, the crop is underused from a public perspective. In particular, the public value for the conservation of agricultural biodiversity is not reflected in markets. On the other hand, if the potential social value of the crop is close or inferior to its private value, then the situation may be solely due to market imperfections. In this paper, we focus on underutilized plant species that have potential public value because they contribute to agricultural biodiversity and support poor farmers. They also have a potential private value, and may be underutilized due to market failures.

Figure 1. Characterization of underutilized plant species by private and public values

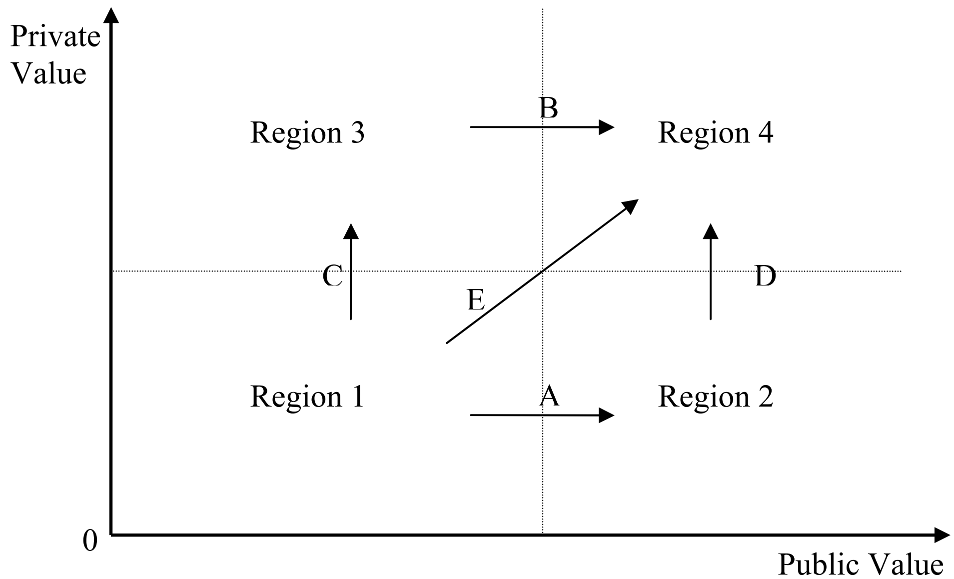


Figure 1 differentiates underutilized plant species according to the relative magnitude of their private and public observed and potential values[5]. The coordinates of each point are the private and public values from the perspective of the agricultural sector. Each underutilized plant species is represented in the figure by an outward vector linking its *observed* value to its *potential* (or current or expressed) value. The origin of the vector is the observed value, which is lower (i.e. closer to zero) by definition than its potential value. Hence, the vector points outwards.[6] An underutilized plant species cannot be a point (i.e., a crop for which the observed value equals its full potential economic value), since a point is a zero vector. Nor can it be an inward directed vector, which would represent an overvalued species.

5 Smale and Bellon (1999) proposed a similar classification at the variety level to relate genetic diversity and conservation strategies.

6 A more restrictive definition of underutilized plant species would be based on a "Pareto" valuation, which would require vectors to be a positive linear combination of unit vector in the direction of A and C. In other words, an underutilized plant species could not lose any of its public or private value by reaching its potential.

The region boundaries are arbitrary but provide a straightforward characterization of different cases. The observed value of the crop can be located in Region 1, 2 or 3. Species assembled in Region 1 have both a low observed private value and a low observed public value. Species with a high expressed public value but a low expressed private value are located in Region 2. Species that currently have a low observed public value but a high observed private value are found in Region 3. No observed values are found in Region 4, since plant species that already have high private and public values are not strictly underutilized.[7] Similarly, the potential value of the crop can be located in Region 2, 3 or 4. We exclude species whose current status and potential are in Region 1, because they may not be relevant underutilized plant species in economic terms - enhancing their value would not improve their status significantly.

Five types of directional vectors are shown in Figure 1 to represent underutilized species. The horizontal vectors A and B link region 1 and 2, and region 3 and 4, respectively. They represent species that are neglected by public policy-makers despite their known contribution as public goods. A policy solution would be to support directly the conservation of the species. For Plant A, which has a low private value (i.e. a wild bush or a grass) policies should focus on *in situ* conservation strategies, such as payment for environmental services to the primary producers or landholders, or on *ex situ* conservation strategies (such as conservation in botanical garden or seed banks). Interventions concerning Plant B, which has a high private value, could be similar or might also involve markets, with the use of public certification and ecolabel schemes and programs to raise public awareness about the social value of the species.

7 In fact, some of the species in Region 4 may be underutilized, but their high value makes them less useful cases to study from a public policy perspective unless doing so sheds light on the causes of success. It may be that policies have already had an effective, positive impact on the production and marketing of these crops.

Vectors C and D share a vertical direction; they represent plant species whose observed private value is inferior to their potential.[8] These cases call for public intervention to help markets function better (see the two sections on market characterization for details). Finally Vector E links Region 1 to Region 4, which means that the associated species has both a private value and public value, neither of which are fully realized. Rice-bean (*Vigna umbellata*) grown in the mountainous areas of Vietnam is an example of a species for which the commercial value of the crop does not reflect its social value. Because of its high nitrogen content, the rice-bean provides an ecological service. The nitrogen content of the rice-bean roots is one of the highest among leguminous plants; this makes it potentially valuable for the production of bio-fertilizer (Ha Dinh Tuan et al., 2003). Policies focused on the improvement of marketing channels and on identifying public good characteristics will help move in this direction. An example might be policies that facilitate agro- ecotourism activities. These can provide direct benefits to rural communities while promoting the conservation and sustainable use of plant species.

Since we have treated observed and potential values as perfectly known and static, the examples provided do not take into account the long run interactions between the public and private value of a species that result from changes in its value. In fact, increasing the private value of the species may decrease or increase the expression of its public value. For example, a plant species that is overexploited and becomes endangered will likely have a decreasing public value because its contribution to ecosystem services will greatly diminish. At the same time, the existence value of the same plant species

8 If we only include species that have a significant potential public value through their contribution to agricultural biodiversity, vector C is not strictly an underutilized plant species.

could increase rapidly as it becomes rare. This example suggests that there may be trade offs between value components. Figure 1 should therefore be interpreted as a short term representation of value.

Level of observed value and knowledge gap

In Figure 1, we represented underutilized species as vectors linking the observed value to the potential value of each particular species. Similarly, the value characterization of each underutilized species can be determined by two points, or by one point, one direction and the norm of the vector. Because it is difficult to assess potential values of the species, we propose to use an evaluation of information related to the observed value and the difference between observed and potential value, directly linked to an evaluation of the knowledge gap.

The observed value of underutilized crops can be assessed based on the market or subsistence value, and the presence of competing crop alternatives. Many underutilized crops are collected rather than cultivated, constituting a significant share of income for those who do not have many other alternatives. Other underutilized crops continue to be cultivated, competing with other crops that are more extensively grown. A revealed preference for farmers to grow underutilized crops when other alternatives are available, especially when policies favor the other alternatives, is an observable indicator of their private observed value. Similarly, it should be possible to evaluate the observed public value for an underutilized species, by assessing its positive externalities and its contribution to local, regional and global public good.

The products made from a plant species are only valued if one or more economic agents has at least a basic knowledge about them. The market value of the products would be greater if all market chain actors had some knowledge of the use and properties of the plant. In addition, better knowledge of the crop's properties could help diversify products derived from these crops, making them more valuable to more consumers.

Local collectors and farmers typically have practical knowledge of the crop based on consuming it, though more distant potential consumers know little or nothing. This information gap results from a combination of the fact that the plant is locally abundant and there is a lack of scientific knowledge it. In turn, this gap is one of the sources of the economic potential of underutilized species: better transmission of knowledge would likely result in a more complete market valuation of products made from the plant.

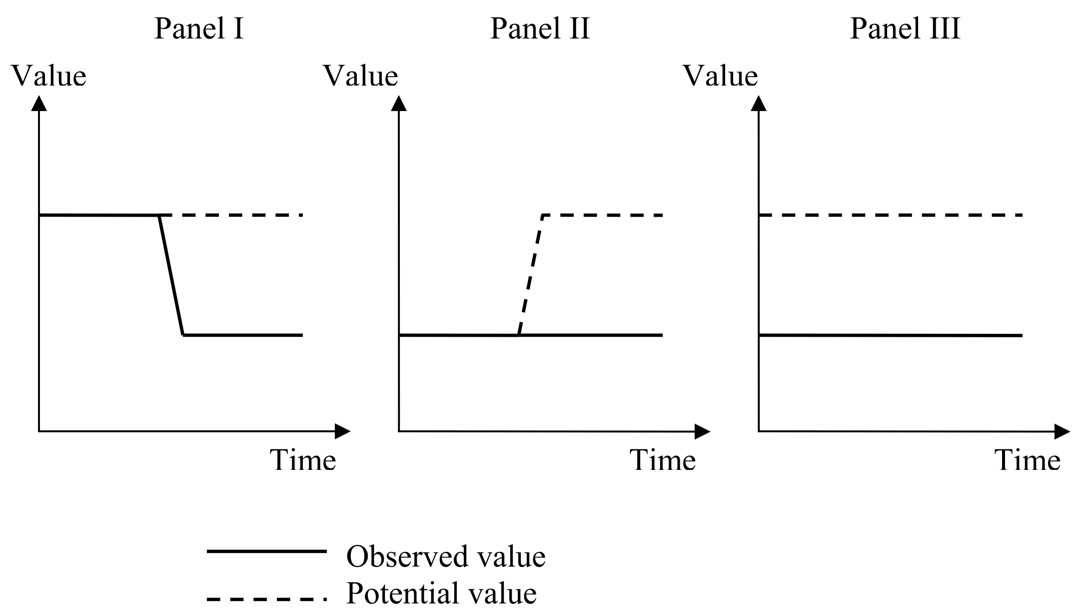
A complete characterization of the value of underutilized species should assess knowledge gaps for all agents and among economic agents (primary producers or collectors, intermediaries, sellers and past, present and outside potential consumers) in an historical perspective. The extent of knowledge about the species, how this knowledge is transmitted, and the gap between the knowledge of local and outside users are important determinants of the difference between observed and potential value. We would assert that while other factors play a role, the gap in knowledge accounts for a significant share of the gap in value.

Temporal characterization: past, present and future

The link between knowledge and value also means that the value of the species is a dynamic asset, and that it depends critically on the transmission of knowledge. Many underutilized plant species are locally valued, thanks to traditional knowledge. Others may become valuable because of new scientific evidence related to their intrinsic properties, new cultural trends or fashions. For example, fonio (*Digitaria* spp.) has been used for centuries in West Africa and its use has been transmitted by local tradition. Other species such as quinoa (*Chenopodium quinoa*) have become fashionable in urban areas of developing or developed countries because of a trend towards exotic products, natural products, or traditional products. Soap made with oil extracted from wild laurel (*Laurus nobilis*) has been produced for centuries in Syria, has now reached the European market through natural products shops channel (Giuliani 2006).

Thus an underutilized plant species is also characterized by the temporal dimension of its economic value. The current value of any underutilized plant species is limited relative to its potential value, with respect to either the past or the future, depending on the evolution of knowledge about the plant species.

Figure 2--Temporal characterization of underutilized plant species



There are three basic cases, as shown in Figure 2. In the first case (Panel I in Figure 2), the observed value of a plant species was equal to its potential value in the past, put its observed value declined. For example, in the past, mallow (*Malva sylvestris*) was used extensively in Syrian rural households to prepare a traditional stew. The stew was lost in urban diets and subsequently in village diets, and is now considered a food of the poor (Giuliani 2006). A second subcategory of underutilized plant species has very limited past value (observed and potential) but recent knowledge has increased its economic potential (Panel II in Figure 2). Cases such as quinoa in the Andes, laurel soap from Northern Syria, and thyme (*Thymus spp.*) from Morocco are examples of underutilized plant species that have long been important only within a restricted area, but are now demanded locally and internationally by consumers interested in health and natural products. A third subcategory of underutilized plant species has always been undervalued despite the knowledge of its potential (Panel III in Figure 2). The multipurpose baobab (*Adansona digitata*) tree is one of the most valuable resources in dry areas of Africa. Despite its wide distribution, the commercial potential for its numerous products has never been realized because of the lack of planting material, management techniques, processing technologies, and organized market chains (ICUC 2004).

Differences among the cases represented in Panels I through III are important because they may help define the appropriate policy response to support underutilized plant species. For example, Figure 2 formalizes the distinction between an old or traditional plant species that is well known but no longer preferred (Panel I) and one for which scientific knowledge and/or consumer demand is emerging (Panel II). In Panel II, a recent increase in potential value could reflect interest generated by scientific discovery or changes in the tastes and preferences of consumers, both induced by greater knowledge and information. Scientific research has a major role to play in identifying and analyzing underutilized plant species and in providing information regarding their intrinsic attributes. Without any knowledge about a species, it is clear that it would not be considered underutilized and would remain neglected, whatever its potential value.

Spatial characterization: local versus regional

Underutilized plant species are defined as locally abundant, implying that they are valued in specific geographic areas. Information on the spatial distribution of the production and use of the species contributes to better analysis of market barriers and opportunities. There are two possibilities. First, the observed value may be limited to a certain area where the species is produced and consumed. Secondly, the observed value may be dispersed among multiple areas, and either the plant species is underutilized in each of these areas, or it is only underutilized in certain areas and not others. For example aloe (*Aloe vera*) is considered to be underutilized in Yemen, whereas there is a large exploitation of the plant in the United States and its products are traded globally. By contrast, minor millets are located in specific regions of Africa and South Asia and are only produced and consumed there. Caper (*Capparis spinosa*) plants are distributed throughout the Mediterranean basin. In Italy, France and Spain capers are extensively produced, consumed and traded, representing a valuable commodity. In Morocco, Egypt, and Syria, their observed value in trade is limited relative to their potential (Giuliani 2006).

ECONOMIC CONSTRAINTS: MARKET IMPERFECTIONS AND MARKET FAILURES

In a perfectly competitive market, no species would be considered "underutilized:" its use would reflect its low value, and limitation of its collection or cultivation to specific areas would be justified. As argued above, plant species are underutilized as a consequence of market imperfections. In addition, certain species are underutilized from the viewpoint of the social optimum, so that their value is not fully appropriable in market exchange. Perfect competition and full appropriation of the product value in a commercial market implies that all economic actors have complete information and both private and public sources of values are reflected in market price. In this state of the world, the use of the good would reflect its social value. Clearly, this situation is rare, but some markets are more competitive than others and value is more fully appropriated in markets for some products than for others. In this section we review the major ways that these market conditions (full information, full appropriation) are not met for underutilized plant species.

Missing output market

When primary producers do not or cannot access a market for underutilized plant species, the output market is "missing." We consider two different possibilities depending on the degree of producer access to markets.

First, in the presence of high transaction costs, which constitute exogenous constraints, producing households may not be able to afford access to markets. This situation is not specific to underutilized plant species: high transaction costs make it impossible for households to sell or buy any type of product. For this situation to characterize an underutilized plant species, the crop must be produced only by households or communities with high transaction costs. This would be the case of a traditional species only available in very high elevations, where a few households live, distant from each other and operating in complete autarky. In addition, the observed value of the underutilized plant species is low relative to its potential, which implies either that the species was used more in the past (in the previous example, the area of production may have diminished due to changes in land use), or that its nutritional or medicinal values are not fully realized.

At the community level, products derived from underutilized plant species may not only require costly transport, but also costly handling to become marketable. This may be due to bulk or freshness constraints, or because making the product usable or suitable for sale is labor-intensive. Consequently, there is no incentive for small-scale, household farms or enterprises to produce or use it, even if the species is highly valued (e.g., nutritionally). For example, extremely short shelf-life, combined with lack of refrigeration, limits the marketability of purslane (*Portulaca oleracea*) in Syria, despite its high potential demand among local consumers who appreciate its taste and suitability in Arab cuisine (Giuliani 2006).

Second, the marketability of underutilized plant species may be limited by endogenous constraints.[9] In this situation, the entire community has access to a local market where the underutilized plant species could be sold, but there is a lack of economic incentive for each household to sell or buy the underutilized plant species. At the same time, community members are able to sell or buy other types of crops. For instance, a species might be used by all producing households but they allocate only a small planting area to it because of its low productivity (e.g., yield) compared to other crops. Alternatively, due to their taste preference, they may decide to grow the underutilized plant species for their own use in the home garden, focusing on other crops for marketing purposes. Both of these cases assume that the plant species is used only for home consumption within the community and that the underutilized plant species is not

9 In our context, endogenous constraints mean that these constraints originate within the community instead of being faced by the community as a whole.

available or produced in any other location. In each case, the underutilized plant species is losing because of the better economic returns from other opportunities, or intra-household competition among crops. For example, jujube (*Zizyphus jujuba*) is cultivated in home gardens along the coast of Syria, where the fruits are known and appreciated. The crop is produced for home consumption and is not traded in local communities because other crops are more competitive, and the fruits are not eaten elsewhere in the country (Giuliani 2006).

We will now focus on situations where there is an established market for underutilized plant species, but where the market equilibrium is suboptimal, due to various market imperfections.

Suboptimal market equilibrium

In a market economy, the situation of underutilized plant species with a potential value that is not fully realized can be interpreted as a suboptimal market equilibrium. This suboptimal equilibrium is the direct consequence of one or more market imperfections. The market price does not reveal the full value of the product or consumer willingness-to-pay and the quantity produced does not represent the optimal scale of production or production capacity. In other words, there is a real potential for these species, but the observed market value is limited. At the sector level, there are three possible explanations: 1) weak market demand, 2) inefficient supply and 3) a combination of the two.

Several factors may have contributed to this outcome. First, the apparent lack of demand may be due to incomplete or asymmetric information among market actors. Consumers may be willing to buy the product, but not in places where it is sold; consumers may have access to the product, but its quality at the point of purchase may be inadequate; or consumers may not know about the product and its quality characteristics. The demand may be restricted to local community users, rural areas, aged consumers (if products of the underutilized plant species lost its appeal), low income consumers, or members of a community who use underutilized plant species products in a traditional fashion that is not known to the outside world. In some cases, introduced species and products are cheaper or more convenient to buy although the native underutilized plant species have greater nutritional value. For example, in Bolivia, rice and maize are consumed locally instead of quinoa because they are sold at lower prices on local markets. Quinoa is mainly produced for the export market.

Secondly, even if there is a strong demand for products derived from an underutilized plant species, there may be inefficiencies that reduce available supply or quality. In developing economies, the lack of credit and physical infrastructure impede the ability of chain actors to improve marketing approaches. Furthermore, the marketing channel may be inefficient or incomplete, due to transaction costs. In particular, an unorganized marketing channel, simple (collection and distribution) or more complex (wholesale, processing and retailing), can by itself create inefficiencies that are sufficient to limit significantly the market for underutilized plant species. An example is the market for caper buds in Syria. There is a high mark-up at the end of the supply chain, a lack of transparency, and mistrust among actors, negatively affecting the income share earned by poor collectors in rural areas (Giuliani 2006). Finally, the species may not have been improved through basic selection, resulting in germplasm with both lower productivity potential and lower value at least for commercially-oriented producers. Such inefficiencies reduce the market price for suppliers than would otherwise be the case.

Market failures

Some underutilized crops are not only underutilized from a market perspective but their limited use also fails to reflect their public value (see section 2.1.1). Market development will help increase the incentive for producers to collect or cultivate these crops but at their use a socially optimum level may also require public intervention. A classic result of public economics is that in presence of public goods, profit maximizing agents will not voluntarily contribute (produce or support) to support its use at the social optimum level (Laffont 1988).

In cases of missing market under endogenous constraints, the lack of incentive to market underutilized plant species due to the presence of other competitive crops, may be associated with a disconnection between the market (or implicit) price and the public value of the crop (for example due to the environmental value or subsistence insurance value of crop biodiversity). In other words, the value of the crop for primary producers may not reflect its social value. As a result the crop is not widely cultivated and might be used in decreasing areas despite its overall larger social gains than alternative crops.

The lack of economic information and the lack of product knowledge can contribute to market failures, as the primary producers and public institutions are not able to assess the social benefits of using the species. For example, local populations may be ignorant of the nutritional benefit of consuming or using products from underutilized species. The lack of knowledge can be a market constraint, resulting in a lower demand than what it would be under full information. But the lack of knowledge can also contribute to market failure if the government supports the production of other primary crops without accounting for the differences in nutritional or environmental effects.

The constraints to social optimum can be characterized by the presence and nature of specific real externalities of production[10] and by its specific public good nature. All underutilized crops contribute to crop biodiversity, and thus implicitly express a public value, but certain crops may also be able to provide ecosystem services. In addition many of these crops contribute to a local public good, such as insurance against food insecurity and helping to improve diet diversity.

CLASSIFICATION OF UNDERUTILIZED PLANT SPECIES

Based on the above, we propose to classify underutilized plant species according to four economic criteria:

1. Observed and potential value characterization: private versus public value; observed value (collected versus cultivated, crop competition), gap of scientific knowledge (production, uses, properties), distribution of knowledge among local users (even versus asymmetric in favor of who); temporal characterization (past, recent or preexisting knowledge); spatial characterization (local versus regional), .

2. Output market: missing or not, due to exogenous or endogenous constraints; particular to species or not.

3. Market imperfections: Demand side (asymmetric information, market access). Supply side: primary producers (incomplete markets for labor, information, risk, credit, or other factors); insufficient quality of inputs or output; marketing channel inefficiencies (organization, information, market power, infrastructure, credit).

4. Market failures: Specific sources of production externality (environmental, health etc), type of public good provision (local, regional, global)

Examples presented in the text are classified in Table 1.

10 A real (or nonpecuniary) production externality is defined as an indirect effect of production created by an economic agent and affecting another without being transmitted through prices (Laffont 1988).

Table 1--Classification of selected underutilized plant species according to economic criteria

Example	Characterization of the underutilized plant species					Economic constraints				
		Economic value				Output market		Market imperfections		Market failures
	Region	Observed value[a]	Knowledge gap[b]	Vector type[c]	Temporal Evolution[d]	Presence	Constraints	Demand	Supply	
Quinoa	Andean region	Cultivated, (rice, maize)	Small in & large out	E	I and II	Yes/No	Endogenous Exogenous	Information	Organization, low productivity	Diet quality
	United States	Cultivated (niche market)	Large out	B	II	Yes	None	Information		Diet quality
Capers	Syria	Collected	Small in & out	C	II	No	Exogenous	Information	Organization, processing, no cultivation	Health
	Morocco	Collected, cultivated	Small in & out	C	II	Yes	Exogenous	Information	Oversupply	Health
	Italy	Cultivated (niche market)	Large in & small out	B	II	Yes	None	None	Labor availability	Health
Laurel	Syria	Collected, managed	Large in & small out	C	II	Yes	Endogenous	Information intermediaries	Quality standards	Health
Rice-bean	Vietnam	Cultivated	Small in & out	A, D	III	No	Exogenous	Information	Low productivity	Ecological services
Mallow	Syria	Collected, cultivated	Small in & large out		I	Yes/No	Endogenous	Insufficient	Handling, organization	Diet quality
Baobab	African dry areas	Collected, managed	Small in & large out	E	II	Yes	Endogenous	Information	Quality standards, processing, Organization	Health
Purslane	Syria	Cultivated, Collected	Small in & out	C	III	Yes	Endogenous	Information	Handling	Diet quality
Jujube	Syria	Collected, managed	Small in & out	C	III	No	Exogenous	Insufficient	Quality standards Organization	Diet quality

c See Figure 1, d See Figure 2. Source: Constructed from case studies conducted or reviewed by Giuliani (2006).

This classification indicates which type of policy intervention would serve to enhance the value of underutilized plant species for the benefit of the poor. Many policy alternatives exist, but they can be divided into three fundamental approaches, used either separately or simultaneously. The first approach gathers policy solutions aiming to enhance the public good value of the plant through in situ or ex situ conservation strategies. The second approach is to design policies that help overcome market barriers and market imperfections (i.e., lower transaction costs). This approach enhances the product and expands income-generating opportunities of the poor. Depending on the characterization of the economic value of the plant, one or the other approach may be preferred. In particular, if the second approach is selected, more targeted policies can be identified (such as marketing solutions) to respond to the constraints identified by the criteria related to the output market performance and market imperfections.

Two types of underutilized plant species will likely require primary intervention in addition to market development. These are: 1) underutilized plant species with limited potential private value but very large public value; 2) underutilized plant species with missing output markets. Set 1 may be better addressed with direct public intervention such as subsidies to support primary producers in order to avoid under-provision of the product. If exogenous market constraints are not particular to the species, Set 2 will call for more fundamental infrastructure investments before any marketing intervention is feasible.

With these two exceptions in mind, we will now suggest necessary conditions for the development of marketing systems in order to increase the observed value of these species relative to their potential, maintain the social benefits of their cultivation or use, and support the income of the poor.

3. NECESSARY CONDITIONS FOR THE SUCCESSFUL COMMERCIALIZATION OF UNDERUTILIZED PLANT SPECIES

By definition, “necessary” conditions are conditions that are implied by the achievement of a targeted outcome. Necessary conditions may not be sufficient to guarantee success for each individual case, but a successful outcome will not be reached unless the necessary conditions are fulfilled. The targeted outcome in our case is the successful commercialization of an underutilized plant species.

We define “successful” commercialization by three criteria. First, the commercialization helps reach a new market equilibrium that better reflects the value of the crop. Second, the distribution of the benefits among actors (e.g. collectors/processors, local/international consumers, etc.) should reveal that actors at the beginning of the market chain earn enough to continue producing. Thirdly, the market should be sustainable over time, which means that prices and margins should be non-decreasing as demand grows. In sum, we are concerned with efficiency gains and equity considerations: the distribution of rent across actors and in time.

The development of marketing channels aims to help increase the value of the crop to primary producers and associated market chain actors. With marketing development, we aim to mitigate market failures, which will be manifest when the new market equilibrium is reached at a higher price and quantity level. In addition we are concerned with the distribution of benefits among actors, so a successful marketing strategy needs to sustain a sufficient level of income for the producers and other poor actors that participate in the marketing chain.

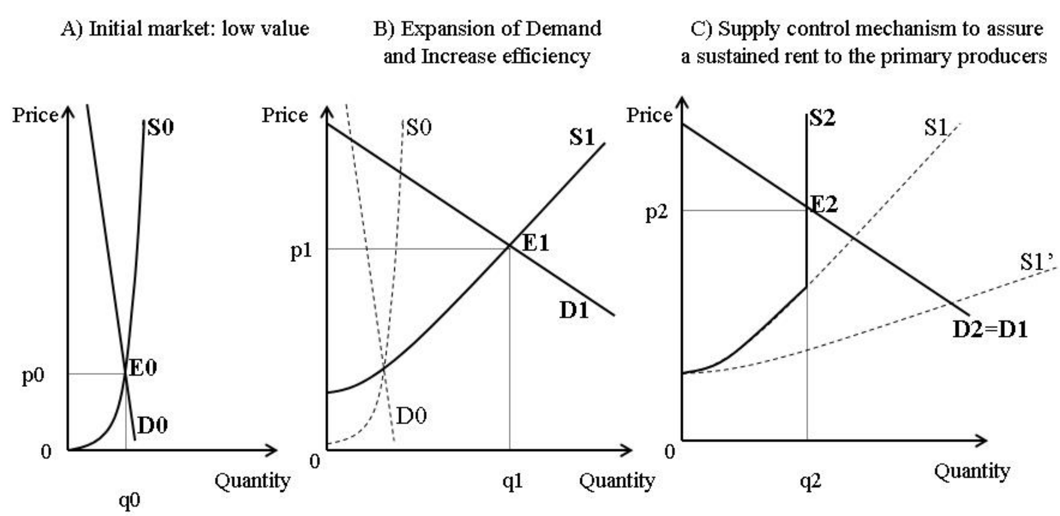
Based on the classification scheme developed in section 2.2.2, we propose three simple conditions that are necessary to achieve a successful commercialization of underutilized plant species:

A. Expansion of demand

B. Improved efficiency of production and marketing channels

C. Supply control mechanism

Figure 3—Market development for underutilized species: Three necessary conditions



We represent these three conditions in partial equilibrium in Figure 3. As mentioned before, the present value of the crop can be defined by a market equilibrium with low quantity and price. Panel A in Figure 3 shows the initial market equilibrium E0 (p0, q0), at the intersection of the demand (D0) and supply (S0) curves. Panel B shows the result of two mechanisms (corresponding to necessary conditions i and ii), first demand expansion, which relates to increasing the market opportunity of the crops, and secondly increased efficiency, i.e., more efficient production and marketing systems. These two steps are represented by an outward rotation of the demand and supply curves, from D0 to D1 and S0 to S1. The market reaches a new equilibrium E1 with a higher price and quantity (p1, q1).

Increasing the value of the crop provides an incentive for the entry of large scale investments, which may drive a process of commoditization. With commoditization, there is greater efficiency and prices are lower, but also lower margins and less incentive for the poor to produce. Because we are interested in generating a sustainable rent for the poor, we propose the use of some type of supply control. Panel C in Figure 1 shows that the new supply curve corresponds to a kink of S1 at a certain level (q2), which is the supply control level. As a result, the price rises from p1 to p2.[11] At the same time, supply control generates a rent to producers that largely exceeds that obtained through commoditization. In a commoditization process, the equilibrium will be represented by the intersection of D2 with supply S1' in Panel C. We will now explain our interpretation of these three necessary conditions in greater detail.

EXPANSION OF DEMAND

To increase the market value of underutilized crops, we need to address the primary causes of underutilization. On the demand side, it is necessary to comprehend the impediments to increasing demand and how to overcome them. An underutilized plant species cannot be successfully commercialized without a well-articulated, strong demand for its products. Our definition of underutilized plant species implies the existence of potential demand (implicit in

11 This case is not necessarily typical. Our goal is to preserve opportunities for the primary producers, and not necessarily to increase the rent they can obtain from relaxing demand and supply constraints.

potential value). This means that the possibility of expanding consumer demand is fundamental. To expand demand, it is necessary to make an assessment of demand opportunities by identifying observed and potential buyers, the potential products that would be demanded, and the scope of the demand.

Several driving factors provide evidence that there are market opportunities for underutilized plant species that could be exploited as consumer incomes rise. First, there is an increasing global demand for an array of natural (and exotic) products, different qualities of products or product attributes, and a range of related niche markets (some based on eco labeling schemes) in both developed and developing countries. Related to that, many countries are experiencing a consumption trend towards traditional food products and regional or national cultural assets. As a consequence of these common trends, certain species (or products derived thereof) could be promoted and used locally and in neighboring areas (countries, villages, regions) where consumers have similar tastes.

Secondly, grassroots organizations, local non-governmental organizations and several international organizations, supported by such fora such as the Convention on Biological Diversity, have stimulated public awareness of the value of plant diversity for the environment and to the livelihoods and knowledge systems of local (including indigenous) communities. There is also increased knowledge and interest about nutritional composition of food products and recognition of the need for better diet diversity as a health prevention strategy. At the same time, there is an increased interest in well-being products (such as natural medicinal or cosmetic products). Third, recent advancement in plant genetics have shown that the availability of these species is important because of their remarkable adaptability to the environment (less favored areas, harsh environment) (IPGRI 2002, Padulosi et al. 2002, Padulosi and Hoeschle-Zeledon 2004).

There are several possible solutions directed towards the products or towards the consumers themselves (both rural and urban) in order to help these species reach their market potential. One way is to provide better information concerning the private and public benefits of the products. Use and demand will be preceded by the transmission of knowledge among observed or potential users. For example, product fairs and rural theaters have been used to promote local products among consumers in rural areas. In Syria, poets worked together with extension agents and local project staff to write songs which were used during local festivals to draw attention to products. Nepalese poets made a rural poetry journey (*Gramin Kabita Yatra*) to sensitize farming communities to conservation issues, highlighting the value of in situ conservation with local examples. Writers created rural roadside dramas (*Gramin Sadak Natak*) based on village accounts. Local farmers and professional actors played the roles, using dance and song in a local setting (Sthapit et al. 2003).

Another way would be to develop different uses for the product, such as the development of processing facilities and processed products. Product differentiation may also help open other market opportunities with labeling (e.g., ecolabels or 'fair trade' schemes), certification and branding. Product focus may help increase the scope of the market.

INCREASE EFFICIENCY OF SUPPLY AND MARKETING CHAIN

On the supply side, producers and actors in the market chain may encounter endogenous and/or exogenous constraints that need to be identified and addressed. A successful marketing chain must be able to bring a product of satisfactory quality onto the market at a reasonable price. There may be an endogenous lack of organizational structure, with a resulting lack of information, and risk and vulnerability for the primary producers. This situation can be improved by coordinating meetings among actors and setting up an institutional relationship linking actors, such as a contractual arrangement. Such a situation may also call for horizontal and vertical integration to allow a more effective or equitable distribution of margins. First, the organization of farmer groups or cooperatives can help them share capital investments, gain bargaining power relative to middlemen, and enforce their contracts. Secondly, in organizing themselves vertically, farmers may benefit not only by collecting but also providing basic processing services in order to sell higher value products on the market.

At the same time, production may be restricted exogenously by the presence of fixed costs, the lack of credit markets, or the lack of infrastructures. The transmission of information may require basic communication tools. For example, in certain countries, the expansion of cellular phone networks has greatly improved basic communications, making it possible for one actor to inquire about the spot price of a product before deciding to bring it to the market. It is also necessary to explore issues related to grants and credit guarantees for producers groups, in order to reduce the risk of production and facilitate market entry. Third, more fundamental investment in infrastructures and transport always helps to increase efficiency within the market chain, lowering major sources of transaction costs.

SUPPLY CONTROL MECHANISM

Even with strong consumer demand and a relatively efficient marketing chain, commercialization may not be "successful" according to our definition. These two conditions do not guarantee that we achieve our objective of transmitting a share of the benefits to the local poor over time. This can be achieved in food markets appropriation of the product, which can also be seen as an indirect restriction of the quantity supplied of a good, which we call "supply control". To avoid pressures toward commoditization and declining prices, supply control is necessary to preserve minimum rents for the producers once market failures have been taken care of and products from underutilized plant species become profitable. An example of caper production in Northern Morocco illustrates this point. Encouraged by a growing demand from Europe, many farmers in the same area started to produce capers. The price decreased dramatically, leading to the abandonment of caper fields (Giuliani 2006).

Supply control can be achieved through different mechanisms: (i) by specifying product characteristics or quality attributes, (ii) by specifying production process or method used, (iii) by linking the product to its area of production (Region of origin labeling). Practically, these three mechanisms may be derived from: natural supply control (if planting is restricted to very specific areas) for (i) and (ii); pre-existing regulatory supply control (laws forbidding the cultivation or harvests in a large area) for (i), (ii) and (iii); and/or private quality[12] brands and labels (region of origin, traditional process, fair trade, or eco label) for all cases. In turn, each of these different strategies depends on the support of well-developed institutions in order to be realized. These include: cooperative arrangements; possible joint-ventures (NGOs, public or private); legal requirements for distinctness; legal frameworks for access to resources and property rights; grading schemes and quality standards. The institutional organization that achieves supply control may be able to legally guarantee a share of the rent for primary producers.

These supply control mechanisms or product differentiation schemes can be interpreted as a direct policy instrument to increase market power. These mechanisms will not necessarily lead to increased market concentration, however. Competition can occur because of substitutions with other products, creating a multiple equilibrium market. There is a possibility of competing entities with similar supply control mechanisms, such as products from different regions that are differentiated by origin, or products that specialize in varied qualities or production processes.

12 As compared to standards imposed through public regulations, private quality brands are imposed by chain actors. This often implies greater quality differentials or finer product distinctions.

Furthermore, this type of supply control implies an institutional arrangement among actors of the supply chain obtaining specific rights on a specific quality attribute, like a specific type of "farmer branding" (Hayes et al. 2004). It does not completely deter entry to the market, but while it is still possible that large investments will occur, these investments will not eliminate the margins of primary producers.

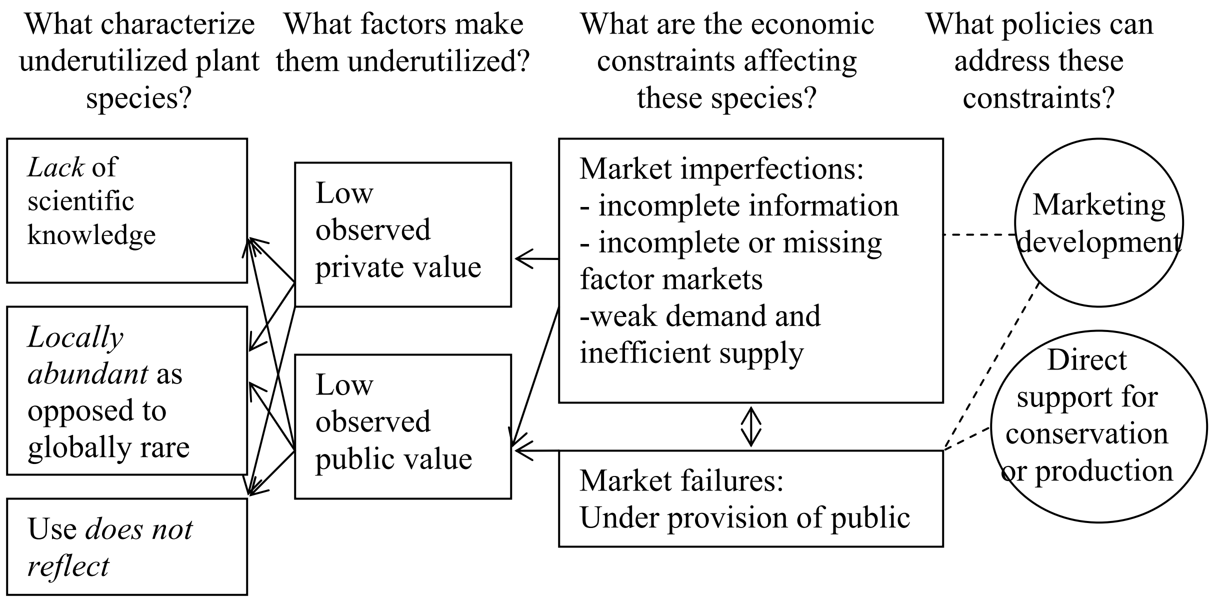
Finally, supply control mechanisms and quality certification present certain caveats. They may not be applicable to all developing countries. Although private and public institutional arrangements of this type have been adopted in most if not all high income countries, they are still rare in poor countries, because of their lack of any type of quality standards (food safety, quality control, quality awareness) and their cost and difficulty of implementation. Public certification systems, such as geographical indications are not recognized by international agreements and may be difficult to protect in international trade (Boisvert 2006). Quality certification may also be perceived as a pro-export strategy that does not correspond to the reality of subsistence farming and local markets. Nevertheless, we think that supply control is necessary to preserve long run rents from commercializing the products of underutilized plant species, and that these developed economy solutions provide examples of good bases for sustaining income generation.

One example is provided in caper production on the island of Pantelleria, in Italy. Over 200 years of selective breeding by farmers resulted in the high quality caper cultivar (*nocellana inermis*), linked with a traditional cultivation and processing methods (Barbera and Di Lorenzo, 1982, 1984). This cultivar has been awarded a certificate of protected geographical indication under Italian and EC regulations, enabling producers, who are organized as a cooperative, to position their product successfully on a niche market. We believe that supply control is a necessary condition for successful commercialization of underutilized plant species after the removal of primary market constraints.

4. CONCLUSION

Underutilized plant species pose a challenge for agricultural development, especially in an era of increasingly privatized agricultural research and less focused CGIAR research agendas. These crops are locally abundant or produced in dispersed areas on small scales, scientific information about them is scant, and their use is currently limited relative to their economic potential. Some are potentially high-value crops. To our knowledge, agricultural economics literature has contributed little to the understanding of how to commercialize these crops of plant products successfully.

Figure 4--Underutilized plant species: from a characterization to policy solutions



In this paper we first identify the economic factors that characterize underutilized plant species. Our classification of species is based on four main factors: 1) the relationship of the observed to the potential economic value of the species;; 2) the presence or absence of an output market; and 3) the presence of market imperfections and 4) the presence of particular market failures. With this economic characterization, we exclude species for which developing markets is in or of itself irrelevant. We then identify three necessary conditions for the successful commercialization of underutilized plant species for the poor: 1) demand expansion; 2) increased efficiency of supply and marketing channel; and 3) supply control mechanism or capacity to differentiate from products that are close substitutes.

Our analysis has helped to link underutilized plant species to the economic constraints they face and possible policy solutions, as presented in a schematic way in Figure 4. Figure 4 can be read from left to right, and follows the outline of the paper. It can also be read from right to left, to indicate which policies will affect which constraints (arrows in Figure 4 can be read as “leads to”), in order to identify the principal limitations to successful commercialization of underutilized plant species.

Figure 4 clearly shows that marketing solutions and policies addressing market imperfection are central issues that likely affect all economic aspects of underutilized plant species. Enhancing the value of this species can have a direct positive effect on the use, income generation for the poor, public conservation efforts and knowledge.

The purpose of developing this simple conceptual framework is to provide a basis for the design of an empirical investigation of marketing solutions for underutilized plant species among the rural poor in developing economies. The framework will help us generate testable hypotheses concerning the commercialization of underutilized plant species, appropriate policy interventions, and social welfare implications.

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