Sustainability **2014**, *6*, 6847-6861; doi:10.3390/su6106847

OPEN ACCESS

sustainability

ISSN 2071-1050

www.mdpi.com/journal/sustainability

Article

Small Mushrooms for Big Business? Gaps in the Sustainable Management of Non-Timber Forest Products in Southwest China

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External Editor: Mark A. Rosen

Received: 30 May 2014; in revised form: 17 September 2014 / Accepted: 23 September 2014 / Published: 30 September 2014

Abstract: The challenge of managing forests for the production of commercial non-timber forest products (NTFPs) lies in promoting economic development by maintaining and even increasing production while simultaneously maintaining or improving ecological conditions. The discussion of forest management therefore encompasses a wide range of social, economic, political, and ecological questions. Empirically, it is clear that both market and government failure can lead to unsustainable management in commercial NTFP use. How can we manage the market and at the same time formulate good policies? Taking cases from Southwest China, this paper critically examines the current development of NTFP commercialization in the mountainous region of Southwest China. It focuses particularly on three pieces of research on mushroom collection and marketing. By examining empirical data, the paper analyzes current gaps in the policy and the market in mountainous areas in the context of promoting sustainable use of NTFP. It examines the market structure from the perspective of market failure and explores the government's failure to promote commercial NTFPs. We recommend economic and political decentralization, capacity building, and government investment as means to improve sustainable management.

Keywords: commercial NTFPs; value chain; market structure; forest tenure; decentralization

1. Introduction

To reduce commercial timber production and conserve the environment, most countries have banned commercial logging in mountainous areas [1]. Concomitantly, an increase in market-oriented development and market liberalization has enabled remote communities to integrate with the global market, providing numerous market opportunities for poor rural households [2]. In the past two decades, therefore, commercial non-timber forest products (NTPFs) have become the focus of alternative forest use [3–9]. Many empirical studies have shown that these so-called "minor" forest products play a significant role in both the maintenance of forests and local economic development [2,10–13]. This dramatic development in the collection of NTFPs has led to local people assuming that their extraction does not destroy the function and structure of forests, and NTFPs have become the most lucrative forest products that they extract. This could become the basis of a development strategy to reconcile the economic, cultural, and ecological values of the ecosystem [11,14–16]. The reality, however, is far more complicated. Resource degradation resulting from the commercialization of NTFP has led to empirical research on the sustainability of extracting and marketing NTPFs.

The impacts of the increasing commercialization and the conservation of resources are not yet clear, however [17]. From the ecological perspective, species distribution, human intervention, and particularly harvesting techniques can impact on the distribution of certain species [18,19]; socioeconomic studies highlight how commercial mushroom production can create unequal benefit-sharing within global trading networks [6,20,21] and lack of sustainability related to certification and resource tenure [19,22]. However, there has been no systematic analysis of commercial mushroom production.

Using examples in Southwest China, this paper critically examines current developments in NTFP extraction in the southwest mountain region, focusing on three pieces of research about different methods of collecting and marketing mushroom varieties. The paper examines the empirical data with the aim of contributing to the current debate in the literature on commercial NTFP development by analyzing existing gaps in the policy and the market in mountainous areas to promote sustainable NTFP use. In the following section, we provide the overall context of mushroom diversity and utilization in Yunnan, Southwest China. This is followed by a description of our research methods. In the fourth section we examine market and policy failures to identify gaps in the market and policy and potential measures to bridge those gaps. The paper concludes with policy recommendations.

2. Mushroom Diversity and Utilization in Yunnan

Yunnan province is situated in one of the twenty-five World Biodiversity Hotspots [23]. The mountain ecosystem in the province is complex; its varied topography and climate offer a wide diversity of habitats from tropical, subtropical, and temperate to alpine zones, and are home to the most endemic-rich temperate flora in the world [24]. In this complicated geophysical and meteorological environment the diverse ecosystem enables the province to grow the richest variety of wild edible mushrooms in China and even the world. Of the recorded 2000 species of edible mushroom worldwide,

938 grow in China and more than 850 in Yunnan [25], including a number of endemic and economically valuable species such as *Tricholoma matsutake*, *Tuber sinense*, *Ophiocordyceps sinensis*, *Morchella conica*, *Lactarius delciosus*, *Lentinus edodes*, *Pleurotus ostreatus,* and *Thelephora ganbajun*. This diversity and abundance of wild mushrooms contributes significantly to local economic and household livelihood development [6,26,27].

Yunnan is also rich in cultural diversity. Its population of 45 million comprises 25 distinct ethnic minorities, most living at between 1000 and 3000 m above see level (masl). This cultural diversity has created a long tradition of ethnic monitories engaging in the collection of a wide range of wild mushrooms for food, sale, and medicinal use [28,29]. Collection activities have recently been heavily commercialized along with the liberalization of the market and a growing tourism industry. Table 1 illustrates the most commercially-valuable wild mushrooms collected by different ethnic monitories in Yunnan's diverse ecosystems.

The commercialization of mushrooms in Yunnan has brought significant regional and local economic benefits from both domestic consumption and international trade. Since 2001, the dramatic growth of the edible mushroom market has led to a significant increase in their production and export value (an annual average of 37.73% and 18.96%, respectively) [6,30]. Products such as truffles, matsutake, and morels are exported to Europe, Japan, and the US and have generated more than 348 million USD in the past five years. With mushrooms now being the most important industry after tobacco in Yunnan Province, the province aims to promote it in order to generate about 14 billion USD by 2015. At the local level, and along with the implementation of the Natural Forest Protection Program, forest dependents have made a huge shift from timber-based livelihoods to the NTFP economy, in particular mushroom collection [26]. Commercial matsutake collection, for instance, accounts for 85% of the cash income of Tibetan villagers in Shangri-la County [27]. Initiatives focusing on the development of trade in wild mushrooms in association with poverty alleviation and community development programs have been widely implemented in rural areas, with positive impacts on livelihoods and the environment [31].

Along with economic success, however, there are incentives for the overuse of NTFPs [6]. Over-extraction often takes place where NTFPs are not well managed, local institutional arrangements are weak or good community leadership is lacking [32]. Over-extraction of NTFPs can destroy the structure and function of the forest and ultimately lead to the depletion of forest resources [13]. The lack of understanding of their requirements, symbiotic relationships, and dependence on microclimates could lead to the extinction of some species, although more in-depth research is required before management strategies can be implemented [33]. Instead of providing an alternative method of sustainable forest management, the collection of NTFPs may have a strongly negative impact on biodiversity and forestry management that leads to overharvesting and even extinction. Therefore there is an urgent need to improve the understanding behind existing policy and the market gaps in order to promote sustainable NTFP development.

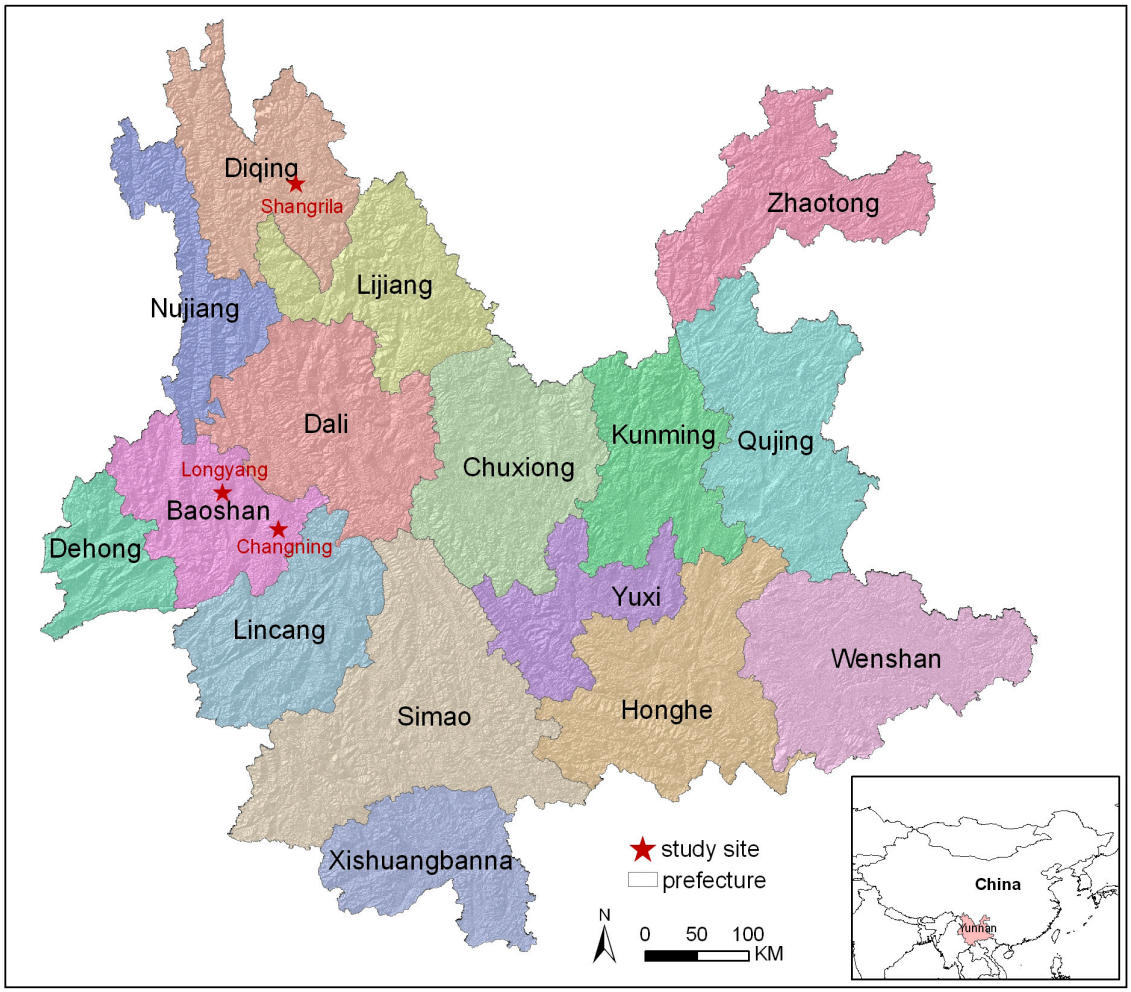
Table 1. Commercial wild mushroom distribution, their ecosystems, and the ethnic groups collecting them in Yunnan.

Ecological Zone	Species	Ecosystem	Utilization	Major Ethnic Group in Collection
Northwest Yunnan 2000–3000 & above	*Ophicocordyceps sinensis*	Alpine rangeland	Medical (export)	Tibetan, Naxi, Yi, Lisu
	Boletus reticuloceps	Mixed pine and oak forest	Edible and delicious (export)	
	Lyophyllum shimeiji	Mixed conifer and broadleaf forest	Edible and delicious	
	Morchlla esculenta	Pine and fir forest	Edible and delicious (export)	
	Rozites emodensis	Pine and fir forest	Edible	
	Hygrophorus russula	Pine forest	Edible	
	Cantharellus cibarius	Mixed forest of pine and oak	Edible and delicious	
	Tricholoma matsutake	Mixed forest of pine and oak	Edible (export)	
Central Yunan 1000–2000 masl	*Catathelasma ventricosum*	Pine forest	Edible and delicious	Yi, Bai, Naxi, Miao, Lahu, Bulang
	Russula virescens	Mixed forest of pine and oak	Edible and delicious	
	Lentinula edodes	Pine forest	Edible	
	Tuber sinense	Pine forest	Edible (export)	
	Thelephora ganbajun	Pine forest	Edible and delicious	
	Termitomyces robustus	Mixed forest, grows in association with termites	Edible and delicious	
	Dictyophroa spp.	Pine and bamboo forest	Edible and delicious (export)	
Southern Yunnan 100–1000 masl	*Boletus edulis*	Mixed forest of pine and oak	Edible and delicious (export)	Dai, Bulang, Lahu, Hani, Jinuo, Wang, Yao, Jingpo
	Termitomyces clypeatus	Mixed forest, grows in association with termites	Edible and delicious	
	Auricularia delicata	Mixed conifer and broadleaf forest	Edible and delicious	
	Schizophyllum commune	Pine forest	Edible and delicious	
	Russula sriseocarnesa	Oak forest	Edible	
	Termitomyces haimui	Mixed forest, grows in association with termites	Edible and delicious	
	Russula squarrosulus	Mixed conifer and broadleaf forest	Edible	

3. Methods

We selected three research projects in different villages to address marketing and policy issues. The villages selected are the World Agroforestry Centre (ICRAF) global benchmarking research sites in China (see Figure 1). Table 2 below, gives a brief description of the study sites. All three villages are upland communities that have traditionally depended on forest and upland farming for their livelihoods and are highly dependent on mushroom extraction. Nearly a decade of commercial mushroom collection has led to a decrease in production, which has been clearly observed by mushroom collectors. There are considerable issues associated with markets and policy.

Figure 1. Location of the study sites.



Data collection was carried out by the authors with field assistants in the villages: during May to September 2008 and 2009 in Sijiaotian, July to September 2009 in Jiedi, and May to December 2010 in Haitang. Additional data collection was carried out to obtain more in-depth insight into mushroom governance throughout May to September 2013. The empirical data were derived from three primary sources: (1) semi-structured interviews with key informants (n = 107) including forest officials at provincial, prefectural, and county levels, village heads and village ex-heads in three villages, mushroom harvesters (elders, women and mushroom experts), and middlemen at different level of the value chain; (2) government documents, including forest policy on forest tenure and mushroom

management at national and provincial level, county and township regulations and government statistics; and (3) insights from separate themes of research in the three villages, led by ICRAF: participatory mushroom management in Sijiaotian [13], commodity chain development in Jiedi [6] and the certification of NTFPs in Haitang [34].

Table 2. Brief descriptions of the three study sites.

Study Sites	Haitang Village, Longyang District	Sijiaotian, Changning County	Jiedi Community, Shangri-la County
Biocultural characteristics			
Area (km^2)	14.02	42.21	214.58
Elevation (m ASL)	2300–2600	1750–1980	2100–4200
Population	1539	2539	1755
Ethnicity	Han-Chinese	Yi	Tibetan
Dominant forest vegetation	*Pinus Yunnanensis* mixed with oak (*Quercus* spp.)	Pine forest (*Pinus yunnanensis* and *P. kesiy*	Oak (*Quercus* spp.) mixed with *Pinus Yunnanensis*
Agricultural land use	Upland farming of corn and wheat	Upland terraces of rice and corn, agroforestry with walnut plantation	Upland farming of potato and barley
Mushroom-related information			
Main species studied	Truffles; matsutake mushroom	Various species	matsutake mushroom
Economic significance of mushroom extraction	80% of household income	65% of household income	85% of household income
Householders involved in collection	Above 90%	About 70%	100%
Market	International (Japan, France)	Domestic	International (Japan)
Mushroom resource dynamics	Decreasing	Decreasing	Dramatically decreased and then stabilized

4. Market Failure and Government Failure: Gaps and Their Bridging

Many analysts look at the roles of markets and government as two key players in development [6,17–21]. Their analysis thus addresses the limitations if one sector becomes the dominant actor driving development. The limitations are known to be market or government failure. The former encompasses a situation in which individuals' pursuit of pure self-interest leads directly to a lack of certain economically-ideal factors which prevents equilibrium [35]. In natural resource management, market failure may lead to unequal benefit sharing and distribution, and a completely market-driven economy may lead to the overexploitation of natural resources. On the other hand, centralized government control discourages market mechanisms in resource allocation leading to the inefficient allocation of resources and lack of incentive for economic development, which are widely regarded as government failure [36,37]. Balancing the roles of the different players is crucial in natural resource management. This section explores recent gaps between the market and policy.

4.1. Market Structure

Studies of the commodity chain in all three village cases revealed that the market structures were hierarchical in their organization of product flows. Several factors indicate gaps in the market.

4.1.1. Information Flows

Information is crucial in marketing mushrooms, as most must be sold fresh to maintain their quality. A good information flow not only enables local farmers to improve their bargaining power, but also, and more importantly, guides their collection practice. In all three villages there are huge constraints to acquiring local information. In most cases mushroom collectors receive pricing information from middlemen who are not accountable for its transparency. The middlemen visit the villages to provide the most updated information. The matsutake collectors in Shangri-la County receive the most up-to-date information about markets and prices, even though they are in the most geographically remote area because the intense competition among middlemen dealing in matsutake mushrooms at the local market engenders a relatively rapid information flow and response, while villagers in Sijiaotian, where the market for mushrooms is less competitive, do not receive the latest information. In Haitang, farmers are able to obtain information via cell phone and members of neighboring communities who visit the local market. The current structure of the mushroom market provides potential for commercial mushroom harvesting but fails to facilitate the accessibility of information. Even though mushrooms play a significant role in both the macro and the micro economy, the government line agency does little to improve the delivery of information. Market transparency could be improved by investment in hardware including an information-release platform, mushroom exchange center.

4.1.2. Market Monitoring and Quality Control

Monitoring trade in wild species of flora or fauna is critical to ensure sustainable harvesting practices. In none of the three case study villages is there a clear market-monitoring system to ensure sustainable harvesting and control illegal trade and quality. Although there are regulations forbidding collecting and trading in immature matsutake mushrooms, their enforcement is poor, and as a result illegal sales are common at all levels of mushroom marketing. Poor enforcement of the rules and regulations means that sustainable harvesting is not ensured and quality control fails. In Haitang and Sijiaotian, mushrooms are traded without any *de jure* regulatory manner. In all three cases traders tend to cheat by hiding poor-quality mushrooms among high-quality ones; this has led to a loss of wild mushrooms' credibility in both international and domestic markets.

4.1.3. Value Addition in the Value Chain

Wild edible mushrooms have become popular in recent years with the increasing concern about human health and global demand for organic food. The trade in mushrooms is organized along a linear and complicated value chain beginning in the remote mountains, from which they are shipped to cities or international markets. Research on the three cases has found, however, that all the mushrooms are traded as raw materials without value addition. Processing and packing are especially lacking at low levels of the chain. As a result, although large numbers of wild edible mushrooms are exported they do

not contribute sufficiently to local and regional economic development, and rural communities only benefit from raw resource collection and trade.

4.2. Middlemen and Benefit Sharing

The longstanding issue of intermediaries, or middlemen, is presented here for discussion with the analysis focused on the commodity chain, to clarify the product flow and how the benefits are shared. Middleman in rural markets used to be regarded as parasitic intermediaries who accumulated wealth at the expense of poor forest-dwelling extractors, giving rise to global debate about the difficulty of improving rural livelihoods. Consequently efforts have been made to eliminate the intermediaries in order to shorten the commodity chain and increase farmers' incomes.

An empirical check of benefit-sharing in the mushroom commodity chain is still required, however. Through a combination of quantitative and qualitative methods, the income, profit, and benefit distribution were examined in the vertical and horizontal dimensions of actors in the commodity chain in the three mushroom extraction case studies. Differences in income distribution were found in both dimensions. Furthermore, the cases show that traders or middlemen are not always parasitic intermediaries who accumulate wealth at the expense of poor forest-dwelling extractors. Their income varies widely across the levels with income distribution skewed even among groups at the same level.

Analysis of the different actors in the market reveals that treating traders as monolithic middlemen causes more problems than solutions in commodity chain analysis [6]. They are very diverse in terms of the benefits they reap, the functions they provide and their relationship with other social actors as well as in terms of their social identities. The concept of the "middleman", therefore, is problematic. The incomes of some are barely above subsistence level, and some are in debt; others higher up the commodity chain reap greater benefits as they are able to monopolize the market. Certain companies have the right to export matsutake mushrooms and hold the export quota as well as a license and these dominate the export market and make the most profit.

However, other middleman, and particularly those who buy truffles and other mushrooms from the Haitang and Sijiaotian to sell directly in cities, profit well in the commodity chain as they provide the only bridge between the producer and the consumer.

The homogeneous concept of the "middleman"—the trader between the extractor and the consumer—is therefore problematic. The traders in the NTFP mushroom chain are heterogeneous. The elimination of traders from the chain should be considered carefully, therefore, since some provide key functions in the commercialization and globalization of NTFPs by providing information, processing credit and connecting actors, which other traders cannot provide. Improving benefit sharing requires not only greater market competition but also government intervention to enhance market transparency.

4.3. Market Mechanisms versus *Government Intervention*

Market mechanisms and government intervention drive the rural market in mushrooms. On the one hand the mushroom value chain is structured and organized by the market pricing mechanism, and market competition enables traders, rural farmers, and companies to profit based on price and quality; on the other hand, mushroom production has also been constructed and shaped by government intervention which has established regulations to include or exclude some actors' access to the market,

and also in order to be able to manage the market. Trading licenses and taxation and quota systems are the instruments of government intervention.

From the local to the provincial level, trading in matsutake mushrooms involves paying five different taxes or fees, and this has discouraged their commercialization. Few of these taxes or fees have been returned to or reinvested in mushroom conservation. Because a huge population is spread across a remote area, mushroom picking and trading licenses are unlikely to achieve the goal of improving sustainable management; instead, they create barriers to trading. Moreover, export rights and licenses allow some companies to monopolize the export market, limiting market competition. In cases involving truffles and other species of mushroom, local governments are more interested in setting up a tax system for the mushroom trade than in making an effort to monitor the market and improve market competition.

Clearly, although the government plays a significant role in market management and monitoring, overrule and excessive involvement on their part threaten to undermine the effectiveness of market mechanisms and fail to benefit sustainable NTFPs management.

4.4. Forest Tenure and NTFPs

Among the many reasons for overharvesting suggested in the literature and analysis of NTFPs, researchers believe that forest tenure is the most critical [2,5,6,19,22]. Strengthening forest tenure and user rights is seen as the key to improving long-term sustainable management and harvesting schemes. From a formal legal standpoint the forest tenure system in China has changed radically from collectivization to de-collectivization over the past four decades. Since the reforms, China's forestry sector has maintained a distinction between state forests (*guoyoulin*), collective forests (*jintilin*) and, increasingly, private forests. State forests can be subordinated to central, provincial, prefecture, and county governments, whereas townships, administrative villages, and natural villages manage collective forests. Villages have both use and ownership rights over collective forests, whereas various levels of government own the state forests [38].

While the forest tenure system has clarified the right to trees, state titling regulations for forests have left property rights in the context of NTPFs unclear [6,13,27,31]. As a result the tenure system for NTFPs is *de facto* open access, with people going wherever they want and harvesting as much as they can. This has led to overharvesting and decreasing production.

In all three case studies, different degrees of resource degradation have occurred in association with commercial mushroom extraction. Increasing market opportunities and benefits drive the exploitation of mushrooms in the forests. Without clear guidelines or long-term experience of engaging with policy development it is hard to develop sustainable NTFP management because insecure ownership leads to overharvesting and short-term opportunistic extraction and marketing. According to the farmers, the critical issue to be addressed in this environment is not who owns the forest or its products but who has legal documented access and the right to harvest mushrooms and, therefore, control over the products. With realization of the potential and value of NTFPs and the transition from timber production to NTFPs extraction, especially with the current restrictions to logging rights, pressure on the resource has increased and the clarification of property rights over forest resources has become essential.

Without a clear legal framework and property relations (lack of *de jure* rights) NTFPs are open-access resources in many areas, and this inevitably leads to competition and eventually the degradation of the resources and accompanying social problems. It is problematical that the state policy is unable to establish property rights for the many NTFPs species and products, each of which has its own different context. A more decentralized mode of resource management would significantly strengthen local use rights and provide the community with incentives for long-term investment and NTFP management, resolving the dilemma.

4.5. Significance of Local Collective Action

With the commercialization process the forest tenure system has become diversified, leading to competition and conflict over resource use and forest access. Increasing pressure on NTFP resources has also threatened their long-term sustainability. In the absence of formal tenure and management the global community has recognized the significant role of collective action for sustainable NTFP management.

Matsutake mushroom extraction in Jiedi village demonstrates that local collective action can prevent gradual resource degradation by setting up sound institutional arrangements. The institutional arrangements in place not only allow spatial and temporal access to resources but also set up arrangements for the formulation, enforcement, amendment, and monitoring of rules. Furthermore, in this case local control of the market is a crucial aspect of demonstrating the market aspects of sustainable mushroom management. Similarly, a mushroom association has been established in Sijiaotian village to manage *Telephora ganbajun*, and a truffle mushroom group in Haitan village has improved the management of mushrooms. Collective action is "action taken by a group (either directly or on its behalf through an organization) in pursuit of members' perceived shared interests" [39], and therefore rules made collectively can be enforced.

Such local collective action as self-governance and joint management practices offers a mechanism for adjusting resource overuse which enables not only more sustainable use of resources but also the inclusive management of resources. Local collective action overcomes the weakness of the *de jure* system of forest tenure by setting up local adaptive and contextual institutions. On the one hand it decentralizes the usufruct of resources to the local community to create incentives for economic development and efficient resource extraction; on the other, the institution introduces a new tenure system to prevent the overuse of resources in the locality. Rules, regulations, and institutions are locally designed, adaptive, accountable, and amendable, as well as dynamic.

There is no similar series of institutional arrangements to regulate the extraction of other mushroom varieties, however. Strengthening local access to and control over forests is a critical approach to collective action to achieve rural sustainable development. Such inclusive and participatory management requires significant investment in decentralization reform which can eventually meet the needs of heterogeneous rural groups and change social, cultural, and economic conditions; in particular, building up several types of property regimes taking the spatial and temporal dimensions into consideration, rather than simply making arrangements based on geography or property, will be more effective for managing NTFPs. The establishment of local institutions and clearly-defined access arrangements can reduce the negative impacts of globalization and commercialization. With their

recognition of local tradition and participatory approaches, joint management and local institutions are critical mechanisms by which governments can implement resource management strategies.

4.6. The Long Pathway to NTFP Certification

The certification of NTFPs is a potential pathway towards balancing economic and environmental goals in Southwest China [34]. The demand for certified products from well-managed forests and agroforestry landscapes is rising. It has been observed that smallholder producers and collectors have benefited from this in various parts of the world, and poor communities in China's mountainous southwest are surely going to participate in this trend. Worldwide certification systems relevant to NTFPs include organic agriculture, sustainable forest management (Forest Stewardship Council, FSC) and Fair Trade. While FSC certification may be the most natural scheme for a forest product it is also the most difficult certification to obtain in terms of the evaluation process and cost. In addition, FSC-certified NTFPs may not sell as well initially as products bearing a well-recognized organic certification label, as many consumers may not have heard of FSC-certified non-wood products. Current international literature has documented difficulties in certification including incompatibility of certification and NTFPs [40], the exclusion of small-scale producers [41] and criteria for certification development [42]. International experiences from many case studies [43] require us to re-examine the possibility of NTFP certification for Southwest China.

None of the mushrooms in the three case studies are certified, and work is needed to secure NTFP certification. Remote communities and poor households are limited in their ability to engage in certification schemes by their poor capacity and knowledge. Lack of finance and sound institutional arrangements are also constrictions. We find that unlike many other countries where farmers were the drivers behind the organic agricultural movement, at least in the early development stages, in China the government's state firms originally organized and managed organic food production initiatives. While the government has now moved away from direct ownership and private firms have taken over, smaller companies and smallholder farmers in poor and remote areas such as mountainous Southwest China will need more government support to overcome the constraints to participation in the growing organic food market in China and abroad. A few large companies that typically engage in managing organic farms control most certified organic wild resource collections. Combining certification schemes, *i.e.*, organic, Fair Trade, and sustainable forest management certification, makes more sense progressively as each of these is moving towards a holistic approach, *i.e.*, towards incorporating ecological, social, and economic aspects into their respective standards, and the overlap between the standards of the three major certification schemes is increasing. NTFPs have played a key role in this discussion, as they can receive certification under any of the three major certification schemes.

Developing a brand name for community products issuing from sustainably-managed farm and forest land, linking with consumers and building trust are steps that need to be explored. Groups and facilitators need to learn from outside experience such as successful promotion supported by the government. Supporting capacity building and pursuing certification or alternative marketing schemes are insufficient in themselves; NTFPs need to be duly recognized and monitored by the government like any other commodity, and their use rights need to be improved. Research organizations must

support more research to understand the ecology, reproductive capacity over time, and sustainable management of NTFPs. Moreover, consumer awareness needs to be raised and innovative partnerships sought with the business sector looking, for instance, at effective public-private partnerships and corporate social responsibility.

5. Conclusions and Policy Implications

The challenge of managing forests with commercial NTFPs lies in promoting economic development by maintaining and even increasing production while simultaneously maintaining or improving ecological conditions [2,13]. The discussion on forest management, therefore, encompasses a wide range of social, economic, political, and ecological issues. It is clear that both market failure and government failure can lead to unsustainable mushroom extraction. The issues that we need to address are how to manage the market and formulate good policies. Drawing on three cases of wild edible mushroom extraction, this paper has presented a critical review of the serious gaps in market strategies and policies regarding the commercial extraction of NTFPs.

To bridge these gaps and balance the role of the market and the government, several steps are required. The first is related to the issue of property rights, which is a crucial part of forest sustainability [32]. Rather than the government taking over NTFP management, a more decentralized mode of forest management that carefully considers the local context should be encouraged to ensure meaningful local decision-making power and provide secure property rights. This would encourage the farmers and give them a long-term incentive to harvest and manage NTFPs sustainably. Moreover, this decentralization would help to establish local institutions, such as collective action and community-based NTFP groups, for good resource governance. The second issue is clarification of the role of the government. It is important to eliminate government control from the market to allow the market mechanism to adjust the market. Instead, the government needs to play a critical role in monitoring the market. The third issue is the need for more government investment or reinvestment from taxation to improve the market structure in terms of information flow, ways of adding value and so forth: The fourth is to improve market efficiency and benefit-sharing, which requires government investment to enhance market transparency and strengthen the function of the middlemen rather than eliminating them. Finally, capacity building and steps to certify NTFPs are needed. In sum, political and economic decentralization would provide a platform for sustainable NTFP management. The government's role in monitoring and investment is crucial in order to balance development with conservation.

Acknowledgments

This study is financially supported by the MISEREOR grant (335-031-1015Z) Facilitating Community Driven Sustainable Development, and by the CGIAR Research Program 6 on Forests, Trees and Agroforestry. We acknowledge the insightful comments of four anonymous reviewers and particularly thank Sally Sutton for the English editing and Huafang Chen for mapping.

Author Contributions

Jun He, Min Dong and Marco Stark jointly initiated the project and structured the paper. Jun He and Min Dong analyzed the data and led the writing. Marco Stark helped with the certification section. All authors read and approved the final manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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