CHAPTER 34

PROSPECTS AND PROBLEMS IN COMMERCIALIZATION OF SMALL-SCALE MUSHROOM PRODUCTION IN SOUTH AND SOUTHEAST ASIA

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1. INTRODUCTION

Mushroom production can be a lucrative cottage industry for low-income rural households in developing countries (Lelley, 1988). The activity is labor-intensive, and can provide full- or part-time employment. A small mushroom production business can be established with low capital investment and with minimal requirements for space and equipment. As with any business, availability of inputs (for mushrooms, agricultural wastes/by-products such as straw and manure) and access to markets are essential. In addition, training and a source of spawn are necessary.

The mushroom market has grown rapidly in recent years. In the United States, fresh mushroom production more than quadrupled in 15 years, from 1975-90; total annual production was 743 million pounds (337,727 Mt) in 1991-92; 68% was for the fresh market, and 32% was processed (USDA, 1992). Imports of canned mushrooms was 53,338 Mt in 1989, accounting for about 40% of all processed mushrooms sold. Although button mushrooms (*Agaricus bisporus*) accounted for 99% of U.S. commercial production, specialty mushrooms (shiitake, oyster and others) accounted for about 5% of dollar sales (McClure, 1990). The average price received by *Agaricus* growers was 87.7 cents per pound in 1991-92, whereas the average price for the specialty mushrooms was US$3.87.

In spite of its growth, the U.S. *Agaricus* mushroom industry is highly competitive, and works on slim and declining margins of profit. In the 1980s, two-thirds of the mushroom growers in Pennsylvania, which accounts for 48% of total U.S. production, went out of business. The labor-

[1] Appropriate Technology International (ATI) is a not-for-profit development assistance organization, headquartered in Washington, D.C., with projects in Asia, Africa, Latin America, and the Caribbean. ATI works with, and on behalf of, small farmers and entrepreneurs in developing countries to boost productivity and income, foster new enterprises, and generate economic growth. ATI's portfolio of projects in Asia includes the application of biotechnologies, such as biofertilizers, biopesticides, plant tissue culture, and mushroom production, for small farmer benefit.

intensive nature of the business has resulted in the increasing use of low-paid Mexican workers; the poor working conditions have been the cause of recent labor strikes which threaten to drive up production costs, and owners are increasingly worried about foreign competition (Hinds, 1993).

Mushroom production represents an important opportunity for developing countries, particularly in Asia. In 1990, world production of edible mushrooms was estimated at 3.8 million tons, with *Agaricus* spp. accounting for 38% (Chang & Miles, 1991). Between 1986 and 1989/90, the worldwide annual increase in all mushroom production exceeded 24%. The most spectacular increases in production have occurred for the specialty mushrooms. For example, the oyster mushroom (*Pleurotus* spp.), which is more readily grown in tropical climates, had an increase in production of 438% over the three year period. China had a 289% increase in overall mushroom production from 1980 to 1986; export earnings for 1986 were $160 million (Chang & Miles, 1989). Tourism can be a major factor in stimulating the development of local markets, such as in Nepal.

Innovations in cultivation and post-harvest processing also make possible new opportunities. For example, growers can use low value agricultural residues instead of hardwood logs for cultivating shiitake (Worrall & Yang, 1992), and fastidious species usually collected from the wild, such as morels or truffles, can now be cultivated, or semi-cultivated in association with trees. New process technologies such as vacuum-drying can be used to prepare a high quality export product.

Non-governmental organizations (NGOs) and development assistance can facilitate the introduction of technologies for mushroom production.

2. THE ROLE OF DEVELOPMENT ASSISTANCE ORGANIZATIONS

In addition to fixed and working capital requirements, a mushroom production facility, and indeed any business, will require other kinds of support, principally in the areas of:

1) Reliable source of inputs/raw materials (for mushroom production, spawn and agricultural wastes);
2) Technical assistance and training;
3) Business skills, including entrepreneurship, administration, and marketing capability;
4) Access to and analysis of markets.

Indeed, it is likely that the most serious obstacles to business success will arise from these areas, and it is particularly here that assistance may be of the most benefit. These areas should ideally be analyzed and presented in a business plan prior to investment, since they contribute so much to the success or failure of a venture. However, access to the information necessary for adequate analysis is often not readily available.

In the case of very small (single owner/operator) facilities, which might be desirable for mushroom production in a developing country, the producers can meet some of the requirements for success through informal cooperative efforts or by formal cooperatives, which combine their skills, and by linkages to public institutions such as universities and/or agricultural institutes for technical assistance and spawn.

Both information and low-cost capital are in very limited supply in the rural areas of most developing countries. In summary, a development assistance organization can play a catalytic role in small business development in a variety of ways:

- Providing expertise to help develop a business plan;
- Improving access to investment capital, either through grants, loans, or venture capital;

- Fostering linkages to technical expertise in universities and research institutions, both in-country and internationally;
- Supporting technical training programs;
- Stimulating and improving business skills and entrepreneurship through several avenues, such as training, guidance, monitoring and evaluation;
- Assisting with market analysis.

3. MUSHROOM PROJECT ACTIVITIES IN THE PHILIPPINES

In 1984, ATI developed an experimental program with the Ayala Foundation, Inc. (AFI, and formerly, the Filipinas Foundation, Inc.). Equity investment financing for seed capital, and technical assistance and training costs, were provided for the establishment of five small-scale commercial enterprises. Two of enterprises established under the program were for mushroom production. The purposes of the program were to test a rural small-scale industries strategy aimed at creating jobs and increasing incomes for poor people, by (1) helping set up new manufacturing enterprises that employed innovative appropriate technologies and could eventually be replicated, and (2) developing a new financing mode using a venture capital mechanism. This program and an early case study on the Antipolo project (discussed below) have been discussed by Cuano (1990).

The equity partner, either a local entrepreneur or a community group, was required to invest a minimum of 30% of the required capital, either in cash or in kind; AFI's equity investment share could be up to 70%. A business plan was developed for each venture, including market assessments. Enterprises selected for investment were expected to have a positive cash flow within one year of start-up, and an average internal rate of return of at least 15%. The venture capital company under the auspices of AFI would exit from a project after 5 years, recouping its investment and share of the returns for re-investment in other enterprises.

The two mushroom projects were developed at different times near the cities of Antipolo and Cebu. Both were to involve a medium-scale mushroom enterprise that produced spawn, and small-scale contract outgrowers recruited from local low-income families, who would be provided with training and hardware, and given a guaranteed price for mushrooms produced. The outgrowers would be given an option to buy shares in the company. This linkage was seen as the key to the sustainability and socio-economic benefits of the enterprise after completion of the projects.

3.1. Antipolo

The first mushroom business established was Valley High Products, Inc. (VHPI), located near Antipolo, Rizal, about 30 to 40 km from Metro Manila. The site was selected because it was close to market outlets (Manila, which represented 80% of the total Philippine market), and because the average temperature (25°C) and humidity conditions (70-90%) were judged to be conducive to growing the selected mushroom varieties. Also, the joint venture partner was a local landowner/ entrepreneur, whose contribution to the equity consisted of land, a growing house and some equipment, and labor (as Manager of VHPI). Total venture capital needed was estimated to be a maximum of US$60,300, recoverable in 3.1 years. VHPI began operations in January of 1986.

The business intended to produce *Auricularia* spp. spawn and mushrooms (dried), and then expand to fresh abalone and oyster mushrooms, and possibly button and shiitake mushrooms. The substrate would be composed principally of composted sawdust, rice bran, sugar, and lime. The

technology had been pilot-tested for two years by the AFI's Science and Technology Research Center, and used successfully by other mushroom growers. Actual biological efficiency or yield for the proposed varieties ranged from 40-75% in pilot test studies. For cost-benefit estimates of profitability, 40% was used (estimates for a worst-case biological efficiency of 25% indicated that income would be reduced by 53% and return on equity would decrease from 21.8% to 13.1%).

The market share aim of the enterprise was 14.7% of the total market for these mushrooms; most of the dried *Auricularia* currently available in the market was imported from China and Hong Kong. Market analysis estimated the demand for *Auricularia*, on a fresh weight basis, at 30,200 kg/month (over 80% by restaurants), and for abalone, at 15,500 kg/month. Market growth was estimated at 10-20%/yr. Oyster mushrooms were not yet commercially available; however, limited test marketing was done, which found high consumer acceptance.

The start-up goal was to produce 20,000 spawn bags and 6,000 kg of mushrooms per month (50% *Auricularia*) by the end of the first year, through in-house production (16 workers plus management staff) and outgrower contracts (20). The plan called for in-house production of 50% and 25% in years 1 and 2, respectively; in year 3, 100% of production would be by the 20 contract growers.

After the first quarter of operation, only oyster mushrooms were being produced. However, financial break-even was achieved after 8 months, and the project financial statements showed a loss of only US$142 for the first year of operation. At the end of the first year, monthly production was approximately 9,000 spawn bags and 4,000 kg of oyster mushrooms. The mushrooms were packaged for the market in styrofoam with a clear plastic cover. Since the average biological efficiency achieved was only about 20%, technical corrections were introduced.

In the fifth and sixth quarters, technical problems, attributed to the use of sawdust that had been chemically treated, caused financial losses. After 18 months of operation, no contract growers had as yet been recruited, but negotiations were ongoing. By the end of the second year, however, production levels varied monthly but were still about the same as at the end of the first year. There were now 4 growers who purchased spawn bags.

The project began to incur losses in the third year, as competitors entered the market. Profitability was lower because of a 20% reduction in the market price of fresh oyster mushrooms (although market volume demand appeared to increase). Staff turnover and a prolonged illness of the Manager created problems. In addition, a typhoon destroyed two of the nine growing houses in the second half of 1988. In March 1990, after just over 4 years of operation, a decision was made by AFI to close the venture for the following reasons:

1) The biological efficiency did not improve. It was concluded that the altitude was too high and the climate was not conducive to oyster mushroom production;
2) The enterprise continued to be a financial drain. A total of US$42,100 had by now been invested;
3) The social objectives were not being achieved. This was partly due to the resistance of the venture capital partner to having contract growers, who were perceived as a threat to profitability.

3.2. Cebu

The second mushroom business, Cebu Farmers Agri-Venture Corporation (CFAVC), started commercial operations in April 1991. It is located about 12 km from Cebu City, and employs 13 people. CFAVC produces *Volvariella* spawn and mushrooms, which are suitable to the local climate. The straw mushroom substrate is simple, consisting of outdoor raised beds of dried banana leaves and dirt, designed to encourage more easier involvement of contract growers.

The equity partner (30%) is a local NGO which shares the same social objectives as ATI and AFI, and can monitor day-to-day operations. The initial capital stock was set at US$50,000 (in cash and kind). In the business plan, the target was to recruit and train 200 contract growers. In-house growing was intended to serve as a model production area, and contribute about 10% to total production. In addition, the plan called for the outgrowers to hold 80% of the equity in five years time.

A market study in 1987 indicated good potential. There was strong demand locally for straw mushrooms, projected to be 3000 kg per month, while supply was only about 15 kg/day. Technical problems with spawn production by an existing grower appeared to be a significant obstacle to increased availability. The business plan indicated that at the then current price of P80/kg, the venture would become viable by the second year at a production level of 1300 kg/month, assuming a median biological efficiency of 15% (10-20% range).

Production performance in 1991 was unimpressive. A typhoon that struck the Philippines had greatly reduced the available supply of banana leaves for the beds for a period of about nine months. Preventing contamination of spawn by bacteria and other fungi was also a problem. Also, the project manager failed to use the substrate recipe from AFI, and instead used one recommended by the local Department of Agriculture office, which was less productive. In late 1991, the project manager was replaced, and new spawn introduced. In-house production for early 1992 (Feb.-Apr.) increased to an average of about 235 kg/month, with an acceptable biological efficiency of 10-20% (given the simple, outdoor beds). However, drought and heat in late April 1992 contributed to a subsequent production failure in May.

By May 1992, only 10 outgrowers had been contracted, and they were producing about 28 kg/month. Mushrooms are a non-traditional crop, and local farmers were reluctant to grow them because of unfamiliarity with the product and the technology. Some initial failures in production increased this reluctance. Consequently, additional land was leased for production by CFAVC to sustain the project.

Increased monitoring and a technician were provided in mid-1992 by AFI to further rehabilitate the project technically and socially. A mid-1992 evaluation pointed out particular problems to be addressed: strain selection and maintenance, improving spawn production technology, disease management, improving yield, increasing the number of contract growers, expansion (labor and equipment), and improved packaging, marketing and delivery. The evaluation also recommended that, if expansion occurred, indoor cultivation be implemented (as suggested by the original plan) and equipment improved; otherwise, for a low-cost venture, production should be restricted to 1500 kg/month and 10-20 outgrowers at a single site, and that more sites in different areas be developed. As of June 1992, approximately $30,000 of the initial capital allocation had been spent. Changes were made to introduce corrective measures, and the project is ongoing as of June 1993; a new evaluation is presently underway.

3.3. Lessons Learned

The business plans and marketing assessments which preceded the projects were important both in the selection of projects and as guidelines to measure success. It is also clear that the Cebu project is attempting to remedy some of the problems uncovered by the Antipolo project experience. Nonetheless, project problems in both cases were related to both quantifiable and non-quantifiable factors, to which more attention should be paid. Perhaps most importantly, the complexity of the projects was underestimated, since so many new and interrelated variables were introduced: in

technology, financing mechanisms, management structure, and social impact.

The mushroom technologies involving spawn production, while having been proven under controlled laboratory conditions and in a very few small-scale commercial activities, are by no means simple. They require a significant amount of technical expertise, e.g., training in sterile technique, and familiarity with mushroom growing conditions, such as substrate mixes, climate, and disease control. These problems plagued both of the projects. At Antipolo, there was no practical evidence that the choice of location would provide good growing conditions. Assumptions regarding production schedules were overly optimistic. It became clear that technical issues must not be underestimated in moving from demonstration and pilot projects to commercialization, and that linkage to a non-profit institution involved with mushroom research is important for troubleshooting technical problems.

The financing mechanism, venture capital, is experimental in the Philippines, and especially so at a small-scale level. Because there has been so little experience with it, a trial-and-error process is expected. For example, choices that prove unsatisfactory can easily be made in terms of project partners. In these particular cases, choosing a project partner with entrepreneurial/management skills, with a social conscience, and at the same time willing to take personal financial risk is a difficult task. Responsibilities, risks and benefits were also poorly defined and/or were difficult to communicate. A simpler supportive financing mechanism, such as low-interest loans, may be more effective, will be easier to understand, and may enlist more committment to the enterprise.

Management and monitoring problems affected both projects, and probably caused the demise of the Antipolo project. Technical problems were not addressed soon enough to be effective. Marketing skills were insufficient. The equity partners were somewhat removed from direct responsibility, benefit and hands-on daily management, and therefore did not have the motivation of a truly profit-motivated entrepreneur. Monitoring by AFI, particularly at Antipolo, was inadequate, and insufficient attention was given to acquainting all parties involved with the complexities of the project.

Finally, the projects were not purely business ventures, but had the principal objective of providing socio-economic benefits for poor people, primarily small farmers with little education. However, new, non-traditional technologies, requiring unfamiliar skills, were introduced to the intended beneficiaries. In similar case histories in development, technology dissemination generally proceeds at a slow pace, and rarely at the rate that the project designers intend. The Cebu project, while more successful than Antipolo, found it necessary to significantly scale back this objective. Community organizing skills were inadequate for the task at hand. Commercialization of a complex technology may be best achieved on a purely for-profit basis, which may better serve socio-economic objectives than a commercial venture with mixed objectives.

It is evident that more attention must be given to these complex factors in future project design, particularly when one of the goals of a program is to achieve replicability in a project.

4. ASSESSMENTS IN SOUTH ASIA

ATI conducted preliminary studies in 1992 to assess the potential for small-scale mushroom production in Nepal, Bangladesh, and India. The studies reported on the market overview, producers and exporters, types and value of mushrooms, processing requirements, and potential for small farm cultivation. Individuals from mushroom laboratories, Departments of Agriculture, growers and processors, and small farmers were interviewed, and numerous site visits were made. The study led

to suggestions for possible project designs. A brief summary is presented here.

The mushroom market study was conducted in order to assist the newly formed Asia Network for Small-Scale Agricultural Biotechnologies (ANSAB), headquartered in Kathmandu, in identifying projects for technology dissemination and commercialization. Experts from nine countries had begun to assess this and other biotechnologies for potential commercialization for the benefit of small farmers during the inaugural ANSAB workshop held in the spring of 1992 (Ferchak & Ribeiro, 1992).

4.1. Nepal

In Nepal, there are numerous microclimates that are quite suited to mushroom cultivation. In the last few years, several hundred small farmers in the Kathmandu Valley (where 90% of production is presently located) produce button mushrooms in small quantities during the cool season and oyster mushrooms during the warm season for the local fresh market, primarily the international hotels. Production of these varieties in Nepal was estimated at 80-100 Mt in 1991. Imports are estimated at 250 Mt, principally canned button mushrooms from China, but also some dried mushrooms from India.

Mushroom activity first began in Nepal at the Entomology Division of the National Agricultural Research Council in 1975. Mushroom spawn is now produced at the Central Plant Pathology Division, which makes it available at subsidized prices to small farmers (Dongol, 1991). However, facilities are inadequate and the spawn is of variable quality. About 8,000 bottles of spawn are sold (70% *Agaricus*); however, the potential demand is estimated to be 50,000 bottles. Distribution of spawn outside the valley remains a difficulty. Yields are also low due to the lack of sterile substrate and poor technique used by the farmers. Paddy straw is in high demand for uses such as thatching, and therefore inferior wheat straw is used for substrate. There are no mushroom processing facilities. Marketing is not organized, and packaging is neglected, which reduces the farmers' market availability, penetration and selling price. No promotion of the product takes place. At least one private commercial venture, which produced its own spawn, is known to have failed; however, new ventures are under consideration.

The climate of the Kathmandu valley is too cold for straw mushrooms. Shiitake has the disadvantage of requiring wood or sawdust, which is in short supply. The cultivation of *Pholiota* is at a research stage. High value mushrooms, particularly morels, are picked in the wild by rural peoples for sale.

The favorable climate in Nepal, coupled with low labor cost and substrate availability, are suitable to expanded mushroom cultivation and export. Small-scale farmers can be assisted in forming cooperatives to develop a quality product in higher quantities, through improved methods of cultivation. A commercial spawn production center is necessary, linked to a strengthened government research institution. A processing facility can be encouraged to develop the mushroom export market.

4.2. Bangladesh

In Bangladesh, initial work began at the Mushroom Culture Centre, Savar, in the mid-1970s to develop and supply spawn. However, commercial cultivation of mushrooms did not begin until 1987. The Mushroom Centre has developed cultivation methods for straw, oyster, and Jew's Ear (*Auricularia)* mushrooms, and has begun to produce spawn for small-scale growers.

Mushrooms are now principally imported, and are primarily consumed at the international

hotels. However, local people have started to produce and use mushrooms in their diet. This start has prepared the way for expanding mushroom growing activities in other regions and potentially for export. A recent economic study on straw mushroom cultivation in Saturia, Manikganj, found that all the mushroom growers were women, who began cultivation as a supplementary work activity for added income (Raquib, 1991).

At present, production of mushrooms and availability of spawn is highly localized. Availability of spawn should be expanded to reach a wider range of growers. Growers need training and assistance in production techniques, and in developing cooperatives and markets.

4.3. India

The mushroom industry in India has grown slowly since its beginning in the 1960s; total production was estimated at 6,000 tons for 1991. Reasons for this slow growth were such factors as traditional fears of mushrooms because of poisonous species, and avoidance by Brahmin classes; lack of government support for extension; lack of quality spawn and substrate; and lack of capital, expertise, and access to foreign markets for entrepreneurs. However, a new National Centre for Mushroom Research and Training was establishing in 1986, and a Mushroom Society of India was formed in 1991. These new developments will encourage mushroom cultivation in India.

5. SUMMARY

Commercialization of new developments in mushroom production and processing requires links between agricultural research and the farmer. Production of high-quality mushrooms needs the support of a well maintained, publicly financed laboratory for the collection, preservation, maintenance, and breeding of varieties, for research into low-cost production techniques, and for support of agricultural extension work. One approach to cultivation is by small farmers in association with a spawn production center, cooperatively owned or in a university laboratory; this system is being applied in Nepal and India. Production is labor-intensive and land conserving, utilizes agricultural wastes, and is suitable for small-scale enterprise. A farmers' cooperative can be linked to international markets.

Some obstacles to increased commercialization of mushrooms by small-scale farmers include lack of access to quality spawn, poor information distribution and lack of training programs, and low productivity due to unsterilized growth substrates. Local markets are frequently limited due to high prices and consumer unfamiliarity or prejudice. Often, small-scale farmers are in the situation of having to sell at low prices to a single canner/wholesaler. Other difficulties include lack of support from government for research, need for national and regional laboratories, shortage of technical expertise, and a lack of regional conferences and cooperative activities (Chang & Miles, 1991).

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