



Georgia Specialty Mushroom Feasibility Study

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Portabello Mushrooms

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Most sincerely,

Douglas C. Bachtel

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Photos courtesy of: David Porter, UGA and The Growing Company (center photo on cover).





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Executive Summary

This report examines the economic issues surrounding the development of a specialty mushroom based industry in Georgia. A mushroom based industry would not only increase job opportunities in rural areas, but consumption of the product would also improve the diet and health of its citizens. The goal of the study is to make recommendations for creating a statewide network of specialty mushroom researchers, spawn makers, growers, and distributors to stimulate mushroom production.

Nationally, the 1999-2000 value of domestic mushroom sales totaled \$867 million, which places mushrooms as the fourth largest vegetable crop in the nation following potatoes, tomatoes, and lettuce. The mushroom industry is a truly international, extremely diverse, and culturally driven market. The National Agricultural Statistics Service mushroom report indicates an increase in sales of approximately 50% during the 1998-1999 season alone. The common button mushroom, which is grown principally in Pennsylvania, currently represents a \$351 million dollar commodity, and a \$3.5 billion support industry in that state.

Specialty mushrooms differ significantly from common button mushrooms (*Agaricus bisporus*) in appearance and in the medium in which they are grown. The U.S. imported approximately 1.1 million pounds of non-*Agaricus* mushrooms per month in 2000. This equates to nearly 50% of all non-*Agaricus* consumed in the U.S. Almost all (94 percent) were imported from either Canada or China. It is believed that most specialty mushrooms imported from Canada are actually repackaged Chinese mushrooms. While American farmers can compete with the Chinese, it will require adoption of more sophisticated and well-organized practices to raise specialty mushrooms to a commodity crop level. The research and start-up costs of such domestic operations are expensive.

The results of this study indicate that the development of a specialty mushroom industry in Georgia has significant economic potential, particularly in rural Georgia. Due to the broad-based appeal of specialty mushrooms and the steadily increasing demand for them, this crop presents an opportunity to provide Georgia farmers with a product that will be immune from the boom or bust cycle which has

characterized American agriculture since the 1950s. Escaping this perpetual dilemma, however, will require a comprehensive public-private partnership that incorporates the research capabilities of The University of Georgia, the legal authority of the Georgia Department of Agriculture, the educational/training capabilities and facilities of post secondary institutions, and the willingness of entrepreneurs to invest in mushroom production facilities.

A variety of demographic and technological trends have occurred that have a potential impact on the continued growth of mushroom consumption in the U.S. and particularly in Georgia. They include: a large and growing population, an expanding minority population, an increase in the number of two working adult families, delayed marriage, and aging baby boomers. In addition, there has been an increased interest in home entertainment and cooking as recreation, as well as more health conscious consumers demanding organic food products. Finally, the ability to market, sell and distribute specialty food items via the Internet is now commonplace.

Further, the positive economic impact of a mushroom industry could be increased if the value added aspects of such an industry were maximized. This includes the use of agricultural by-products from the spent substrate, or mushroom growing medium, development of firms that use mushrooms in products such as meals ready-to-eat (heat and serve), e-commerce, tourism and festivals, and use of mushrooms in the pharmaceutical industry. These endeavors will further assist with the creation of much needed additional job opportunities in rural Georgia. Factors associated with the success of this industry are clearly present in Georgia. They include a large, growing, and diverse population that has familiarity with specialty mushrooms, and available land, water, and other natural resources such as forestry and agricultural by-products necessary for substrate and mushroom production. Georgia's location on the eastern seaboard also means close proximity to other large population centers and potentially lucrative markets due to reduced transportation costs. The cultivation of specialty mushrooms has the potential to produce a commercially successful crop, create jobs, and assist with the process of turning waste products into profitable agriculture for the state of Georgia.





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This report examines the economic issues surrounding the development of a specialty mushroom based industry in Georgia. The University of Georgia's Housing and Demographics Research Center received funding from the state legislature to determine the feasibility of developing such an industry in Georgia. A mushroom based industry would not only increase job opportunities in both rural and urban areas, but consumption of the product would also improve the diet and health of its citizens. The study, which was begun in July of 2001, took approximately one year to complete.

The goal of the study is to make recommendations for creating a statewide network of specialty mushroom researchers, growers, distributors, and spawn makers to stimulate mushroom production. The economic feasibility of developing a mushroom based industry in Georgia is dependent on a variety of factors. These include: the creation of a commodity commission, marketing, consumer education, developing value added products, improved packaging, and alternative medical and industrial uses. The study investigates the strengths, weaknesses, opportunities, and potential threats for such an industry to succeed. A profile of resources and constraints is developed, as well as an analysis of external influences on the proposed mushroom industry. The investigation relied heavily on input from farmers, distributors, and consumers to help understand the market characteristics. (See Appendix A for a more detailed presentation of the study.)

Importance of Agriculture in Georgia

Georgia has a rich agricultural heritage. Historically, the state's agricultural emphasis has evolved from rice, indigo, cotton, tobacco, corn, peaches, pine trees, poultry, and horticultural products to vegetables. Currently, vegetables rank first with regard to crops in cash receipts and second only to poultry (Georgia Agricultural Facts, 2001). Despite the importance of manufacturing and the growth of service related industries, agriculture remains a significant contributor to the state's economy. According to the U.S. Bureau of Economic Analysis, the value of production agri-

culture in Georgia in 1999 was \$3.6 billion dollars. When most people think about farming, however, they only think about food, yet agriculture encompasses a vast array of industries, issues, and concerns that go far beyond food production. For example, agribusiness, which encompasses the distribution, processing, and marketing of food and fiber as well as the manufacturing of farming and agricultural related equipment, is one of Georgia's largest industries (Doherty & McKissick, 2000).

Georgia's specialty mushroom industry is in its infancy. Since the market for this product is so large with significant growth potential, the window of opportunity for development will not remain open for long. Out-of-state entrepreneurs, primarily from Pennsylvania, are already successfully entering the Georgia market. As is the case with many new types of developments, current efforts are fragmented, and in this type of environment spheres of influence and expertise tend to be isolated. Therefore, a comprehensive approach that incorporates the numerous disparate interests and agendas must be undertaken to focus state-wide efforts in a unified direction. In addition, public and private decision makers will need to be cognizant of the infrastructure improvements and investments required to support a mushroom industry and the new value-added developmental activities which may arise from the creation of this new enterprise.

The combination of over production and low commodity prices in virtually every major agronomic crop grown in Georgia are among the primary factors which make the introduction of a new agricultural commodity extremely advantageous. In addition, drought, changing consumer preferences, and urban sprawl are forcing many farmers to identify alternative enterprises that will create profits and reduce risk (Ferland, McKissick, Reynolds, & Estes, 2001).

Until the Civil War, Southerners had little to no experience eating mushrooms. However, as food supplies ran low, Southern troops foraged for and ate wild mushrooms (Haygood, 1987). Mushrooms may once again have a chance to play a role in Southern survival, not only by providing essential nourishment, but through the creation of economic opportunities in rural Georgia. The specialty mushroom industry has the potential to be immune from the boom or bust agricultural cycle that has been pervasive throughout the rural South since the 1950s because cyclic economic contractions do not appear to affect the domestic consumption of mushrooms.¹





An Overview of the Commercial Mushroom Market

The mushroom industry is an international, extremely diverse, and culturally driven market. Worldwide, mushrooms are a significant agricultural commodity. In 2001, world mushroom production was approximately 5.5 billion pounds (FAO, 2001). Together, China and the U.S. produce nearly 50% of all mushrooms. In 2001, nearly 860 million pounds of mushrooms were sold in the U.S. with the value of sales totaling \$863 million (NASS, 2001). Mushrooms are the fourth largest vegetable crop in the U.S. following potatoes, tomatoes, and lettuce (USDA, July 2001). The common white button mushroom (*Agaricus bisporus*) which is grown principally in Pennsylvania, currently represents a \$351 million commodity, and a \$3.5 billion support industry in that state (PSU, 2001).

A viable mushroom market exists beyond the white button mushroom crop. "Specialty mushrooms" is the term used for all other commercial edible mushrooms. These include Portobellos, Shiitake, Oyster mushrooms and many others. Specialty mushrooms represent an array of species with diverse flavors, textures, and colors that have a documented food and medicinal value.

According to the 2001 National Agricultural Statistics Service Mushroom Report, 111 million pounds of specialty mushrooms were sold in the U.S. in 2000-2001 with a value \$157 million. Specialty mushrooms, therefore, represented approximately 13 percent of the quantity of all mushrooms sold in the U.S. and nearly 20 percent of the total value. See Appendix B for a list of commercial mushroom production Internet sites for more information regarding specialty mushrooms. In addition to Portobellos, Shiitake, and Oyster mushrooms it is recommended that Snow Crab, Enoki, Velvet Ear, and Frondosa mushrooms be included as potential crops for a Georgia specialty mushroom initiative. Appendix C lists information about these and several other different types of specialty mushrooms.

Many specialty mushrooms (for example Shiitake and Oyster) grow on wood waste material (hardwood sawdust or wood chips) supplemented with grains or bran, but other cellulosic substrates may also be used. Agricultural wastes including peanut shells, cereal straw, cotton seed hulls, as well grains and waste paper can be recycled to grow specialty mushrooms. The leading cellulose decom-

posing mushroom sold today is Shiitake or Oak Mushroom.

The global demand for fresh mushrooms should not be viewed as simply a fad. Specialty mushrooms can provide reliable profits to farmers, and are rapidly evolving into a commodity market. International mushroom symposiums have been convened to encourage farmers to increase production to assist with escalating consumer requests (AMI, May, 2001). The American mushroom industry is currently being consolidated and vertically integrated. This includes the common button mushroom industry, as well as the specialty mushroom industry. There still remains, however, considerable room for the development of a domestic, specialty mushroom industry, particularly in Georgia, but the window of opportunity will not last forever. The double digit annual increase in sales of fresh specialty mushrooms is clearly an attraction that has not gone unnoticed. There is also a tremendous opportunity in the value added arena. This will make specialty mushrooms available to an even larger, diverse customer base. Increased consumer demand also has the potential to create additional support industries.

Portabello mushrooms afford a particularly good opportunity for Georgia because of their consumer popularity. Among all mushrooms, Portobellos have the fastest growing sales. Portobellos and Crimini (baby Portobellos) are considered specialty mushrooms, but are actually just a brown variety of the white button mushroom. Portobellos are grown on composted manure and thus, in addition to their high sales potential, could create a significant value-added industry as a recycler of unwanted animal waste material like chicken litter. Recent research has suggested that Portobellos might be cultivated on a sawdust-based medium (Sanchez & Royse, 2001). These and other exciting production and marketing options for Portabello mushrooms point to the need for a Portabello-specific feasibility study.

Specialty Mushroom Imports

The quantity and value of specialty mushroom imports has only recently been recorded. Prior to January 2000 there was no distinction made between specialty and non-specialty mushrooms entering the U.S. The American Mushroom Institute (AMI) successfully petitioned the International Trade Commission to assign a separate tariff





number to fresh specialty mushrooms² due to the numerous specialty mushroom growers, almost exclusively Shiitake, complaining that their markets were inundated by low priced imports. From January - October, 2000 the U.S. imported approximately 1.1 million pounds of specialty mushrooms per month (AMI, Feb. 2001). About 78 percent were imported from Canada and 15 percent from China. It is believed, however, that most specialty mushrooms imported from Canada are actually repackaged Chinese (Shiitake) mushrooms.

The quality of imported mushrooms from China is often extremely poor, and the methods of preservation may be suspect to U.S. safety regulations. Nevertheless, the large volume of imported specialty mushrooms clearly indicates the potential to create a viable domestic specialty mushroom market. This effort, however, will require a well developed and coordinated public and private sector market strategy. Elements of this activity include crop improvement programs, spawn production, growing medium research, grower training programs, increased mechanization, innovative use of technology, and consumer education.

The lack of coordinated activity has meant that American mushroom farmers have not been able to consistently meet the demand for specialty mushrooms. When U.S. supply displacements occur, Chinese grown mushrooms are imported more aggressively. Chinese grown mushrooms, however, emit a pungent smell and have a reduced shelf life. The problems associated with Chinese grown mushrooms have the potential to dissuade consumers from buying specialty mushrooms because they associate them with "poor quality". This, in turn, hurts the market by eroding consumer confidence.

Recently, the Canadian Food Inspection Agency issued a warning to individuals with a sensitivity to sulphites to avoid consuming fresh Shiitake mushrooms distributed by a farm in British Columbia and from China (August, 2001). In addition, the European Union received an alert from French authorities with respect to Shiitake mushrooms imported from China which contain formaldehyde (RSSL-food e-news, 2001, July 11-18). Sulphites and formaldehyde are used to prolong the "shelf life" of mushrooms that

are imported from China by ship to both the United States and Europe. The absence of chemicals in mushrooms grown by domestic U.S. specialty mushroom producers would give them a competitive edge over Chinese producers.

Chinese farm workers currently work for approximately \$1.00 U.S. per day (AMI, May, 2001). Thus even with significant import expenses, Chinese producers are able to sell specialty mushrooms at a lower price than American

farmers. To compete, American farmers must adopt more sophisticated and well-organized practices that raise specialty mushrooms to a commodity crop level. The research and start-up costs of such domestic operations are expensive, have been slow to germinate, and will need well developed leadership as well as public and private cooperation to progress further.



Portabello Mushrooms

Trends Influencing the Specialty Mushroom Industry

Demographic Trends

Georgia's growing and diverse population is an important factor in the success of a new specialty mushroom industry. With slightly over 8 million residents, Georgia has the 10th largest population of any state in the nation. During the 1990s, Georgia was the 6th fastest growing state in the nation on a percentage basis, and the 4th fastest growing state on a numeric basis. The Atlanta Metropolitan Area is the second fastest growing metro area in the nation (U.S. Census, 2000). Approximately sixty percent of Georgia's population growth during the 1990s was due to migration. While most new residents relocated from other U.S. states, over 100,000 of these new residents were immigrants (U.S. Census, 2000). Both domestic and international migrants are attracted to Georgia due to jobs created by a well diversified economy.

The U.S. Census Bureau reported that in 2000 there were 2.25 million African Americans in the state giving Georgia the 5th largest number and 4th highest percentage of African Americans of any state in the nation. Officially,





Hispanics represent 5.3 percent of the population and number 435,227. Unofficially, the figure is closer to 10 percent or slightly over a million. Asians account for 2.1 percent and number 173,170. People from India represent the largest number of Asians. As Georgia's minority populations and cultural diversity continue to expand, new market opportunities will emerge for local farmers, and one of these opportunities is the establishment of a consistent supply of quality, specialty mushrooms. Targeted marketing can be used to take advantage of these growing populations and their culinary appeal of many varieties of mushrooms. For example, Hispanic meals often include mushrooms (Guzman 1989; Uhl, 2001). In addition, Hispanic buying power has risen 250.6% from 1990 to 2001. (Humphreys, 2000). Therefore, an opportunity exists to take advantage of niche marketing to sell products to this increasingly diverse population with unique tastes and needs.

Other Demographic Trends

The growth of two working adult families (due in part to delayed marriage, and aging baby boomers) is a demographic trend with direct implications for increased mushroom consumption as well as the development of value added mushroom products. The increasing demand for home-meal replacement (pre-packaged, ready-to-serve) foods, especially in the vegetable category, has changed the product mix sold in grocery stores (Freeman, Lahiry, Mundt, Rogg, & Sakura, 2000). Prepackaged produce is growing exponentially and represents about one-third of all produce in supermarkets. Few categories have grown as fast as bagged salads in the past few years (Freeman et al, 2000). Other home meal replacement items that have experienced a sharp increase in demand are microwavable products, boiling pouches, and pre-marinated meats (Litwak, 1998). Thus, an excellent opportunity exists for suppliers to develop partnerships with retailers to create and market new items containing specialty mushrooms. The challenge, however, is for firms to absorb expensive research, development, and quality assurance costs, as well as the high costs associated with re-equipping facilities with the latest technologies to facilitate these new product demands.

Additional Trends Influencing Mushroom Consumption

Kitchens are much larger today than in the past. They have become the focal point of many homes and often are the center for family activity and entertainment (Klemenc, 2001). The increased popularity of cooking shows on television is also evidence of the trend toward kitchens as entertainment centers and cooking as recreation. The popularity of cooking has even produced a cable TV channel "The Food Channel" dedicated solely to cooking. "Great Chefs of the World" is a popular TV cooking show with many imitations. The development of a specialty mushroom based industry in Georgia neatly fits into these trends not only due to the popularity of mushrooms in gourmet recipes, but in everyday recipes as well (Epicurious, Gourmet magazine, 2002).

Organic Food

The growth of organic-type food products is rapidly evolving as consumers become more health conscious. The aging population significantly contributes to this trend as producers are becoming increasingly aware of the profits being generated in this lucrative market (Chernoff, 1995; Libbon, 2000). The consumption of fresh fruits and vegetables is expected to continue increasing in part due to national public awareness campaigns such as the National Cancer Institute's "5 A Day" recommendation to eat at least five fruit and vegetable servings a day (Freeman et al., 2000). Another indicator of the growing acceptance and popularity of these products is the increased use of the terms "organic", "free-range", and "hormone-free" on menus, labeling, and advertisements. These terms are no longer exclusively associated with vegetarian menu items. A holistic health strategy is becoming an accepted and sought after marketing approach in consumers' everyday lives. In addition, increased awareness of pesticide use, bacterial contamination, and country of origin labeling has steadily grown (Smith, 1999).

Food Safety

The expansion and acceptance of the organic produce market is an indisputable trend; however, it points to an underlying threat to the mushroom industry. As consumers become more aware of the health benefits of produce, they also demand a greater emphasis on product safety. At the 2000 annual convention of the Produce Marketing Association, food safety ranked second behind industry consolidation as the most prominent issue facing the





industry. Citing the tremendous positive publicity that produce has sustained over recent years, industry insiders warn that consumers have "long memories" when they hear something about food not being safe. As such, the food industry is gradually beginning to conform to a "safety-first" mind set, where businesses reward handling practices through incentives and compensation (Smith, 1999). These industry trends create an opportunity for suppliers who can develop products that target consumers' increased health consciousness and create an identity for maintaining high levels of product quality.

Technological Trends

Technological innovations offer new opportunities in the mushroom industry. The Internet can assist by creating efficiencies in sales to businesses, including inventory management, purchasing processes, distribution, and sales. Innovative practices must accompany the development of the mushroom industry due to the competitive nature of the food industry. The Internet as a vehicle for the distribution for a variety of products including food is commonplace. Although consumers may currently be hesitant to purchase produce "sight unseen," it is likely that they may become more comfortable with buying specialty fresh produce online as online shopping continues over the next several years. For example, live lobsters can be ordered and purchased over the Internet (e.g., www.thelobster.net.com). Harry and David's Fruit of the Month Club represents another example of the distribution of a perishable product through the mail and the Internet. This company has approximately \$400 million dollars in annual sales (Horovitz, Dec.3, 1999).

In summary, a variety of demographic and technological trends have occurred that have a potential impact on the continued growth of mushroom consumption in the U.S. and particularly in Georgia. They include: a large and growing population, an expanding minority population, an increase in the number of two working couple families, delayed marriage, and aging baby boomers. In addition, there has been an increased interest in home entertainment and cooking as recreation, as well as an increased demand for organic food products. Finally, the ability to market, sell and distribute specialty food via the Internet is now commonplace and will likely expand in the future.

Materials and Resources Required for a Specialty Mushroom Industry in Georgia

Specialty mushroom production requires a combination of agricultural and forest products. It also requires a basic community infrastructure such as a steady source of electricity, natural gas/propane, water, access to transportation, communication networks, and educational training facilities. Human resources such as farm labor, as well as various types of equipment repair personnel, are also needed. The actual amount of these resources, of course, varies greatly with the size of the production facility.

Strengths, Weaknesses, Opportunities, & Threats (SWOT) Analysis of a Specialty Mushroom Industry in Georgia

No new product can accurately be assessed for its economic impact without first exploring the strengths, weaknesses, opportunities, and threats of the market (See Table 1). Georgia currently possesses numerous strengths for the successful development of a state-wide specialty mushroom industry. Most importantly, it has a well developed agricultural sector with a knowledgeable and committed technical support network. The presence of a large, growing, and diverse resident base is also an important factor in the market for fresh produce in general, and specialty mushrooms specifically. In addition, the necessary resources for a mushroom based industry are at least adequate and in most cases abundant in both rural and urban areas.

Since the proposed development is the creation of a new industry and not a transformation of an established operation, the existence of a specific mushroom based infrastructure is limited in the state. That is, with only a few mushrooms farms currently in operation the scale of current production is relatively small, along with weak marketing and distribution networking systems. The lack of product recognition, as well as a knowledgeable and loyal consumer base is a further shortcoming of this market not only in Georgia, but in all areas of the U.S.

The opportunities for this market to be successful in Georgia however, are extensive. Most importantly, the formation of appropriate public/private partnerships has pro-





Table 1
Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis

| | |
|---|---|
| <p>Strengths</p> <ul style="list-style-type: none"> Large land mass Large metropolitan population Atlanta is the 2nd fastest growing metro pop. in the U.S. Sizable sector of population with disposal income Strong existing produce market Substantial history with small grain farming Strong economic base Strong research resources (educational institutions) Well developed poultry and forestry industries Location: close to raw materials Excellent climate Excellent consultants and technical support Adequate supply of water Good agricultural engineering research facilities Strong interest of Georgians to buy Georgian grown Strong value added process facilities Excellent transportation routes and roads Excellent airfreight and seaport capacity State supported commitment to develop new agri-jobs Necessary mushroom production capabilities | <p>Weaknesses</p> <ul style="list-style-type: none"> Limited pre-existing specialty mushroom farms Limited mushroom marketing networks Limited economies of scale for mushroom production Limited economies of scale for spawn production Limited product recognition Limited familiarity for home use Limited brand name recognition No existing commodity commission Isolated distribution range in southeast |
| <p>Opportunities</p> <ul style="list-style-type: none"> Ability to develop a specific marketing strategy Potential private/state partnerships Large growth in organic market Prevalence of buying and decision autonomy Growing market for value added products Growing market for home replacement meals arena Growing market for fresh cut produce retailing Growth of e-commerce for retail direct distribution Growth of consumer direct distribution Current fragmentation of and expected consolidation of nutraceuticals market Growing pharmaceuticals market | <p>Threats</p> <ul style="list-style-type: none"> Prevalence of high slotting fees in retail Consolidation in produce retail Loyalties to existing distribution channels Moderate level of buying decisions and autonomy of chain grocers Large established out-of-state button mushroom producers beginning to enter the specialty mushroom Large established out-of-state producers in the produce retail industry Potential food borne illness that could cause mushroom scare |

duced beneficial results in the past, e.g., Vidalia Onions, and most recently, carrots. This demonstrates clear potential to create and develop the necessary marketing and production strategies. Further, the growth of markets complementary to both distributing and consuming specialty mushrooms cannot be understated. These include direct distribution, e-commerce, value added products, home replacement meals, organic produce, as well as the nutraceuticals and pharmaceuticals markets.

The main threat to the development of a mushroom based industry in Georgia is the existence of a well established large-scale white button mushroom production in Pennsylvania. However, the infrastructure in place is old and outdated. With the state-of-the-art technological developments proposed for the Georgia mushroom industry this would not be a long term problem. In order to be successful, this effort will require the coordinated activities of researchers in the university system, retailers, and growers. In addition, without a well functioning Commodity





Commission that vigorously controls production, the success of the industry is problematic. Implementing these production controls will help eliminate the boom or bust cycle that currently plagues agricultural enterprise primarily due to overproduction.

Community Infrastructure Requirements

Georgia currently has many of the necessary mushroom production infrastructure requirements already in place; however, in numerous rural areas, especially those designated by the Georgia Rural Development Council (GRDC) as Tier 1 counties, the human capital requirements are problematic (GRDC, 2001). The physical infrastructure requirements, such as electricity, natural gas, and surface transportation can easily be accommodated since mushroom growing houses do not require an unduly large amount of land, electricity, water, sewage, etc. typically associated with large scale developments. In addition, mushrooms do not require complex processing facilities, such as those in the poultry, livestock, or aquaculture industry. However, cultivating specialty mushrooms is an agricultural based enterprise that will require physical and human infrastructure improvements, especially if the production facilities are located in Tier 1 counties. The key benefits for investing in these human resource improvements are that the specialty mushroom industry will provide year round employment opportunities both in the agricultural sector and in the development of facilities that produce home replacement meals and other value added products.

A statistical profile of Georgia's Tier 1 counties is presented in Appendix D. The following characteristics are common to these counties. They have relatively low levels of population and most had more residents in the 1930's than they have today. During the 1990s these areas experienced relatively slow population growth. They tend to have a large African American population as well as a relatively high proportion of births to unwed mothers. In general, there is a relatively high dependency ratio. That is, compared to the number of residents of working age (18 to 64) there is a relatively large number of both children under 18 and people over 65.

In general, the residents of Tier 1 counties live in low-income households and are less educated compared with other counties in the state. Specifically, with only a few

exceptions, Tier 1 counties' per capita income is below that of the state of Mississippi (\$20,686), the lowest of any state in the nation. In every Tier 1 county the percentage of adults without a high school education exceeds the state average. In addition, the unemployment rate in these counties tends to be well above the state average (3.7 percent) and in most cases it is double. The housing stock consists of a large percentage of mobile homes and thus less available and affordable stick-built housing than other counties.

Successful economic development opportunities must take into consideration the social, demographic, and cultural characteristics of the local area. In particular, the labor force may not be properly prepared for high tech jobs requiring sophisticated skills. A job creation model that stresses the production of already over-supplied agricultural commodities will not work to create job opportunities in these disadvantaged Tier 1 counties. Instead, new products and value added commodities must be developed. The socio-economic profile of Tier 1 counties underscores the advantages of generating mushroom production facilities accompanied by value added business development in these areas. The start-up costs, labor needs, infrastructure requirements, and suitability of the proposed development along with the prevailing culture and customs of rural areas are compatible.

Growing Medium Requirements and Waste Product Utilization

Hardwood sawdust, supplemented with grain and minerals, is the required growing medium for nearly all specialty mushrooms (See Appendix C). Typically small and large grain additives to this substrate are millet, corn and sorghum. Other agricultural by-products such as straw and manure are also used as growing mediums for mushroom spores. All of these products are abundant and readily available throughout Georgia (Georgia Agricultural Facts, 2001). Most of the latter constitute "waste" or "problem" by-products that exist in such large quantities that their disposal is a dilemma for farmers and businesses. The potential for specialty mushroom production turning "waste" products into commercially viable ones is significant. Due to the proliferation of these waste products in Georgia, increased investigation is warranted. Some examples of these waste products and their uses in the specialty mushroom industry follow.





Sawdust

Georgia has an abundant supply of hardwood sawdust, a forest industry by-product. In fact, in 1997, the Georgia Forestry Commission indicated that 21 million cubic feet of hardwood sawdust was produced in this state. The sawdust is considered a waste material by wood product manufacturers. For example, TS Hardwoods (Milledgeville, Georgia), a producer of milled hardwood lumber, generates approximately 20,000 tons of sawdust annually. An estimated 13,000 tons of this output is oak sawdust. This company has two other mill locations, one in Georgia and the other in North Carolina (T.S. Hardwoods, personal communication, Nov 19, 2001). Removal of this waste product is considered a "problem" and the majority of the sawdust is sold for fuel. Hardwood (especially oak) sawdust, however, could become a sought-after commodity with the development of a viable mushroom industry in Georgia. The amount of oak sawdust produced by the Milledgeville, Georgia plant alone is more than adequate to supply the spawn making needs of the proposed new mushroom producing facilities in the state.

An additional economic benefit for using this industry by-product is that the sawdust first be sterilized before it is used in the spawn making process to ensure a pure culture. Sterilization eliminates other microbial species which are in competition with mushroom spores. The need for sterilization facilities would further add to the value of the by-product and create additional economic opportunities.

Other examples of the potential uses for agricultural by-products in the specialty mushroom industry can be seen in the cultivation of the Portabello variety of *Agaricus* and the Paddy Straw Mushroom. The Portabello is usually

grown on a mixture of poultry litter and straw. Recently, Sanchez & Royse (2001) proposed a method to grow Portabello mushrooms on an oak sawdust based medium infused with grain. All of these products are available in abundance throughout the state.

The Paddy Straw Mushroom (*Volvariella volvacea*) is routinely used in Asian recipes and was traditionally grown on rice straw, hence its name. Although the yield was not high when rice straw was used as the substrate, it was the primary base material for many years. Other substrates such as dried banana leaves and oil palm bunch waste have been tried but have not been very successful. Thus, for a long time, this species was not very profitable as a commercial mushroom. It was not until 1970, when cotton waste was introduced as a substrate that a substantial gain in yield occurred. By 1973, cotton waste had completely replaced rice straw in commercial cultivation of this species in Hong Kong (Chang, 1974). This eventually led to the Paddy Straw Mushroom becoming successfully commercialized in Hong Kong, Thailand, Taiwan, and Indonesia (Wong, 2001).

Georgia has been a cotton producing state and cotton waste remains a "problem." Recently, new products and by-products, created from the disposal of the cotton waste have been created. For example, cotton waste contains nutrients similar to medium-quality hay, many Georgia cotton producers are now feeding it to their cattle which saves the milling plant disposal costs and gives farmers a source of cattle feed (USDA, 1996). If the specialty mushroom industry were to use this agricultural "waste" as an additional substrate, even greater use would be made of this product. The cultivation of the Portabello, Paddy Straw and other specialty mushrooms that can take advantage of these agricultural by-products has the potential to produce a commercially successful crop, create jobs, and assist with the process of turning waste products into profitable agriculture for the state of Georgia.

Specialty Mushroom Farming Labor Needs

In general, mushroom farming is not significantly different than any other agricultural enterprise. The vegetable crop must be grown and harvested, and various management and labor aspects must be coordinated. Since commercial mushrooms are grown indoors however, careful control and monitoring of the environment is crucial. Successful





mushroom cultivation depends on the ability to control potential contaminants, and thus it requires a "clean room" environment. Consequently, all workers must maintain good personal hygiene. Since the growing conditions for mushrooms are also ideal for the rapid growth of mold contaminants which can inhibit the mushroom crop and rapidly spread throughout the growing rooms, constant and informed attention to the emerging crop is required or rapid damage can occur. In addition, environmental conditions (temperature, humidity, light, air flow, etc.) need to be changed for different mushroom crops at various times in their maturation cycle. Therefore, the success of mushroom production is directly correlated with the degree of attention to the daily management of the growing rooms.

The proposed specialty mushroom industry would employ individuals at all skill and education levels. However, all production workers should be able to read at a high school level with good comprehensive skills. These "workers" perform the daily activities for mushroom cultivation. Jobs include harvesters, pickers, sanitation workers, block handlers, and packers. Depending on the size of the operation these jobs could be performed by a few individuals or one worker per duty. Ideally, in large operations, these jobs would be "rotated" among workers to enhance the knowledge of the overall growing process and operation of the facility. This not only improves efficiency and production, but also enables the workers to gain the necessary experience and new skills for job mobility. Due to the constant possibility of contamination, workers must wear "clean suits" and surgical gloves and exercise particular care when handling the mushrooms at all times since they are delicate and can be easily damaged.

The cultivation supervisor oversees the mushrooms, machinery, and workers. In general, this position requires knowledge of mushroom cropping, mechanical aptitude, and good interpersonal communication skills. This person must pay close attention to detail and have a knowledge of growing mushrooms. They must be able to recognize the proper appearance and timing of the mushroom crop as it matures, as well as recognize problems with abnormalities, contaminants and environmental conditions. If they are not able to respond quickly to correct a specific problem themselves they must request technical assistance. This may be accomplished through distance diagnosis or face-to-face meetings with a specialty mushroom consultant.

In order to run the day to day business operations of a mushroom farm, an office operations manager must be employed. This job involves general accounting, book-keeping, and detailed crop record keeping. Basic computer skills with the ability to learn other computer programs is also needed. Knowledge of an appropriate word processing package and the ability to operate in a Windows environment is necessary. Access to web based information systems and distance diagnosis is also mandatory. The office manager must effectively manage and prioritize the workload, and keep detailed records and farm files. The general manager of the mushroom farm may, or may not, be the owner. This individual oversees the overall day-to-day operation. In addition, they would also be responsible for general promotion, marketing, and distribution.

Finally, a mushroom growing operation must have a general maintenance worker either on site or available when needed. This person must have the ability to diagnose malfunctions in mechanical and other equipment and to determine adequate corrective measures. Skill with hand and power tools is necessary. Other needed personnel, such as drivers, generally would be employed on a contractual basis. One of the intangible elements associated with having "good labor" for a mushroom production facility is to employ people who have an interest in either mushrooms or horticulture. Workers who possess this characteristic appear to be more motivated and are willing to take the necessary training to become knowledgeable about the challenges associated with cultivating specialty mushrooms (Personal Communications with Bob Johns, The Growing Company).

Checklist of What a Grower Needs to Get Started

In order to get started in the specialty mushroom business, a grower will need the following:

1. Education and training regarding the nature of mushroom farming. This may be learned from a reliable consulting or technological support network. See Appendix E for a list of topics of a proposed specialty mushroom seminar.
2. Adequate financial resources.
3. Knowledge of the location and extent of specific specialty mushroom markets.





4. Convenient access to transportation routes for both receiving starting materials for spawn plant and mushroom farms, and for shipping mushrooms to market. To maintain quality of the product a refrigerated trailer is needed for shipping. A driver would then be contracted.
5. Access to utilities, labor, land, and other necessary production inputs. In addition, the grower must be aware of local building and zoning ordinances.
6. Access to a reliable and consistent substrate and spawn or colonized block supply.
7. Consistent and affordable production and packaging supplies.
8. Affiliation with a Commodity Commission to license, lobby, regulate, promote, and market the product.

The Need for Cooperatives

Similar to other industries, American agriculture has undergone numerous organizational changes in recent times. Increased recognition of changing consumer preferences and the need to create more value added products during the production process has caused many farmers to reevaluate their operations (Merrett & Walzer, 2001). The successful creation of a mushroom based industry in Georgia will require a producer driven cooperative to help growers understand and deal with many of the market forces, governmental regulations, and technological changes occurring in today's dynamic agricultural environment.

Farmers and ranchers were granted the legal right to form cooperative associations to work together for their mutual benefit by the enactment of The Capper-Volstead Act in 1922. There are several accepted definitions of a cooperative. According to The National Council of Farmer Cooperatives (NCFC) a cooperative is "a business owned and democratically controlled by the people who use its services and whose benefits are derived and distributed equitably on the basis of use." Agricultural cooperatives have a long history of assisting farmers as they adapt and prosper in a changing environment. Cooperatives are quite numerous particularly in the Midwest, but in the South participation rates are low (USDA, 1998).

The basic reason for a well developed mushroom cooperative is to control production. American farmers have been the victims of their own success due to overproduction which leads to vastly reduced prices. This in turn creates an environment of excess government regulation and entrenched bureaucracies that create unnecessary levels of complexity. As an example, the over production of milk has resulted in the creation of volumes of federal legislation and multi state compacts that seek to regulate milk production and its distribution. Row crops also suffer from over production, and even the forest industry is not immune. This situation need not be recreated with specialty mushrooms. From the beginning, efforts need to be devised so specialty mushroom growers can control production.

A relatively new type of cooperative, the "New Generation" cooperative, may be the prototype required for Georgia's specialty mushroom industry. The basic concept is that producers capture profits that occur beyond the farm-gate by owning and controlling the local businesses that are positioned to earn those profits. The motivation of New Generation cooperatives is more offensive, and therefore, they are proactive rather than reactive. The main emphasis of cooperatives of this type has been on value-added processing and niche marketing. In addition, producer/members view themselves as producing a finished food product rather than a raw commodity (Ferland et al, 2001).

One of the keys to the success of a New Generation cooperative is producer commitment. Other keys to success include public policies that support cooperative formation, financial institutions willing to fund the cooperative, and consultants or facilitators to help guide producer groups through the various aspects of the process. Cooperatives take on numerous different forms, functions, and of course expectations. The key ingredient to any cooperative agreement, however, is producer input and involvement. Strong leadership is also a key component. With appropriate financial support, a mushroom cooperative formed during the early developmental stages will have more success than one formed during the later stages (Ferland et al, 2001). See Appendix F for additional information regarding cooperatives.





Marketing Orders and Product Differentiation

From the beginning, Georgia mushroom growers should develop efficient marketing strategies and educate consumers by developing an identifiable product. The success of perishable vegetable and fruit crops involves the timely sale of products by numerous different firms. When problems occur due to spoilage or bruising, the opening or demand for substitute products is increased. Therefore, Georgia specialty mushroom growers must differentiate their products from other competitors so that consumers will make repeat purchases and develop brand loyalty.

The U.S. legal system has adopted institutional devices such as federal or state "marketing orders" and "trademarks" to foster coordination and product differentiation. In Georgia, the growth and success of Vidalia onions has greatly benefitted from these devices by separating this product from other competitors (Centner, Turner & Bryan, 1988; Huang & Epperson, 1990). Product differentiation enables consumers to make an informed decision based on the quality and price of a product. These institutional devices are designed to protect consumers by providing producers legal recourse against competitors who may try to benefit from the use of confusing, deceiving, or misleading labels and advertising. Thus, institutional devices provide producers a means of protecting their investment through the process of producing quality products.

Group coordination of the promotion, advertising, and marketing of Georgia specialty mushrooms would be a useful strategy for the proposed industry to develop. A "marketing order," authorized by the U.S. Congress through the Agricultural Marketing Agreement Act of 1937, is a legal device available for such a group effort. In general, marketing orders are designed to help stabilize market conditions for agricultural products, including specialty crops, and are binding on all individuals and businesses who are classified as "handlers" in a geographic area. The major purpose for most fruit and vegetable marketing orders is to establish quality requirements, regulate the flow of product to the market, standardize containers, share market information, conduct production research and development, promote market research, and sponsor advertising. A marketing order for Georgia specialty mushrooms would provide funds for and facilitate the establishment of advertising and promotional activities to ensure

the success of the industry. Marketing orders can contain provisions concerning quality control which allow producers to differentiate their product from others. Another, related avenue for product differentiation is the establishment of a trademark. Trademarks, generally referred to as brand names, can be employed to effectively preclude producers of similar products from adopting another's trademark in the same geographic area.

Survey of Georgia Consumers

One of the first steps in the current feasibility study involved a survey of 403 randomly selected adult residents of Georgia to participate in a telephone survey. See Appendix G for survey methods and procedures. The purpose of the survey was to learn about the attitudes and opinions of Georgia residents toward specialty mushrooms. Interviewees were selected from a random-digit dialed sample of households in Georgia. The survey was designed by The University of Georgia's Survey Research Center and administered between the 5th and 11th of July, 2001. This section presents findings from a series of six related questions concerning survey respondents' attitude's toward and experience with specialty mushrooms. Each question, accompanied by response frequencies, is presented in table and discussion format. Almost one-half (46.2 percent) indicated they had "eaten or prepared specialty mushrooms," either frequently (14.4 percent) or occasionally (31.8 percent). (See Table 2.) It is not surprising, however, that the other one-half (53 percent) reported not having experience with the product since vast amounts of specialty mushrooms must be imported due to the infancy of U.S. production. Only two respondents, however, said they did not know about the product.

Table 2

Consumer survey question 1

"Have you ever prepared or eaten specialty mushrooms, like Shiitake, Portabello, Oyster, Snow Crab, or Chanterelles at home or in a restaurant?"

| | Frequency | Percent |
|--------------|-----------|---------|
| Yes | 186 | 46.2 |
| Frequently | 58 | 14.4 |
| Occasionally | 128 | 31.8 |
| No | 214 | 53.1 |
| Don't Know | 2 | 0.5 |
| NA | 1 | 0.2 |
| Total | 403 | 100.0 |





Of those who had experience with specialty mushrooms, almost two-thirds (61.8 percent) indicated they had eaten specialty mushrooms in the past month; approximately nine percent (8.6 percent) daily, nearly one-fourth (23.7 percent) within the last week, and almost one-third (29.6 percent) within the last month. (See Table 3.) Clearly, a large number of Georgia consumers are well aware of, and have had experience with, specialty mushrooms.

Table 3

Consumer survey question 2

"When was the last time you used them? Would you say daily, last week, last month, 6 months ago, or more than 6 months ago?"

| | Frequency | Percent |
|------------------------|-----------|---------|
| Recently | 115 | 61.8 |
| Daily | 16 | 8.6 |
| Last Week | 44 | 23.7 |
| Last Month | 55 | 29.6 |
| Not Recently | 61 | 32.8 |
| 6 months ago | 35 | 18.8 |
| More than 5 months ago | 26 | 14.0 |
| Don't Know | 10 | 5.4 |
| NA | 0 | 0.0 |
| Total | 186 | 100.0 |

At first glance it seems somewhat surprising that 8.6 percent of surveyed respondents indicated they eat mushrooms on a daily basis; however, an increasing number of people are eating specialty mushrooms not only for their nutritional value, but for their medicinal value as well. A growing body of scientific research is currently devoted to investigating the effects that certain types of specialty mushrooms have on human diseases such as cancer and AIDS (Chang, 1996). In addition, the appeal of the nutritional approach to medical and health issues has increased significantly in recent years. This is especially apparent among those in the Baby Boom generation (Chernoff, 1995).

Although many American consumers have had experience with common mushrooms (as a pizza topping, e.g.), the specialty mushroom market can be described as being in its infancy. Portabello mushrooms are the trendiest mushrooms on American menus. Categorized as a specialty mushroom due to its larger size, the Portabello mushroom is simply a common Button mushroom that is allowed to

mature. The large caps allow unique recipes to be created that would not otherwise be possible with the smaller common Button mushroom. The market potential for large mushrooms such as Portabello, Oyster, or Oak (Shiitake) is enormous since many of these recipes involve the popular American past time of grilling.

Thirty-nine percent of respondents indicated they would use specialty mushrooms either much more (15.1 percent) or a little more (23.8 percent) often "if specialty mushrooms were available at a quality price." (See Table 4.) Almost 60 percent, however, indicated they would not. This finding strongly suggests that vigorous marketing and promotional activities will be required to educate consumers about the product. New food products, especially those that are imported and differ from the standard American diet, routinely require promotional activities before they are adopted and accepted. The acceptance of Kiwi fruit, an imported food product, is an example of a successful marketing campaign that rapidly educated consumers and thus increased consumer demand.

Table 4

Consumer survey question 3

"If specialty mushrooms were available at a quality price would you use them more often?"

| | Frequency | Percent |
|---------------|-----------|---------|
| Yes | 157 | 39.0 |
| Much more | 61 | 15.1 |
| A little more | 96 | 23.8 |
| No | 232 | 57.6 |
| Don't Know | 11 | 2.7 |
| NA | 3 | 0.7 |
| Total | 403 | 100.0 |

In addition to a well developed marketing campaign, survey findings indicate the creation of recognizable "brand name" products will be needed to ensure the success of the specialty mushroom industry. Specifically, 62 percent of those surveyed said "specialty mushrooms were available where they routinely shop for groceries" most of the time (43.4 percent) or sometimes (18.6 percent). (See Table 5.) About 38 percent, however, replied either that specialty mushrooms were not available (21.1 percent) or did not know (16.1 percent).





Table 5

Consumer survey question 4

"Are specialty mushrooms available where you routinely shop for groceries?"

| | Frequency | Percent |
|------------------|-----------|---------|
| Yes | 250 | 62.0 |
| Most of the time | 175 | 43.4 |
| Sometimes | 75 | 18.6 |
| No | 85 | 21.1 |
| Don't Know | 65 | 16.1 |
| NA | 3 | 0.7 |
| Total | 403 | 100.0 |

Sixty percent of respondents said they "would be more likely to use quality Georgia grown mushrooms if they were available." The remaining 40 percent either said no (33.5 percent), did not have an opinion (4.5 percent), or did not respond. (See Table 6.)

Table 6

Consumer survey question 5

"Currently, most specialty mushrooms are imported. Would you be more likely to use quality Georgia grown mushrooms if they were available?"

| | Frequency | Percent |
|------------|-----------|---------|
| Yes | 242 | 60.0 |
| No | 135 | 33.5 |
| Don't Know | 18 | 4.5 |
| NA | 8 | 1.9 |
| Total | 403 | 100.0 |

Developing a recognizable Georgia grown product is critical to the success of the specialty mushroom industry for a variety of reasons. First, it greatly assists with marketing and appeal of the product. Consistency is the issue here; people want to rely on a familiar brand name that will meet their expectations each time they use the product. Name brand recognition goes a long way in achieving this goal. Second, consumers prefer fresh locally grown products because of its shelf appeal. The Vidalia onion is an excellent example of a recognizable Georgia grown product that has developed remarkable acceptance and success not only among Georgia consumers, but nationally as well.

American consumers expect quality products. For produce, quality is defined by taste, appearance, and freshness. In the grocery store, consumers buy with their eyes, not their mouths (PMA, 2001). Brand names that provide

consistency also allow consumers to buy with their memory. Vidalia onions suggest "sweet and mild" flavors and are "guaranteed" to taste this way when a consumer seeks this brand name. For example, a Georgia Oak mushroom would be recognized by a smoky taste, a trimmed stem, and a less blemished cap, where a Pennsylvania grown mushroom would not offer these same qualities.

Finally, almost one-third (31.7 percent) of respondents reported they "would be more likely to purchase a pre-marinated specialty mushroom in a heat and serve package over an unprepared product." (See Table 7.) Sixty percent, however, responded negatively to this idea. Currently, this type of product is not available, and as a result, consumers have had little or no experience with it. Equally important is the lack of an identifiable brand name, recognition, or trademark with a ready to eat product.

Table 7

Consumer survey question 6

"If you could buy a pre-marinated specialty mushroom in a heat and serve package would you be more likely to purchase this product over an unprepared product?"

| | Frequency | Percent |
|------------|-----------|---------|
| Yes | 128 | 31.8 |
| Definitely | 57 | 14.1 |
| Maybe | 71 | 17.6 |
| No | 244 | 60.5 |
| Don't Know | 23 | 5.7 |
| NA | 8 | 2.0 |
| Total. | 403 | 100.0 |

The survey also requested information related to the respondents' general socio-economic background; age, race, gender, marital status, educational attainment, income, and residential status; as well as their attitudes toward and experience with specialty mushrooms. To gain a deeper insight into the respondents' disposition regarding specialty mushrooms, responses were analyzed simultaneously with their demographic characteristics. Cross tabulations were performed for all six questions discussed above by the seven respondent characteristics.

In general, respondents who reported being middle age, white, male, married, and more educated were more likely to have tried specialty mushrooms. Those who reported an annual income in the \$25,000 to \$49,999 range also were also more likely to have eaten mushrooms. Middle





age, married, more educated, and metro residents were more apt to say they would use the product if it were available at a "quality" price. More educated respondents and those who live in metropolitan areas were more likely to shop at grocery stores where the specialty mushrooms are available. Middle age, more educated, and married respondents were more likely to be receptive to purchasing Georgia grown mushrooms if they were available. Respondents aged 65 years old or older were more likely than all other age groups to be favorable toward a ready to heat and serve specialty mushroom products. The joint distribution frequency tables can be found in Appendix H accompanied by a corresponding discussion of the results.

Determining Market Demand by Type of Specialty Mushroom

The target market utilized in this analysis is a 500 mile radii of Athens, Georgia. Athens was chosen because it is the location of The University of Georgia. The 500 mile radii was determined by the maximum number of miles that a fresh specialty mushroom product may be transported and still maintain an optimum appearance of quality and freshness. With increased research and development on packaging, however, the distance can be increased. To determine the number of pounds of specialty mushrooms by type needed to satisfy this targeted market, two different methods of analysis were employed. Although the two methods are different, the results are quite similar, and it is believed that a mid-point between the calculations would be the most accurate estimate derived from the available information.



Oak (Shiitake) Mushrooms

Method 1

The first method relied on information from the Georgia Poll Survey and U.S. Census data regarding the number of households with incomes \$35,000 and above in the target market area.³ Using only households with incomes greater than the national median household income of \$27,317 this method highlights the fact that those with more disposable income have a greater propensity to consume specialty mushrooms than lower income households. The average household size was used to determine the number of individuals per household in the targeted market area. The information derived from the Georgia Poll was used to calculate the number of potential mushroom consumers among the households within the target market. This figure was multiplied by the frequency of their usage. Finally, this number was multiplied by the amount of mushrooms consumed by an average individual. The following illustrates the first method used.

The number of households within a 500 mile radius of Athens, Georgia with incomes of \$35,000 or more equals 10,746,708 households. To determine the number of people who live in these households the number of households was multiplied by the respective state average household size. The average household size ranged from 2.4 in Washington D.C. to 2.9 in Mississippi. That number yielded a total population of 28,609,457 persons within the target area. Since very young children, who may not eat mushrooms, are included in the average household size the estimated number of potential mushroom consumers may be too high.

Information from the Georgia Poll indicated that 46.2 percent of the respondents had either prepared or eaten specialty mushrooms at home or at a restaurant. The findings also revealed that about half of these consumers used the mushrooms on a weekly basis, while another half use these mushrooms on at least a monthly basis. By taking this average into consideration a multiplier of 25 was determined as the annual frequency of purchase weeks.

Next the average amount of mushrooms consumed per serving was calculated. Several sources were used in reviewing specialty mushroom recipes, including issues of *Bon Appetit* (2001) and *The Complete Vegetarian Cuisine* (Elliot, 1988). From these sources it was determined that the average mushroom serving size was 2 ounces per person.





Equations

Number of people in 500 mile radius = 28,609,457 people
 Frequency of potential consumers = x 46.2%
 Potential consumers = 13,217,569 consumers

Serving size (oz) per meal / per consumer = x 2 oz
 26,435,138 oz. per consumer

Per pound consumed = 26,435,138 = 1,652,196 pounds consumed per purchase
 Ounces per pound =16 16

Average annual frequency of purchases weeks per consumer = 25
 Total production demand of ALL specialty mushrooms= 41,304,903 pounds consumed annually

Percent Specialty Mushrooms by Type Nationally based on NASS reports⁴

| | | |
|----------------|------------------------------------|-------|
| Portabello | 96,297,000 lbs./ 111,800,000 lbs.= | 86.1% |
| Oak (Shiitake) | 9,327,000 lbs./ 111,800,000 lbs.= | 8.3% |
| Oyster 3, | 437,000 lbs./ 111,800,000 lbs.= | 3.1% |
| "Other" | 1,975,000 lbs./ 111,800,000 lbs.= | 1.7% |

Total Specialty Mushroom Demand within a 500-mile radius of Athens, Ga. By type

| | | |
|------------|---------------------------|-----------------|
| Portabello | 41,304,903 lbs. x 86.1% = | 35,563,521 lbs. |
| Oak | 41,304,903 lbs. x 8.3% = | 3,428,307 lbs. |
| Oyster | 41,304,903 lbs. x 3.1% = | 1,280,451 lbs. |
| "Other" | 41,304,903 lbs. x 1.7% = | 702,183 lbs. |

Method II

A second method used to calculate the demand for specialty mushrooms in the target area was to multiply the national per-capita rate of specialty mushroom consumption (0.4 lb. per person) by the population figure for this area. This method may yield a high estimate if there are a significant number of low income households, who may not consume specialty mushrooms at the same rate as higher income households, in the target area as compared

with the nation as a whole. Again, children are also included in the number of potential mushroom consumers. Next, we multiplied this number by the market percentage for each variety of mushroom to determine the respective poundage demand. There are 85,820,307 persons within a 500-mile radius of Athens, Georgia (U.S. Census, 2000). This number is multiplied by 0.4 pounds of specialty mushrooms that are consumed on average per capita in the United States.

Equations

(111,000,000 lbs. specialty mushrooms/ 280,000,000 total U.S. pop. = 0.4 lbs.)

Pounds of specialty mushrooms consumed within a 500-mile radius of Athens, Ga.

85,820,307 Population x 0.4 lbs. = 34,328,123 lbs.

Percentage of specialty mushroom market by type mushroom:

| | | |
|----------------|------------------------------------|-------|
| Portabello | 96,297,000 lbs./ 111,800,000 lbs.= | 86.1% |
| Oak (Shiitake) | 9,327,000 lbs./ 111,800,000 lbs.= | 8.3% |
| Oyster | 3,437,000 lbs./ 111,800,000 lbs.= | 3.1% |
| "Other" | 1,975,000 lbs./ 111,800,000 lbs.= | 1.7% |

Total Specialty Mushroom Demand within a 500-mile radius of Athens, Ga. By type

| | | |
|----------------|---------------------------|-----------------|
| Portabello | 34,328,123 lbs. x 86.1% = | 29,522,185 lbs. |
| Oak (Shiitake) | 34,328,123 lbs. x 8.3% = | 2,849,234 lbs. |
| Oyster | 34,328,123 lbs. x 3.1% = | 1,064,172 lbs. |
| "Other" | 34,328,123 lbs. x 1.7% = | 583,578 lbs. |





The final equation took an average of the two methods in order to determine the market demand for each variety of mushrooms within the targeted area.

| | |
|--|-----------------|
| Portabello (29,522,185 lbs. + 35,563,521 lbs.) / 2 = | 32,542,853 lbs. |
| Oak (Shiitake) (2,849,234 lbs. + 3,428,307 lbs.) / 2 = | 3,138,770 lbs. |
| Oyster (1,064,172 lbs. + 1,280,451 lbs.) / 2 = | 1,172,312 lbs. |
| "Others" (583,578 lbs. + 702,183 lbs.) / 2 = | 642,881 lbs. |

Table 8 presents the annual demand in pounds by type of mushroom for both methods. The average demand of the two methods is in the last column.

Table 8
Annual Demand in Pounds by type of Mushrooms

| Type of Mushroom | Method I (lbs.) | Method II (lbs.) | Average of I and II (lbs.) |
|---------------------|-----------------|------------------|----------------------------|
| Portabello..... | 35,563,521 | 29,522,185 | 32,542,853 |
| Oak (Shiitake)..... | 3,428,307 | 2,849,234 | 3,138,770 |
| Oyster..... | 1,280,451 | 1,064,172 | 1,172,312 |
| "Other"..... | 702,183 | 583,578 | 642,881 |
| Total..... | 41,304,903 | 34,019,169 | 37,496,816 |

Note The total of the average of I and II does not equal the average of the totals for method I and II due to rounding.

Factors Determining Market Share

Additional variables were used to determine competition within the target market area. This involved examining study area strengths and weaknesses to determine the percentage of market share that could be achieved by Georgia growers. Current trends show that the common button mushroom industry is consolidating and a few large companies dominate the market. It will only be a matter of time until these companies enter the specialty mushroom market. Knowing this, it would be best to position the Georgia specialty mushroom industry for success and sustainability by developing highly efficient progressive farms that can compete with out-of-state growers. A list of U.S. spawn producers and mushroom companies is shown in Appendix I. Following is a discussion regarding factors affecting the market share of Oak mushrooms (Shiitake), Oyster mushrooms, and "Other" mushrooms that Georgia growers could expect. See Appendix J for an examination of the Portabello market.



Oak (Shiitake) Mushrooms

Oak Mushrooms (Shiitake)

Oak Mushrooms (Shiitake) present a unique opportunity for Georgia. Whereas Portabello production has increased nearly 100% over the past three years, at an average at about 33.3% per year, Oak mushroom (Shiitake) production has grown by only 14% per year. This is still, however, a large number. The opportunity to capture a significantly higher market share of Oak mushrooms (Shiitake) is predicated by the fact that technology and quality assurance are notably higher in Georgia than anywhere else in the country. More modern technologies coupled with newer facilities makes Georgia's ability to control this market outstanding. There has been a supply shortage for many years, and a wider consumer knowledge of the product is apparent through market surveys.

Better technology resulting in reduced prices could accelerate the Oak mushroom market comparably to the Portabello market. Oak mushroom (Shiitake) farms tend to be relatively small, thus ruling out economies of scale as a





competitive advantage, and limiting the consumer base. Quality competitors in the targeted market area are nominal. For these reasons, it is suggested that larger, more modern and efficient farms be built focusing on a premium production of mushrooms at a competitive price.

The possibility of a Georgia growers' network controlling a higher percentage of the Oak mushroom market share is distinctly larger than for Portabello mushrooms. Building ten oak mushroom farms producing approximately 225,000 pounds a year would be a sound investment. This equates to approximately two million pounds of production annually, and would capture 66% of the targeted market area, and as much as 20% of the national market. This scenario would put Georgia Oak mushroom producers on the map as the country's largest suppliers of specialty mushrooms.

Oyster Mushrooms

Oyster mushrooms are one of the most cultivated and consumed mushrooms in the world; however, the U.S. market only demands approximately 3.4 million pounds annually. Although they are delicious mushrooms, highly variable in color and shape, as well as easy to grow, they are difficult to market. These mushrooms require a very short distribution radius because they are highly perishable. For this reason, it is recommended that the distribution radius for Oyster mushrooms be limited to 200 miles. Due to the high spoilage rate of these mushrooms, purveyors will not pay a high price. A pristine product, however, could yield a much higher return. Thus, research and development regarding packaging needs should be conducted for this product.



White Oyster Mushrooms

Oyster mushroom farms will have to be increasingly automated in order to assure a low cost of production. These farms, however, do not require the extensive labor of Oak mushrooms. There are numerous varieties of Oyster mushrooms. Each require specific environmental parameters.

For this reason ideally each variety should be grown on individual farms. However, this is not economically feasible. A combined White Georgia oyster and Golden oyster mushroom farm capable of producing 200,000 pounds annually (100,000 of each type) is recommended. This would represent 5.7% of the national production for this genera of cultivated mushroom. Special care must be given to these more perishable mushroom varieties to insure less spoilage in the event of a bumper crop. A dried mushroom market as an oversupply remedy should be investigated. It is recommended that all of the Oyster mushroom farms coordinate themselves with an affiliated distribution network. Pooling resources with Oak and Portabello farms will allow purveyors a one-stop shopping scenario. If this model works in Georgia, there is a good potential for licensing similar farms in other states. There will always be a demand for locally grown, premium Oyster mushrooms. Georgia growers should proceed slowly into the market because an oversupply of these mushrooms could be catastrophic. Though it is estimated that a demand of over one million pounds per year in the 500 mile targeted area exists, starting slowly with the more perishable varieties would be the sensible approach.

"Other" Mushrooms

The "Other" types of mushrooms present a broad spectrum of environmental and technological concerns. There is a diverse array of "Other" mushrooms, and many of them have their own particular needs. Each mushroom should be grown at different farms and with a distribution system that follows the Oyster mushrooms. Although many of these "Other" varieties of mushrooms do not have the problem with shelf life that is associated with Oyster mushrooms, they will need special attention and special considerations. Because each variety of mushroom will need a specific number and type of growing houses, and the workers will need special training, it is recommended that individual farms and cultivators grow each type of mushroom mono-specially. This will prevent confusion to beginning farmers. As the markets expand and their expertise increases, the potential for successfully growing a variety of mushrooms at one location increases. Location of these farms will be a significant issue. Several small farms could be set up as research and development type farms that would essentially work out the complications before the market demand for these mushrooms rises. Though it may seem risky, growing the lesser-recognized





Snow Crab Mushrooms

mushrooms, if marketed to the custom markets and ethnic centers, will actually put these growers in an opportunistic position to be on the ground floor and without competition.

If a good promotional campaign is estab-

lished, it would not be surprising to see many of these mushrooms rival the level of demand for the oyster mushroom in a very short time. It is recommended that four "other" specialty mushroom farms be established in Georgia with between 40,000 and 90,000 pounds per year capacities.

Smaller farms producing "Other" species of specialty mushrooms would better serve the developing Georgia industry as niche businesses. The small farms could also be used to research and establish prototypes for larger scale operations in the future. These smaller farms should network with the larger operations so as to create a win / win situation by offering retailers a broad variety of products from a single source. This kind of marketing is referred to as one stop shopping and is considered a typical buying practice of large produce retailers.

Technological Developments Required in the Mushroom Industry

To prosper and become a viable industry in Georgia, the specialty mushroom industry, as with all industries seeking to become economically competitive, would greatly benefit from adopting technological innovations. The primary advantage of this strategy is to reduce production costs and improve efficiency. These cost saving would help to elevate specialty mushrooms from a luxury or niche item to the status of a commodity item.

Research

A vigorous research component is the basis for sustaining and improving any commodity level crop. Strain selection, testing, storage, quality control, and crop improvement are essential to the continued development of a competitive

and cost effective commodity. New strains need to be obtained on a continual basis as source material for breeding experiments and as backup for strains that may be senescent (aging). Many commercially produced specialty mushrooms are closely related to their wild relatives and collections from nature are a viable source of new strains. Breeding and genetic selection procedures, however are necessary to generate specific attributes in strains. For example, in oak mushrooms, disease resistance has a tremendous economic impact on production. A cooperative venture between The University of Georgia and The Growing Company has developed disease resistant strains which has increased their Oak mushroom productivity. Selection or breeding of strains with increased growth rates might decrease the time required for the development of a crop and increase productivity. Breeding for strains with different mushroom texture qualities could affect shelf life of the product and lead to more efficient distribution qualities. Preservation and storage are also important components of a crop research facility. Cryopreservation guarantees genetic stability of the accessioned strains and is the present method of choice; however, constant testing of this and alternative methods for storage is appropriate.

Genome level research to identify the complexity, similarities, and differences in specialty mushroom genomes is currently being initiated at The University of Georgia. The long term goal of this work will be to identify potentially useful genes for crop development as well as for medical and nutraceutical benefit. Research into mushroom production on different substrates has the potential for increased productivity. Modification of substrate such as the use of a different cellulosic material or the enrichment of the substrate material with bran or grains can increase yield per spawn block.

A Research Center for specialty mushrooms could be financially supported through competitive research grants, commodity commission funds, and ancillary product profits as well as from patents and other sources. It is recommended that the specialty mushroom research center incorporate test growing houses as well as research laboratories.

Additional technological innovations that would enhance the specialty mushroom industry include advanced communication and imaging systems. These systems would aid consultation and technical services significantly and are





critical to the survival of all aspects of the specialty mushroom industry. Communication networks would permit consultants and university researchers to monitor the grower's production facility. The networks could include temperature and humidity monitors as well as imaging systems that would allow remote viewing of the production facilities from distant research facilities.

Spawn Production

The process of creating "seeds" or "roots" for the growth of mushrooms is referred to as spawn making. Spawn is the mature biological inoculum (mycelium) used in the permeation of substrate for the generation of mushrooms. Spawn making is a highly complicated process in which a pure strain of a selected fungus is chosen to generate a specific variety of mushroom. Spawn making requires a great deal of understanding of both environments and technique and thus represents science as well as art. Spawn can be created using extremely primitive methods for some fungi. A successful commercial mushroom farmer however, depends upon obtaining a reliable quality and quantity of spawn in order to achieve prolific and consistent crop yields.

Asians began mushroom cultivation some two thousand years ago. It consisted of laying broken branches and twigs under live mushrooms where the spores would fall onto the broken branch areas. The spores gave rise to mycelia (mature fungal tissue) and would colonize the branches. As the nutrition became depleted, the mushrooms were naturally signaled to fruit, thus completing the life cycle. This "natural culture" method, while quite primitive, continues to be used to this day and has actually been recommended as an alternative crop for low-income rural farmers (Alabama A&M, 1998).

Due to the importance of growers being able to obtain a stable source of quality spawn at reasonable prices, spawn making facilities represent a critical component of the mushroom industry. Although the start-up costs of technologically advanced and innovative spawn making systems are expensive, the development of centralized operations is necessary to maximize economies of scale. Examples of technological innovations in spawn making involve the development of efficient material handling equipment, advanced sterilizing, blending, and inoculation technologies. Such advanced spawn making systems are already

utilized in the *Agaricus* industry. Substrates used in *Agaricus* spawn production versus most other specialty mushroom spawn production, however, are different. Therefore, new technologies based on new concepts will need to be employed in the manufacture of specialty mushroom spawn in order to ultimately reduce costs to the grower.

Today's spawn systems and technologies are burgeoning worldwide. Some recent mushroom economic development strategies have relied upon spawn making techniques that are literally thousands of years old. This creates a huge opportunity as the cost of spawn directly affects the success of a mushroom farm. As the mushroom industry continues to evolve into a competitive, commercial agribusiness, spawn making innovations will become increasingly essential to meet growing consumer demands both in availability and price. Ultimately, the cost of production is balanced with what consumers are willing to pay for the final products. The single most expensive operating cost to a specialty mushrooms grower is the price of spawn. For example, to produce 450,000 pounds of Shiitake mushrooms a year a grower needs 180,000 blocks of spawn (2.5 pounds of mushrooms per block). At a cost of \$4 per block, without shipping costs, the total cost of spawn would be \$720,000. Shipping costs from Pennsylvania, a major producer of U.S. spawn block, can add 50 cents to the cost of an individual production ready spawn block. It is readily apparent that the acquisition of economically and quality spawn is central to the development of a specialty mushroom based industry in Georgia.

Most specialty mushrooms are grown on a sawdust-based substrate. Modifications in substrate composition are relatively small for different mushrooms. Different methods of spawn making are defined by the type of vessel used in the sterilization of bulk substrates. The two types of commercial spawn making commonly used are Conventional Double Door Autoclave Steam and Automated Steam Sterile Fill. Both systems use steam heat and pressure as their sterilizing agents.

Conventional Double Door Autoclave Steam

Double door spawn facilities have been used in spawn production since 1941 and are still commonly used in commercial spawn making. The process is thorough, but has numerous steps, is time consuming, labor intensive,





and not energy efficient. This process, however, does effectively control contamination rates in the cooling, inoculation and sealing processes. Mid-size companies are more likely to continue using this method of autoclaving because of its relatively inexpensive set up costs.

Automated Steam Sterile Fill

Currently, the best model for spawn making is an Automated Steam Sterile Fill system, which would be modified from technologies used in the *Agaricus* industry. This technology sterilizes the substrate in a large tumbling vessel, which is then cooled and inoculated with fungal mycelium and mixed automatically. The sterilized and inoculated substrate is then dispensed into pre-sterilized spawn bags and incubated to form the mushroom production blocks. The same machine could be used for all varieties of mushrooms. Because these facilities are critical to the success of the industry they should be designed using highly automated energy efficient systems.

"Magnetic" Sterile Fill

Recently, concepts using even more energy efficient systems, such as "Magnetic" Sterile Fill, which would replace steam sterilization methodologies, have been proposed. Although these systems have not yet been proven, the concept goes hand in hand with the objectives pointed out in the spawn making section of this report. The model would revolutionize the industry, as it would continue to improve on labor and energy efficiency and would drive down the costs of spawn far below current spawn market prices, thus giving Georgia growers a distinctive advantage over all other national competitors. Despite the fact that the start up costs of such facilities will be high, the cost benefit over long-term production will be more than justified. Further, these facilities could compete nationally for out-of-state accounts. As a result, a rigorous analysis of spawn making facilities will be needed because of the importance of this activity and the rapid technological advancements made in this area. The scope of such a study should be comprehensive due to the international aspects of the mushroom industry.

It is recommended that spawn making be divided into a single master spawn facility and several satellite production spawn facilities. This will reduce the possibility of contamination in the master spawn facility and create a

more efficient distribution network to farmers. To determine the type and quantity of spawn needs for the proposed Georgia specialty mushroom industry customer demand was established in pounds of mushrooms for each variety desired in a 200-500 mile distribution radius from Athens, Georgia. Table 9 presents spawn block requirements based on the number of pounds of specialty mushrooms by type needed to satisfy a targeted market. (See pg. 14-16 for methodology.)

Cultivation

The development of harvestable mushrooms from spawn blocks is the first production step in mushroom farming. Farmers will purchase spawn blocks from the spawn making facility and tend them appropriately until maturation, followed by harvesting and packaging. The farms consist of environmentally controlled houses where humidity, CO₂, temperature, and light are all regulated depending on the variety of mushroom produced. At present, much of the effort in production involves labor intensive procedures, but automated production and material handling can greatly reduce costs that currently keep farm gate prices high. Improvements in air handling and climate control systems also would enhance crop quality and yield. This would reduce production costs, increase crop value at the market place, and improve shelf life. Shelf life could be further increased by advancements in post-production packaging and handling. On-going research in these engineering and biological processes is a requirement for the viability of the specialty mushroom industry.

Monitoring cultivation problems of growth or disease can be centralized when tied to a system such as the Distance Diagnostics through Digital Imaging system presently in operation through The University of Georgia's College of Agriculture and Environmental Sciences (www.dddi.org). These systems permit university researchers to monitor a grower's facility via interactive video systems and computer monitoring gauges for humidity and temperature. This approach greatly reduces the chances of problems that may adversely affect the crop.

Distribution

Technology will play an important role in improvements in distribution related systems. Packaging of portioned fresh mushrooms is only the beginning. Increased shelf life





Table 9

Preliminary Recommendations for Spawn Requirements for Sawdust Based Mushroom Growth

| Mushroom type | Master Spawn Units | Production Blocks (in units) |
|----------------------------|--|---|
| Oak (Shiitake) | 50,000 units per year (sawdust) 961 units per week (sawdust) 5,000 units per year (grain) 96 units per week (grain) | 1,000,000 units per year 19,000 units per week |
| Georgia White Oyster | 2,000 units per year (grain or sawdust) 40 units per week (grain or sawdust) | 40,000 units per year 770 units per week |
| Golden Oyster | 2,000 units per year (grain or sawdust) 40 units per week (grain or sawdust) | 40,000 units per year 770 units per week |
| Pink Oyster or Rose Petals | 1,000 units per year (grain or sawdust) 20 units per week (grain or sawdust) | 20,000 units per year 390 units per week |
| Blue Oyster | 1,000 units per year (grain or sawdust) 20 units per week (grain or sawdust) | 20,000 units per year 390 units per week |
| Snow Crab | 2,000 units per year (grain or sawdust) 40 units per week (grain or sawdust) | 40,000 units per year 770 units per week |
| Froncosa (Maitake) | 2,000 units per year (grain or sawdust) 40 units per week (grain or sawdust) | 40,000 units per year 770 units per week |
| Velvet Ear | 2,000 units per year (grain or sawdust) 40 units per week (grain or sawdust) | 40,000 units per year 770 units per week |
| Enoki (winter mushroom) | 10,000 units per year (grain spawn) 200 units per week (grain spawn) | 150,000 units per year 2,885 units per week |

packaging presents an enormous opportunity to the scientific community as its success could bring a more consistent supply of quality product to the consumer. Mushrooms such as the Oyster, Froncosa, and Snow Crab could be marketed in a dramatically more aggressive fashion. Further, value-added products are just beginning to appear for Portabello mushrooms, but there is no reason that specialty mushrooms could not enjoy this type of diversification once they are produced at an abundant level.

High tech inventory, tracking, and delivery systems could be dramatically improved and implemented. Such systems would be effective in driving operating costs down by reducing shrinkage and spoilage frequently associated with mismanagement of these types of perishable prod-

ucts. The concept also holds true for frozen, refrigerated, as well as other value added products. A well organized distribution center in the Southeast is sorely needed to educate distributors about the marketing of these proposed products. Central and satellite distribution hubs would minimize less efficient distribution competitors.

The Internet is a possible factor to be explored. Buying food items sight unseen, however, can be a chancy affair. Technological advancements in other forms of communication as well as in transportation systems also offer great potential benefits to distribution networks. Technologies that increase fuel and energy efficiency would be beneficial to distribution as well as spawn production and cultivation operations.





Promotion

The success of a specialty mushroom industry in Georgia is also dependent upon an effective marketing campaign. This effort must be well-coordinated, centralized and targeted. Without a clear focus, consumers view sporadic appearances of these products as faddish, and insignificant. Intermittent supply of new products almost always means high prices and marketing efforts often fall into endless repetitive promotional strategies. Customers easily lose interest in and appreciation for such halfhearted marketing campaigns. The development and implementation of a major promotional effort is vital. Consistency of product, especially when associated with well-recognized trade names, boosts consumer curiosity and acceptance for new products.

The sales force and promotional personnel in the front lines present some of the most critical elements to the success of any new product line. Without appropriate enthusiastic cooking demonstrations, recipes, promotions, and presence, consumers simply do not know how to prepare the products. In addition, if the prices for these products are comparatively high, most consumers will not buy the product. Television ads would greatly accelerate consumer interest over magazines because magazines tend to cater to the converted. Culinary publications have already offered recipe suggestions for many of these types of mushrooms for several years now, but these magazines rarely cater to the masses. This effectively minimizes the buying public, and limits the potential for the agribusiness's success.

Estimated Construction and Start-up Operating Costs

This section presents the estimated construction costs and start-up operating costs for the recommended mushroom farms. These start up costs are conservative estimates for specific mushroom plant construction costs and one-tenth of annual operations capital for each farm. The estimates are subject to change based on economic conditions, specific county regulations, insurance stipulations, local government policies, and local concerns.

At this time it is recommended that seven different mushroom farms be built in the state of Georgia and the number of recommended licenses should be carefully regulated. It is further recommended that an affiliation of farms work collectively through a common trademark and central distribution center to better capitalize on name brand recognition, diversity of product line, and economy of scale. Interested parties are encouraged to contact qualified business/financial consultants to further investigate a proprietary feasibility study. Reliable consultants usually provide such studies on a need-to-know basis. Appendix K lists the major advantages and disadvantages however, of growing and selling various mushroom species. As in all new markets it must be understood that until it reaches a commodity level dramatic fluctuations may occur.

The information in Table 11 and Table 12 reveals the various parameters used to determine the start-up costs associated with growing specialty mushrooms, reported in Table 10. This information can be provided to potential lenders and/or financial institutions. The information developed in the spreadsheet format can be customized for different species of specialty mushrooms. For example, the rate of return, quantity and type of inputs for Oak mushroom (Shiitake) production is different than for Snow Crab. The time it takes for Oak mushrooms (Shiitake) to mature is slower than Snow Crab mushrooms, and therefore are more labor intensive. From these tables certain production factors, such as the cost of spawn, can be recognized as the focus of technological innovation to reduce costs to the farmer and ultimately to the consumer. The computerized spreadsheet budgets can be customized for individual growers and can also be used in applying for USDA or other sources of funding.





Table 10

Estimated construction costs start-up operating costs by type of mushroom¹

| Type of Mushroom | Construction costs | Start-up operating capital | Consulting fee ³ | Total production poundage | Percent margin before taxes (EBIT) | Number of employees (including management) |
|---|---------------------------|----------------------------|-----------------------------|---------------------------|------------------------------------|--|
| Oak (Shiitake) ² large farms | \$1.4 million per farm | \$280 K per farm | \$90 K per farm | 2 million | 22.1 | 56 per farm |
| Oak (Shiitake) ² medium-large farms | \$838 K per farm | \$200 K per farm | \$74 K per farm | 2 million | 21 | 38 per farm |
| Oak (Shiitake) ² medium size farms | \$666 K per farm | \$150 K per farm | \$66 K per farm | 2 million | 19.2 | 29 per farm |
| Oak (Shiitake) ² minimal size farms | \$400 K per farm | \$80 K per farm | \$54 K per farm | 2 million | 15.2 | 15 per farm |
| Combined Golden & White Oyster | \$300,000 | \$20 K | \$62,000 | 200,000 | 16.7 | 14 |
| Snow Crab | \$200,000 | \$50,000 | \$54,000 | 97,200 | 29.3 | 7 |
| Fondosa | \$320,000 | \$35,000 | \$60,000 | 45,000 | 22.8 | 5 |
| Enoki (Winter) | \$170,000 | \$40,000 | \$40,000 | 91,800 | 18.2 | 6 |
| Velvet Ear (Cloud) | \$275,000 | \$30,000 | \$60,000 | 97,200 | 16.7 | 6 |

1 Since further research is required regarding the specifics of a Portabello facility the information is not included here.
 2 This table presents four alternative farm sizes all capable of producing two million pounds of oak mushrooms. Not all of these are suggested. See initial recommendations.
 3 Since the specialty mushroom industry is in its infancy in Georgia new mushroom growers will need to consult with existing growers regarding the necessary technology for specialty mushroom production and general education about crop specific production. This includes mushroom house construction technology, crop handling and mushroom management (recognition of disease, proper humidity, etc.), and sales and distribution.

Information in Table 12 shows the requirements for growers by mushroom type and volume of production. The information reveals technological requirements, spawn needs, size of growing facilities, transportation needs, and cooling, storing and packing facilities. The information in Table 11 and Table 12 represents a first step in the budgeting process necessary for individual growers to become

fiscally knowledgeable about the specialty mushroom industry. Additional information will be needed. This includes both labor and management training needs. These needs, however, could fluctuate depending upon the location of the growing facility and the expertise of the grower.





Table 11

Sample Spreadsheet for Mushroom Cultivation Scale and Projected Income Statement

The specific values rely on variable construction costs and operating expenses depending on technological innovations and mushroom type.

Scale of production

- # of Climatized Growing Houses
- Blocks per cycle
- Cycles of blocks per house per year
- # of Spawn Blocks
- Cost Per Spawn Block
- Unskilled Labor Cost Per Hour
- Price Per Pound
- Pounds Produced
- Pounds Per Spawn Block (Avg.)

Mushroom Cultivation Projected Income Statement

- Sales
- Operating Costs
 - Spawn Blocks
 - Utilities
 - Chemicals
 - Water
 - Filters
 - Equipment Maintenance
 - Building Maintenance
 - Vehicle maintenance (Farm Pick Up Truck)
 - Payroll Taxes
 - Packing Supplies
 - Miscellaneous
 - Spawn Delivery Truck

Labor

- Block Handlers
- Cultivation Supervisor A
- Harvesters
- Sanitation
- Packing
- Growing House Clean Down
- Cultivation Supervisor B
- General Manager
- Office Manager
- Property Taxes and Insurance
- Insurance
- Product Liability and Vehicle
- Workers' Compensation
- Telecommunications
- Legal and Accounting
- G&A Expenses
- Depreciation
 - Building
 - Equipment
- Payment on Loan
- Sales and Distribution
 - Sales manager
 - Delivery truck driver
 - Delivery truck and usage
- Total Operating Costs
- Earnings Before Income Taxes
- Margin on Sales
- Taxes
- Net Earnings After Income Taxes
- Total Labor (including salaries and wages)





Table 12

Assorted Farm Set Up Requirements

| Mushroom Type (# of Farms) | Production Volume in pounds per year | Requirements |
|--|---|--|
| Oak (Shiitake) (2-8) | 2 million total: 8 farms at 225,000 or 2 farms at 900,000 (recommended economies of scale and repeat costs) | Head house High tech growing rooms Dunking facilities Sorting and packaging facilities Cold storage facilities and loading docks Dump truck |
| Combined Georgia White Oyster and Golden Oyster (1) A: sawdust based space bag cultivation methods | 200, 000 total 1 White Oyster farm at 100,000 and 1 Golden Oyster farm at 100,000 | 10 high tech growing rooms Manicuring and packaging room 2 Cold storage facilities; 1 post-harvest and 1 post-pack Loading dock Dump truck |
| Alternative cultivation for Combined Georgia White Oyster and Golden Oyster (1) B: straw based column bag | | Straw bale storage facility Wetting and chopping slab Semi-automated pasteurization facilities Cooling tunnel Inoculation and filing station Overhead transport racking system 10 high tech growing rooms; 5 each Manicuring and packaging room Cold storage and loading docks Dump truck |
| Snow Crab (Pom Pom) (1) | 97,200 | 6 medium to high tech growing rooms Sorting and packaging room 2 Cold storage facilities; 1 post-harvest and 1 post-pack Loading dock Dump truck |
| Froncosa (Maitake) (1) | 45,000 | 9 high tech growing rooms Spawning cold shock refrigeration Sorting and packaging room 2 Cold storage facilities; 1 post-harvest and 1 post-pack Loading dock Dump truck |
| Velvet Ear (1) | 97,200 | 9 high tech growing rooms Sorting and packaging room 2 Cold storage facilities; 1 post-harvest and 1 post-pack Loading dock |
| Enoki (Winter) (1) | 91,800 | 3 high tech growing rooms (Walk-in cooler style) capable of cold shock Sorting and packaging room Semiautomatic harvesting, weighing and vacuum packing station Walk-in cooler Automated bottle washer Loading dock Dump truck |





Additional Economic Impacts

The economic benefits of a mushroom based industry are not limited to food. Practitioners in both traditional and modern medicine have discovered a wide-range of medically- active compounds in plants and fungi, taxol being an especially visible example. Viable economic development strategies exist in genomic approaches to identify genes that are the basis for the synthesis of naturally-occurring anti-cancer compounds that might be up-regulated to enhance the nutraceutical properties of existing crops, or transferred to confer such properties to new crops.

Due to a variety of reasons including location, climate, international immigrants, industry organizational efforts, spawn making capability and facilities, and entrepreneurial activity, U.S. commercial mushroom production has been heavily concentrated in the state of Pennsylvania since the early 1900s. Beginning in the 1970s, Pennsylvania State University also became a major factor in the growth of the U.S. mushroom industry through its efforts to help growers improve mushroom production.

An impact analysis of the mushroom industry conducted by Pennsylvania State University determined that the mushroom industry in that state produces more than 353 million pounds of button mushrooms a year with a cash value of nearly \$255 million (PSU, 2001). In addition, mushroom production generated an estimated \$150 million in annual payroll, and a support industry which generates in excess of \$3.5 billion in that state. Due to the fact that button mushrooms are grown in manure and hay, the use of agricultural byproducts is enormous. The mushroom industry was responsible for composting 210,000 tons of mulch hay, 115,000 tons of poultry manure, and 245,000

tons of other by-products at mushroom operations to make the substrate required for growing button mushrooms (PSU, 2001).

An economic input-output analysis was NOT used in the present study. In traditional input-output analysis certain important explanatory variables may be omitted, frequently the depth and breadth of future spinoff type of developments cannot be accurately determined or may not even be known, some variables included may be measured improperly, and the proper time span may not have been used to determine the full value of both inputs and outputs. However, information in Table 13 presents the sales tax revenue the state of Georgia could expect to generate from the production of the volume of specialty mushrooms recommended in this report. Assuming a six percent sales tax and a 150 percent mark-up (personal communications with Ed McLaughlin, Professor of Marketing, and Director of the Food Industry Management Program at Cornell University, Ithaca, New York, 2002, March) over the national average farm gate price (NASS, 2001), the state of Georgia could expect to receive \$ 1.1 million in sales tax revenue from the sale of the final mushroom products.

Medicinal Uses of Mushrooms

Mushrooms offer an especially promising opportunity to discover anti-cancer genes and pathways. A strong medical literature supports the anti-cancer properties of mushrooms (Kurashige, Akuzawa & Endo, 1997; Ooi & Liu, 2000; Nanba, 1997). The mushroom genome, however, is virtually unexplored, as exemplified by the fact that (as of 7 November 2001) there are only 21 DNA sequences from edible mushrooms in GenBank (the leading DNA sequence database) versus 130,266 for maize, 218,973 for soybean, and even 100,925 for minor crops such as

Table 13

State sales tax revenue from sale of final mushroom product

| Mushroom | Pounds produced | Farm gate Price per pound | Retail Price per pound (avg. national price) | Sales revenue | Revenue from 6 % sales tax |
|----------------|-----------------|---------------------------|--|---------------|----------------------------|
| Oak (Shiitake) | 2 million | \$3.00 | \$7.50 | \$15 million | \$900,000.00 |
| Oyster | 200,000 | \$2.18 | \$5.45 | \$1,090,000 | \$65,400.00 |
| "Other" | 331,200 | \$3.76 | \$9.40 | \$3,113,280 | \$186,797.00 |
| Total | 2,531,200 | | | \$19,203,280 | \$1,152,197.00 |





sorghum (Andrew Paterson, Director, Center for Applied Technologies, UGA). Recent technology developed in the Paterson lab at The University of Georgia has provided a new methodology to efficiently capture the "sequence complexity" (the sum total of DNA sequences that make an organism unique) of an organism. The opportunity to capture anti-cancer properties from the production of high-value exotic mushrooms further enhances a sound economic opportunity for Georgia. Special attention will need to be given to the abundance of novel genes that are discovered in mushrooms, but have not yet been described in other organisms studied previously.

The National Research Council (NRC, 2000) reports that a competitively priced bio-based products industry will eventually replace much of the petrochemical industry. Substantial economic opportunities exist through development of genomic enabling tools to accelerate the improvement of plants and animals that are the foundation for bio-based regional industries. Mushrooms may assist with the opportunity to discover the genes that comprise the genetic blueprint of a higher plant or animal at manageable cost. "Genomics," an alternative and complement to controversial biotechnology approaches, will help reap the potential benefits of many research goals in a publicly acceptable manner. "Gene encyclopedias," including most genes that comprise the genetic blueprint of an organism, enable researchers to tailor new genotypes to the needs of bio-based industries through better understanding of the role(s) of each gene in the life cycle.

This goal may be achieved by implementing a new model for a bio-based industry. This new enterprise would integrate research and education with a business plan to develop the necessary technological innovations required for bio-based industries which have so far been overlooked by national research initiatives. The enabling tools to be developed will be useful on national and international scales as well. Key among the shared interests of academic institutions, state governments, and the private

sector, is the nurturing of cadres of young professionals with the training needed to exploit new technology-based enabling tools.

The University of Georgia, the nation's third largest land-grant institution in terms of research expenditures, can provide "home-grown" professionals positioned to advance the state of the regional bio-based industries while preserving their links to rural communities that have long been the victims of "brain drain." Dividends from this investment include new ventures to expand and diversify regional bio-based industry opportunities, assistance for small businesses to compete with multi-nationals by partnering with public researchers as a "virtual R&D resource," strengthening the national science infrastructure by adding enabling tools for new plants and animals, and partnering with existing outreach networks such as local 4-H programs to identify and train "home-grown" professionals with the education needed to exploit these tools.



Yellow Oyster Mushrooms

Uses for Spent Mushroom Spawn

A value added product of the mushroom industry that has potential for income generation and job creation is the utilization of spent mushroom spawn for use as potting soil as well as a soil amendment.

Spent mushroom spawn is an excellent growing medium for not only house plants, but it can be used on lawns, gardens and by farmers to improve soil texture and fertility. This product, if packaged and sold as soil amendment for use by landscapers and as potting soil in garden shops, has the potential to get higher prices than mushrooms. The spent substrate from both specialty mushrooms and Portabello is a sought after commodity. An example of the economic potential of selling spent mushroom spawn involves a landscaping supply company in South Carolina. They sell truckloads of *Agaricus* compost at \$18 / cubic yard. They currently import the product from Pennsylvania and sell it in bulk (J. Sharpe, Dixie Landscaping Supply, Lexington, S.C, personal communication, March, 2002).





Tourism

An opportunity also exists to use mushrooms to enhance tourism. Similar to the attraction of vineyards in the Napa Valley region of Northern California for wine connoisseurs, mushroom aficionados could be enticed to sample fresh mushrooms where they were actually produced. Visitors of course could not have unrestricted access to the growing houses, due to problems associated with contamination; however, tasting rooms or showcase facilities could easily be built into the production facility. This type of activity could be incorporated into a "mushroom trail" type of tourist activity to sample a variety of different mushrooms on a regional basis. This activity could be used as an added incentive to the growing number of tourists who look at alternatives to interstate highway travel.

State Sponsored Products

Generating funds for product research and development is always problematic, but during recessionary times it is doubly difficult. In addition, producers are frequently reluctant to levy taxes and surcharges to fund research activities that have no immediate payoff. In Pennsylvania the state developed an innovative program to generate funds for the mushroom industry. Mushroom growers need containers (cardboard boxes) to get their crop to market. The state devised a program to supply these containers after obtaining them at low prices because of the economies of scale associated with volume buying. The state resells the containers to producers at a modest profit, but still charges less than the producer would normally expect to pay due to the saving realized by the large volume of orders. The income generated is used for projects and research associated with the industry.

A similar type of arrangement could be developed in Georgia. Not only could containers be sold, but because specialty mushrooms are grown in clean environments, coveralls, shoe coverings, rubber gloves, and hair nets could be sold to producers in "bulk" by the state in a similar fashion as the Pennsylvania situation. The income generated could be used to fund the commodity commission as well as other research and development projects.





The results of this study indicate that the development of a specialty mushroom industry in Georgia has significant economic potential, particularly in economically depressed rural areas. Due to the broad-based consumer appeal of specialty mushrooms and its untapped potential, this multi-dimensional industry presents an opportunity to provide Georgia farmers with a product that will be immune from the boom or bust cycle characterizing American agriculture since the 1950s. Capitalizing on the economic potential of a mushroom based industry will require a comprehensive public-private partnership that incorporates the research capabilities of The University of Georgia, the legal authority of the Georgia Department of Agriculture, and the educational/training capabilities and facilities of post secondary institutions. Ultimately, the success of the industry will depend on the willingness of entrepreneurs to invest in the necessary facilities for the proposed mushroom industry. Development of cutting edge technologies will be essential for the Georgia mushroom industry to attract recognition at the national and international level. Comprehensive training programs must be developed to ensure that investors have all of the information that will need to become successful producers. The timely acceptance of key innovations will not only intensify the potential and level of success of Georgia's mushroom industry, but will also define it on the regional, national, and international levels.

The positive economic impacts of a mushroom industry could be increased if the value added aspects of such an industry were maximized. This includes the use of agricultural by-products for spawn development, creation of products that use mushrooms, such as meals ready to eat (heat and serve), e-commerce mushroom sales, bio-regeneration, and bio-mediation using spent mushroom compost, and the use of mushrooms in the pharmaceutical industry. These endeavors will further assist with the creation of much needed job opportunities in rural Georgia.

Other critical issues include the creation of a mushroom commodity commission, licensing, quality control, consumer education, marketing, promotion and state spon-

sored sale of innovative packaging and supplies. In addition, state of the art spawn making facilities, equipment development, producer education and training programs are critical to the development of this industry. Further, a well-developed research and development component, which continually seeks to uncover new and innovative uses and products in the mushroom industry, is crucial.

Finally, factors associated with the success of this industry are clearly present in Georgia. They include a large, growing, and diverse population with familiarity with specialty mushrooms, and available base materials such as land and water. Georgia's location on the eastern seaboard also means close proximity to existing and potentially lucrative markets due to reduced transportation costs. If done properly, this proposed new Georgia industry represents an ecologically sound, regenerative business enterprise that can become the model for Georgia agriculture.

Recommendations

- The structure of Georgia's mushroom industry should be technologically innovative and utilize economies of scale associated with increased production. Small "Mom and Pop" type operations should not be pursued because they have limited chance of success and profitability due to higher production costs and inefficiencies, and limited access to larger and lucrative markets.
- Due to the economic benefits of value added products, efforts should be undertaken to examine the merits of value added mushroom based products. This includes fast food products, meals ready to eat, pharmaceuticals, and the use of alternative substrate materials for spawn production.
- The potential for e-commerce should also be investigated. Mushroom products, made available similar to the fruit in Harry and David's Fruit of the Month Club, have enormous economic potential. The viability of merchandising mushroom thru e-commerce should be examined with a pilot study utilizing an Internet server such as Yahoo.com. "Yahoo! Store" is a feature of this particular server that allows merchandisers to create an online storefront and includes tracking and sales tools which enable producers to evaluate a business venture.





- A fundamental step in the creation of this new industry is the stable supply of superior quality, economically priced mushroom spawn. Due to rapidly changing technologies, and the potential for growth in the mushroom industry, a Georgia spawn production facility should be built. This facility also should be developed in incremental stages to allow for future growth and expansion. This facility must be state-of-the-art and include on-site research capabilities for alternative substrate development and spawn production technology. By significantly reducing the cost of spawn, while maintaining integrity, Georgia can produce and sell spawn to a world wide market.
 - An agricultural commodity requires a research component dedicated to strain improvement and development, preservation and quality control. In addition to basic strain selection and breeding, mushroom genomic research has been initiated at The University of Georgia, where genomic level investigation on other agricultural crops and on medically important fungi is currently being carried out. Ongoing and continued collaboration with The University of Georgia and other research institutions is therefore needed.
 - Additional research regarding alternative substrate development for Portabello mushrooms, one of the best selling in the U.S., is needed to produce this economically successful agricultural product in Georgia. Portobellos are technically not specialty mushrooms; rather they are a brown variety of *Agaricus*. Typically, they are grown on a pasteurized manure/straw substrate, but recent research suggests that they can be grown on a sawdust/grain substrate like other specialty mushroom species. Since the Portabello is a highly lucrative crop, additional research needs to be conducted to maximize its economic potential.
 - An opportunity exists for the state of Georgia to become involved with and profit from the production and sale of essential products for the mushroom industry. These products include the containers for growers to package and transport their product, sanitized coveralls, gloves, and shoe covers for workers, and communication and computer monitoring devices to allow interaction between university researchers, consultants, and individual growers.
- These products can be produced in bulk quantities to achieve cost efficiencies and resold to growers at a fair price while still producing a profit for the state. The profits can be used to fund the commodity commission, create training programs, develop marketing activities, and conduct research.
- Create a Mushroom Commodity Commission operated and controlled by growers. The commission would tightly control production to avoid problems of oversupply which could depress prices and reduce profits. The commission would be funded through the sale of products required by growers. In addition, the commission also should be involved with the marketing, distribution, and production of value added mushroom related products.
 - Due to the relative newness of specialty mushrooms, a series of comprehensive training programs should be developed and initiated. Production training facilities for growers, (laborers and management), distributors, wholesalers, retailers, University researchers, extension agents, chefs, and consumers should be created. The production of educational videos could enhance the success of these training programs. Efforts to incorporate innovative and sound mushroom farming practices and techniques into the current management curriculum of the state's Vocational Technical Colleges and higher educational institutions should be investigated.
 - Efforts to cooperate and network with the poultry, forest and horticulture industry could yield new partnerships and uses for agricultural waste products. In addition, working with various commodity commissions, like the grain and soybean commissions, could provide new uses for Georgia agricultural products for spawn production.
 - Hold a series of state-wide educational meetings to publicize the results of the feasibility study and provide information about opportunities in the mushroom industry. These meetings should be held in various locations around the state using the facilities of institutions of higher education and vocational technical colleges.
 - One of the most popular mushrooms in Georgia and in the U.S. is the Oak mushroom (Shiitake). This product should be renamed to avoid any adverse





connotations or misconceptions which may occur due to its name. The new name should be registered and would become the trademark used to create an identifiable, Georgia produced product that would create brand loyalty. Possible names include "Georgia Oak Mushroom" or "Georgia Red Oak Mushroom".

- The potential use of mushrooms in bio-medical research has been shown to have considerable merit. Therefore, producing mushrooms for bio-medical research at laboratories for medical research should be explored at The University of Georgia and other educational institutions.
- The following mushroom farm construction and production levels are recommended for the establishment of an effective specialty mushroom industry in Georgia. Two to 10 oak (Shiitake) mushroom farms (depending on scale) producing approximately 2 million pounds annually. One or two dedicated Oyster mushroom farms producing a total of 200,000 pounds annually. One farm each for Snow Crab, Frondosa, Enoki, and Velvet Ear mushrooms producing a combined 330,000 pounds annually. It is also recommended that spawn making be divided into a single master spawn facility and several satellite production spawn facilities. This will reduce the possibility of contamination in the master spawn facility and create a more efficient distribution network to farmers.
- Future research is needed to investigate ways of improving the shelf life and packaging of specialty mushrooms to increase shipping distances. This would allow Georgia mushrooms producers to reach more and distant markets and ultimately would help to reduce costs to the consumer.
- Mushroom growing, spawn research, and value added production facilities should be strategically located across the state to maximize the economic impact of those facilities. Locating these facilities, where feasible, in Tier 1 economically depressed rural areas should be given serious consideration.
- Substrate research and development activities represent an important ongoing component of the present and future growth of the mushroom industry. Determining efficient uses of alternative substrates can improve production and enhance collaboration with other agricultural and forestry units seeking to manage waste materials. Efforts which improve and lower the cost of spawn benefit the entire industry including consumers. Substrate research and development also plays a role in economic development as the mushroom industry continues to grow and expand. Supplying spawn to not only Georgia but U.S. growers could become a lucrative enterprise. In addition, mushroom substrate is an agricultural waste product and its expanded uses creates a valuable commodity out of previously discarded products. Finally, building and maintaining substrate research facilities could also generate job opportunities particularly in rural areas.





References

- Alabama A&M University. (1998) School of Agricultural and Environmental Sciences. Tennessee Valley Authority Agricultural Institute Small and Part Time Farmers Program. (<http://saes.aamu.edu/sust.htm>).
- American Mushroom Institute (AMI). (2001, February). *Mushroom News*, Vol. 49 No.2.
- American Mushroom Institute (AMI). (2001, May). *Mushroom News*, Vol. 49 No.5.
- Arora, D. (1986). *Mushrooms Demystified*. (2nd ed.) Berkley: Ten Speed Press.
- Bon Appetit. (2001). (<http://eat.epicurious.com>).
- Buchanon, G. A. (2001, August) UGA College of Agricultural and Environmental Sciences. "Impact of Agriculture on Georgia's Economy: Executive Summary." Third Annual Symposium on the Future of American Agriculture: Southern Region. Can Production Agriculture Survive? Athens, Georgia.
- Canadian Food Inspection Agency. (2001, August). "Allergy Alert: Yu's farm fresh shittake mushrooms may contain sulphites."
- Centner, T.J., Turner, S.C & Bryan, J.T. (1988). Differentiating Vidalia Onions to preserve grower's price premium. University of Georgia, Department of Agricultural Economics. FS88-08.
- Chang, R. (1996). Functional properties of edible mushrooms. *Nutrition Reviews*. Vol. 54. Issue 11. Part 2. pp.91-93.
- Chang S. T. (1974). Production of the straw mushroom (*Volvariella volvacea*) from cotton wastes. *The Mushroom Journal*. 21, 348.
- Chang, S. T. & Miles, P. G. (1989). *Edible mushrooms and their cultivation*. Boca Raton, Florida: CRC Press, Inc.
- Chernoff, R. (1995). Baby Boomers Come of Age: Nutrition in the 21st Century. *Journal of the American Dietetic Association*. Vol. 95. Issue 6.
- Doherty, B. A. & McKissick, J. C. (2000, October). "The Economic Importance of Food and Fiber Production and Processing to Georgia's Rural Economy." University of Georgia, College of Agricultural and Environmental Sciences.
- Elliot, R. (1988) *The complete vegetarian cuisine*. Pantheon books.
- Ferland, C., McKissick, J. C., & Reynolds, A. E. (2001, April). "Report on the Feasibility of a Goat Meat Processing Facility in Washington County Georgia Area (Draft)." University of Georgia, College of Agricultural and Environmental Sciences.
- Food and Agriculture Organization of The United Nations (FAO). (2001). FAOSTAT online database, Agricultural production, Crops primary, World mushroom production.
- The Food Network. (<http://www.foodtv.com>).
- Frederick, D.A. (1997). USDA: Rural Business-Cooperative Service, Cooperative Information Report 55: Co-ops 101 An Introduction to Cooperatives.
- Freeman, D., Lahiry, S., Mundt, H., Rogg, K., & Sakura, C. (2000). Competitive Market Analysis of the Specialty Mushroom Industry; The Growing Company. University of Georgia, Terry College of Business Consulting Team.
- Georgia Agricultural Facts, 2001 Farm and Income Expenses report. Georgia Agricultural Statistical Services. (www.nass.usda.gov/ga/pubs/agfacts/fmncsec.pdf).
- Georgia Rural Development Council Technical Advisory Committee. (2001, September) State of Rural Georgians: Executive Summary.
- Gourmet Magazine. (2002). (<http://eat.epicurious.com/gourmet>).
- Guzman, G. (1989). El uso de los hongos in Mesoamerica. *Ciencia y Desarrollo*. 9/59:17- 27.
- Haygood, T. M. (1987). *Henry William Ravenel, 1814-1887: South Carolina scientist in the civil war era*. Tuscaloosa: The University of Alabama Press.
- Horovitz, B. (1999, December 3). Selling pears at \$5 a pound picture-perfect fruit feeds Harry and David's success. *USA Today*.





- Huang, W. T., & Epperson, J. E. (1990). A Dynamic control approach to discerning the potential for a supply-management marketing order for southeastern sweet onions. University of Georgia, Georgia Agr. Exp. Sta. Faculty Ser. FS90-13, 15.
- Humphreys, J. M. (2000, July-August). Georgia Business and Economic Conditions. Vol. 60, No. 4. University of Georgia, Terry College of Business, Selig Center for Economic Growth.
- Klemenc, S. E. (2001, November/December). Kitchens are bigger, better and more beautiful. Georgia Builder. 16-20.
- Libbon, R. P. (2000, April). Datadog. *American Demographics*. Vol. 22, Issue 4.
- Litwak, D. (1998, July). Nature's newest private label. *Supermarket Business*. New York.
- Merrett, C.D., & Walzer, N. (2001). *A Cooperative approach to local economic development*. Quorum Books: Westport, Conn.
- National Agricultural Statistics Service (NASS). (2001, 2000, 1999, 1998, 1997, 1996, 1995, and 1994, August). Mushrooms. (Vg 2-1-2(8-01)-(8-94)). U.S. Department of Agriculture, Agricultural Statistics Board.
- National Council of Farmer Cooperatives (NCFC). (<http://www.ncfc.org>).
- National Research Council. (2000). Renewable power pathways: A review of the U.S. Department of Energy's renewable energy programs. Committee on programmatic review of the U.S. Department of Energy's Office of Power Technologies, Board on Energy and Environmental Systems.
- National Rural Electric Cooperative Association (NRECA) (<http://www.nreca.org>).
- Pennsylvania State University (PSU), College of Agricultural Sciences. (2001) Mushroom Production: Sweetening the Smell. *Pennsylvania Impact*.
- Produce Marketing Association (PMA) Fresh Summit Workshop Summary. (2001) Fresh Trends 2001: Understanding Consumers and Produce.
- RSSL-food e-news. "Product recall of shiitake mushrooms containing formaldehyde." (2001, July 11-18). (rssl.com/food-enews).
- Sanchez, J. E. & Royse, D. L. (2001) Adapting substrate formulas used for shiitake for production of brown *Agaricus bisporus*. *Bioresource Technology* 77: 65-69.
- Smith, A. (1999, April). Enjoying the view. *Progressive Grocer*.
- Stamets, P. (2000). *Growing Gourmet and Medicinal Mushrooms*. Ten Speed Press. Berkeley, California.
- Stein, H. & Foss, M. (1999). *The Illustrated guide to the American economy*. The American Enterprise Institute Press: Washington D.C.
- SPSS Base System Syntax Reference Guide 6.0. (1993). SPSS Inc.
- Uhl, S. (2001, July). America's taste heads south...of the border. *Food Product Design*.
- U.S. Census Bureau, County Population Estimates and Demographic Components of Population Change: Annual Time Series. July 1, 1990 to July 1, 1999.
- U.S. Census Bureau. (2000). Statistical Abstract of the United States.
- U.S. Department of Agriculture. (1996, March). New Agricultural Products. 3/96.
- U.S. Department of Agriculture, Economic Research Service. (2001, July). Vegetables and specialties yearbook.
- U.S. Department of Agriculture, Economic Research Service. (2001, December). Mushroom industry report.
- U.S. Department of Agriculture, Rural Development Administration, Cooperative Services. (1998) Farmer Cooperative Statistics, 1998. CS Service Report 43.
- Wong, G., (2001). Lecture Notes BOT135 Magical Mushrooms and Mystical Molds. (www.botany.hawaii.edu/faculty/wong/BOT135/Lect18.htm). Subject: Re: Mushrooms





ENDNOTES

1. The following analysis suggests that historically, economic contractions do not affect the domestic consumption of mushrooms and would not be a factor in the degree of success of the proposed Georgia specialty mushroom industry. Since inception of the U.S. specialty mushroom industry 25 years ago there has never been a decline in domestic mushroom production, or sales, during an economic contraction. Since 1973, the U.S. has experienced the following economic contractions (Stein & Foss, 1999): November 1973-March 1975, January 1980-July 1980, July 1990-March 1991, and Current 2001. During the same time periods there has been only one year that the domestic mushroom market experienced a decline in value of sales. The total dollar value of sales (Fresh and processed) decreased from \$ 731,173,00 in 1994-1995 to \$727,578,000 in 1995-96. (NASS, 1994, 1995). Since domestic production increased during this time from 541 million pounds to 546 million pounds, it must be concluded that the dip in the dollar value is due to a drop in price. Further, it was not in a year of economic contraction.
2. Technically, the number assigned for duties or tariffs is for "non-*Agaricus*" mushrooms. All non-*Agaricus* mushrooms are considered specialty mushrooms, but not all specialty mushrooms are non-*Agaricus*. Specifically, two mushrooms classified as specialty, Portabello and Crimini, are brown varieties of *Agaricus* mushrooms. In terms of mushroom import statistics, however, the terms non-*Agaricus* and specialty can be considered synonymous since most imports are Shiitake, which are non-*Agaricus* mushrooms.
3. The 2000 Census of Population and Housing has been conducted, however, the data regarding income and other similar types of information have not been released for inclusion in this report. As a result, information from the 1990 census was used to develop the following section. This information, although dated, is still a useful measure to determine the amount of mushrooms because fluctuations in structural variables such as income are not subject to rapid shifts or swings because they take rather long periods of time to change.
4. The monetary value of the 2000-2001 season showed a healthy rise again with combined specialty mushroom sales equating to \$156 million dollars. To determine the percentage of specialty mushrooms grown, including Portabello and Crimini, the NASS crop report for the 2000-2001 season was used. In the report the Portabello and Crimini were added into the total *Agaricus* (button) mushrooms as "brown mushrooms", while Shiitakes (Oak), Oysters, and "Others" were separately tabulated. We first took the total number of *Agaricus* pounds produced (839 million) and then added all specialty mushrooms (15.5 million pounds), which totaled 854.5 million pounds. Then we took the total number of Portabello and Criminis produced (96.3 million) and added Shiitake, Oyster and "Other" pounds produced (15.5 million), resulting in 111.8 million pounds. For the complete percentage of *all specialty mushrooms* grown relative to total U.S. mushroom production this last season, we divided the number of pounds produced of specialty mushrooms by the total number of pounds produced of All mushrooms and multiplied by one hundred. The conclusion was that specialty mushrooms comprised 13 percent of the entire mushrooms grown. That is, $(111.8 \text{ million} / 854.5 \text{ million}) \times 100 = 13\%$.





APPENDIX A

ELEMENTS OF THE SPECIALTY MUSHROOM FEASIBILITY STUDY

The University of Georgia Mushroom Feasibility Study will examine the following issues:

- Research the potential consumer market for growing and distributing specialty mushrooms.
- Analyze attitudes and experiences with specialty mushrooms of wholesale and retail food distributors key decision makers.
- Investigate the potential for developing value added products derived from mushrooms such as ready to eat prepackaged mushroom dinners and meals.
- Analyze the optimum building size, equipment needs, and technology requirements for producing specialty mushrooms as well as mushroom spawn producing equipment.
- Examine labor needs and requirements.
- Develop profiles of economically depressed rural areas to locate possible sites for establishment of the mushroom farms, centralized spawn production facilities, transportation needs and networks, warehouses, growing medium requirements, demonstration farms, and management training programs needs and locations.
- Investigate the organizational structure needed to ensure optimal development of the specialty mushroom industry. This includes farm size requirements, capital investments, equipment needs, labor requirements, loan availability, choice of specialty mushroom varieties, creation of cooperative ventures, investigation of potential benefits and limitations of vertical integration, geographic concentration of farms, environmental and food safety concerns, legal requirements and potential barriers to cooperative marketing agreements and arrangements, and potential for public/private cooperation.
- Explore the research and training needs required by the mushroom industry. This includes basic biological research on mushrooms, alternative growing mediums, development of disease resistant varieties, acquisition of new and improved strains, equipment needs, management requirements, the role of technology, and remote monitoring of mushroom farm cultivation conditions.
- Examine the feasibility of alternative uses of mushrooms in industrial, commercial, medical, and food uses.

APPENDIX B

MUSHROOM INTERNET SITES

Commercial mushroom support organizations

<http://www.americanmushroom.org>
The American Mushroom Institute

<http://www.mushroomcouncil.com/>
The Mushroom Council

<http://mushroomspawn.cas.psu.edu/>
Penn State University mushroom research and information

Mushroom production organizations

<http://www.biopilze.de/>
German organic mushroom grower

<http://www.thegrowingcompany.com>
The Growing Company home page

<http://www.montmush.com/>
Monterey Mushroom home page

<http://www.phillipsmushroomfarms.com/>
Phillips Mushroom Farm Site

<http://www.sylvaninc.com>
Sylvan Inc., worldwide mushroom spawn producer

Value added mushroom products companies

<http://www.fungi.com/>
Fungi Perfecti, a supplier of materials and supplies for growing specialty mushroom

<http://209.238.83.52/dixielandscape/mushroom.htm>
Mushroom compost sales

<http://www.nammex.com/>

<http://www.treeoflife-medicinals.com/>
Mushroom extract companies

www.gmushrooms.com
A mushroom product company

Miscellaneous informational sites with mushroom links

<http://www.keil.ukans.edu/~fungi/>
Internet virtual library for mycology

<http://www.mv.com/ipusers/dhabolt/dad/linkcommercial.html>
Links to various commercial mushroom sites





APPENDIX C

SPECIALTY MUSHROOM DIVERSITY AND SUBSTRATES FOR MUSHROOM PRODUCTION

| Scientific name | Common name(s) | Substrate |
|-------------------------------|---------------------------------------|---|
| <i>Agaricus bisporus</i> | Portabello | Manure enriched straw (grain enriched sawdust) |
| <i>Agaricus bisporus</i> | Crimini | Manure enriched straw (grain enriched sawdust) |
| <i>Lentinula edodes</i> | Oak mushroom or Shiitake | Grain enriched hardwood sawdust |
| <i>Pleurotus spp</i> | | Straw,cottonseed hulls, peanut hulls, sawdust etc |
| <i>P. ostreatus</i> | Oyster mushroom | |
| <i>P. citrinopileatus</i> | Golden oyster mushroom | |
| <i>P. djamor</i> | Pink oyster mushroom | |
| <i>Hericium erinaceus</i> | Snow Crab or Pom-pom | Grain enriched hardwood sawdust |
| <i>Grifola frondosa</i> | Frondosa, maitake or hen-of-the-woods | Grain enriched hardwood sawdust |
| <i>Auricularia polytricha</i> | Velvet ear | Grain enriched hardwood sawdust |
| <i>Pholiota nameko</i> | Nameko | Bran supplemented hardwood sawdust |
| <i>Flammulina velutipes</i> | Enoki | Grain enriched hardwood sawdust |
| <i>Morchella esculenta</i> | Morel | Experimental |
| <i>Volvariella volvacea</i> | Paddy Straw mushroom | Rice straw, wheat straw |
| <i>Cantharellus cibareus</i> | Chantrelle | Mycorrhizal - experimental |

Source: Arora, D. (1986); Chang, S.T. & Miles, P.G. (1989).





APPENDIX D

STATISTICAL PROFILE OF TIER 1 COUNTIES

| County | Tier | POPULATION | | | | | | | 2000 Unemp Rate | 1998 Percent Living in Poverty | 1990 Percent Without H.S. Diploma | 1999 Percent Unwed Births | | |
|-----------------|------|----------------|---------|-----------------------------|---------------------------------|------------------------------|-----------------------|---|-----------------------|---|--|------------------------------------|--|------------------------------------|
| | | Percent Change | | Total Dependent Ratio | 1990 Percent Mobile Homes | 1999 Per Capita Income | 2000 Unemp Rate | 1998 Percent Living in Poverty | | | | | 1990 Percent Without H.S. Diploma | 1999 Percent Unwed Births |
| | | 1990-00 | 2000 | | | | | | | | | | | |
| APPLING | 1 | 10.6% | 17,419 | 30.8% | 19.6% | 63.9 | 29.6% | \$17,737 | 8.5 | 19.5% | 39.6% | | | |
| ATKINSON | 1 | 22.5% | 7,609 | 10.4% | 19.6% | 65.6 | 33.1% | \$19,843 | 7.5 | 23.3% | 42.4% | | | |
| BACON | 1 | 5.6% | 10,103 | 43.2% | 15.7% | 64.0 | 23.2% | \$18,891 | 6.1 | 20.8% | 45.8% | | | |
| BAKER | 1 | 12.7% | 4,074 | -47.9% | 50.4% | 69.5 | 30.3% | \$20,940 | 5.0 | 23.4% | 41.7% | | | |
| BALDWIN | 2 | 13.1% | 44,700 | 95.4% | 43.4% | 47.7 | 22.9% | \$21,267 | 4.4 | 17.9% | 53.7% | | | |
| BANKS | 3 | 39.9% | 14,422 | 48.6% | 3.2% | 57.9 | 32.9% | \$19,408 | 3.2 | 14.0% | 30.8% | | | |
| * BARROW | 3 | 55.3% | 46,144 | 272.1% | 9.7% | 60.0 | 23.0% | \$21,127 | 3.1 | 11.6% | 25.1% | | | |
| * BARTOW | 3 | 36.0% | 76,019 | 199.7% | 8.7% | 59.5 | 25.8% | \$22,755 | 4.1 | 11.0% | 30.4% | | | |
| BEN HILL | 1 | 7.6% | 17,484 | 34.0% | 32.6% | 69.0 | 19.6% | \$22,537 | 6.2 | 20.6% | 55.4% | | | |
| BERRIEN | 1 | 14.7% | 16,235 | 10.8% | 11.4% | 65.9 | 29.4% | \$18,454 | 5.6 | 19.3% | 33.0% | | | |
| * BIBB | 2 | 2.5% | 153,887 | 99.7% | 47.3% | 64.8 | 3.4% | \$26,895 | 4.8 | 20.3% | 51.6% | | | |
| BLECKLEY | 2 | 11.9% | 11,666 | 27.7% | 24.6% | 67.1 | 19.7% | \$21,771 | 3.7 | 18.0% | 41.8% | | | |
| BRANTLEY | 1 | 32.1% | 14,629 | 112.2% | 4.0% | 62.4 | 46.7% | \$17,413 | 5.8 | 18.6% | 34.5% | | | |
| BROOKS | 1 | 6.8% | 16,450 | -22.9% | 39.3% | 72.1 | 25.5% | \$18,037 | 5.7 | 23.9% | 56.6% | | | |
| * BRYAN | 3 | 51.7% | 23,417 | 293.4% | 14.1% | 62.3 | 30.8% | \$21,314 | 2.8 | 11.3% | 31.4% | | | |
| BULLOCH | 2 | 29.8% | 55,983 | 111.2% | 28.8% | 46.2 | 20.3% | \$19,582 | 2.7 | 19.4% | 39.9% | | | |
| BURKE | 1 | 8.1% | 22,243 | -23.9% | 51.0% | 72.8 | 29.6% | \$16,386 | 7.8 | 24.7% | 61.0% | | | |
| BUTTS | 2 | 27.4% | 19,522 | 108.9% | 28.8% | 52.2 | 16.5% | \$19,994 | 5.2 | 15.4% | 47.4% | | | |
| CALHOUN | 1 | 26.1% | 6,320 | -40.2% | 60.6% | 53.0 | 19.4% | \$21,646 | 8.1 | 28.8% | 55.2% | | | |
| CAMDEN | 3 | 44.7% | 43,664 | 588.9% | 20.1% | 58.5 | 22.6% | \$16,904 | 3.5 | 10.9% | 26.0% | | | |
| CANDLER | 1 | 23.7% | 9,577 | 6.5% | 27.1% | 72.4 | 27.8% | \$19,617 | 5.1 | 24.3% | 49.7% | | | |
| * CARROLL | 2 | 22.2% | 87,268 | 154.6% | 16.3% | 56.0 | 20.1% | \$21,031 | 4.1 | 13.9% | 34.4% | | | |
| * CATOOSA | 3 | 25.5% | 53,282 | 465.6% | 1.3% | 60.5 | 17.8% | \$19,871 | 2.5 | 11.3% | 25.5% | | | |
| CHARLTON | 1 | 21.0% | 10,282 | 134.7% | 29.3% | 59.1 | 39.6% | \$16,817 | 4.2 | 18.6% | 45.3% | | | |
| * CHATHAM | 3 | 7.0% | 232,048 | 120.1% | 40.5% | 60.9 | 6.2% | \$27,910 | 3.8 | 18.2% | 46.4% | | | |
| * CHATTAHOOCHEE | 2 | -12.1% | 14,882 | 67.3% | 29.9% | 43.3 | 14.5% | \$23,792 | 7.9 | 14.6% | 16.5% | | | |
| CHATTOOGA | 2 | 14.5% | 25,470 | 65.3% | 11.2% | 59.2 | 18.5% | \$19,770 | 3.1 | 14.8% | 40.9% | | | |
| * CHEROKEE | 4 | 57.3% | 141,903 | 609.4% | 2.5% | 53.5 | 12.7% | \$25,900 | 2.0 | 6.0% | 16.5% | | | |
| * CLARKE | 3 | 15.9% | 101,489 | 296.2% | 27.3% | 35.0 | 7.6% | \$24,985 | 2.7 | 18.2% | 44.1% | | | |
| CLAY | 1 | -0.2% | 3,357 | -51.6% | 60.5% | 82.6 | 28.7% | \$17,082 | 6.5 | 30.9% | 57.8% | | | |
| * CLAYTON | 3 | 30.4% | 236,517 | 2205.2% | 51.6% | 55.9 | 3.8% | \$22,277 | 3.6 | 13.4% | 45.4% | | | |
| CLINCH | 1 | 11.7% | 6,878 | -2.0% | 29.5% | 65.8 | 25.7% | \$18,379 | 5.7 | 21.1% | 49.5% | | | |





POPULATION

| County | Tier | 2000 | Percent Change | | 2000 Percent Black* | Total Dependent Ratio | 1990 Percent Mobile Homes | 1999 Per Capita Income | 2000 Unemp Rate | 1998 Percent Living in Poverty | 1990 Percent Without H.S. Diploma | 1999 Percent Unwed Births |
|-----------------|----------|---------------|----------------|---------------|---------------------------|-----------------------------|---------------------------------|------------------------------|-----------------------|---|--|------------------------------------|
| | | | 1990-00 | 1930-00 | | | | | | | | |
| * COBB | 4 | 607,751 | 35.7% | 1616.4% | 18.8% | 49.2 | 2.6% | \$35,974 | 2.5 | 6.5% | 14.2% | 24.4% |
| COFFEE | 2 | 37,413 | 26.4% | 89.5% | 25.9% | 61.7 | 29.4% | \$21,686 | 5.3 | 20.3% | 42.0% | 42.5% |
| COLOUITT | 1 | 42,053 | 14.8% | 37.3% | 23.5% | 67.5 | 20.8% | \$19,504 | 5.9 | 21.7% | 43.0% | 45.6% |
| * COLUMBIA | 4 | 89,288 | 35.2% | 915.4% | 11.2% | 60.2 | 14.9% | \$22,931 | 2.7 | 7.6% | 18.9% | 20.9% |
| COOK | 1 | 15,771 | 17.2% | 39.4% | 29.1% | 70.1 | 26.1% | \$18,276 | 5.1 | 20.4% | 44.8% | 37.7% |
| * COWETA | 4 | 89,215 | 65.7% | 255.1% | 18.0% | 59.3 | 11.9% | \$24,237 | 3.4 | 9.5% | 32.6% | 27.6% |
| CRAWFORD | 2 | 12,495 | 39.0% | 78.0% | 23.8% | 58.2 | 34.5% | \$19,097 | 4.1 | 14.8% | 39.8% | 28.7% |
| CRISP | 1 | 21,996 | 9.9% | 26.8% | 43.4% | 72.3 | 18.5% | \$20,343 | 6.1 | 27.5% | 43.8% | 61.3% |
| * DADE | 2 | 15,154 | 15.3% | 265.5% | 0.6% | 55.9 | 25.9% | \$18,714 | 2.6 | 13.7% | 44.7% | 20.7% |
| DAWSON | 4 | 15,999 | 69.7% | 356.9% | 0.4% | 52.4 | 29.3% | \$23,691 | 1.6 | 10.5% | 39.9% | 14.6% |
| DECATUR | 1 | 28,240 | 10.7% | 19.5% | 39.9% | 71.8 | 20.5% | \$19,879 | 5.8 | 23.8% | 40.2% | 47.7% |
| * DEKALB | 4 | 665,865 | 21.9% | 847.5% | 54.2% | 48.4 | 0.3% | \$33,592 | 3.6 | 12.9% | 16.1% | 41.9% |
| DODGE | 1 | 19,171 | 8.9% | -11.2% | 29.4% | 64.5 | 21.7% | \$18,581 | 4.6 | 21.8% | 43.2% | 34.9% |
| DOOLY | 1 | 11,525 | 16.4% | -36.1% | 49.5% | 59.7 | 22.2% | \$18,690 | 6.5 | 27.6% | 45.3% | 54.1% |
| * DOUGHERTY | 1 | 96,065 | -0.3% | 330.7% | 60.1% | 64.8 | 7.0% | \$22,985 | 6.9 | 23.9% | 32.5% | 59.3% |
| * DOUGLAS | 4 | 92,174 | 29.6% | 874.3% | 18.5% | 54.2 | 11.5% | \$23,917 | 2.7 | 8.6% | 27.7% | 25.7% |
| EARLY | 1 | 12,354 | 4.2% | -32.4% | 48.1% | 79.9 | 19.6% | \$21,115 | 7.6 | 29.4% | 45.9% | 57.0% |
| ECHOLS | 1 | 3,754 | 60.8% | 36.8% | 6.9% | 62.2 | 42.0% | \$18,290 | 4.7 | 19.5% | 39.0% | 26.7% |
| * EFFINGHAM | 3 | 37,535 | 46.1% | 269.3% | 13.0% | 61.2 | 36.2% | \$21,764 | 2.9 | 10.5% | 34.0% | 27.3% |
| ELBERT | 1 | 20,511 | 8.2% | 11.0% | 30.9% | 68.8 | 21.2% | \$21,302 | 7.8 | 18.5% | 45.7% | 43.5% |
| EMANUEL | 1 | 21,837 | 6.3% | -9.4% | 33.3% | 69.9 | 20.1% | \$18,336 | 9.5 | 26.3% | 47.4% | 54.6% |
| EVANS | 1 | 10,495 | 20.3% | 47.8% | 33.0% | 66.9 | 26.0% | \$19,774 | 4.8 | 23.6% | 41.5% | 50.3% |
| FANNIN | 2 | 19,798 | 23.8% | 52.7% | 0.1% | 66.5 | 17.6% | \$18,495 | 3.1 | 16.5% | 44.2% | 27.7% |
| * FAYETTE | 4 | 91,263 | 46.2% | 953.2% | 11.5% | 61.2 | 8.0% | \$31,922 | 1.9 | 3.8% | 13.5% | 14.0% |
| FLOYD | 3 | 90,565 | 11.5% | 86.1% | 13.3% | 62.6 | 9.6% | \$24,509 | 3.6 | 15.3% | 36.1% | 37.0% |
| * FORSYTH | 4 | 98,407 | 123.2% | 826.3% | 0.7% | 53.8 | 21.8% | \$31,576 | 1.5 | 4.7% | 32.4% | 11.5% |
| FRANKLIN | 2 | 20,283 | 21.8% | 27.6% | 8.8% | 64.6 | 25.7% | \$22,492 | 3.5 | 16.5% | 45.9% | 31.1% |
| * FULTON | 3 | 816,006 | 25.8% | 143.4% | 44.6% | 49.0 | 0.4% | \$45,473 | 3.7 | 17.4% | 22.2% | 45.3% |
| GILMER | 2 | 23,456 | 75.5% | 219.4% | 0.3% | 59.9 | 25.0% | \$19,635 | 3.3 | 15.2% | 47.7% | 28.2% |
| GLASCOCK | 2 | 2,556 | 8.4% | -41.8% | 8.3% | 72.6 | 31.0% | \$19,496 | 4.5 | 16.2% | 49.7% | 27.3% |
| GLYNN | 3 | 67,568 | 8.1% | 248.3% | 26.5% | 66.0 | 12.9% | \$27,888 | 3.5 | 15.6% | 25.7% | 47.2% |
| GORDON | 3 | 44,104 | 25.8% | 161.8% | 3.5% | 57.9 | 17.0% | \$21,812 | 3.7 | 13.0% | 41.6% | 32.5% |
| GRADY | 1 | 23,659 | 16.7% | 23.2% | 30.1% | 68.1 | 23.8% | \$18,794 | 6.3 | 22.8% | 45.1% | 40.1% |
| GREENE | 1 | 14,406 | 22.2% | 14.2% | 44.4% | 65.2 | 18.4% | \$20,292 | 6.1 | 19.8% | 48.8% | 55.1% |
| * GWINNETT | 4 | 588,448 | 66.7% | 2012.7% | 13.3% | 50.6 | 3.6% | \$31,893 | 2.3 | 5.4% | 13.3% | 19.3% |
| HABERSHAM | 3 | 35,902 | 30.0% | 181.6% | 4.5% | 59.6 | 22.4% | \$23,525 | 3.4 | 11.7% | 41.0% | 24.5% |
| HALL | 4 | 139,277 | 45.9% | 359.5% | 7.3% | 57.0 | 19.9% | \$25,631 | 2.3 | 11.9% | 34.9% | 31.6% |





POPULATION

| County | Tier | 2000 | Percent Change | | 2000 | Total Dependent Ratio | 1990 Percent Mobile Homes | 1999 Per Capita Income | 2000 Unemp Rate | 1998 Percent Living in Poverty | 1990 Percent Without H.S. Diploma | 1999 Percent Unwed Births |
|------------|------|---------|----------------|---------|-------|-----------------------------|---------------------------------|------------------------------|-----------------------|---|--|------------------------------------|
| | | | 1990-00 | 1930-00 | | | | | | | | |
| HANCOCK | 1 | 10,076 | 13.1% | -22.9% | 77.8% | 56.4 | 31.7% | \$16,787 | 9.5 | 26.7% | 50.5% | 80.9% |
| HARALSON | 2 | 25,690 | 17.0% | 93.7% | 5.4% | 64.2 | 24.9% | \$19,923 | 4.4 | 15.9% | 44.0% | 29.1% |
| * HARRIS | 4 | 23,695 | 33.2% | 112.7% | 19.5% | 60.1 | 20.6% | \$26,403 | 2.9 | 10.9% | 35.0% | 27.9% |
| HART | 2 | 22,997 | 16.7% | 51.6% | 19.4% | 66.7 | 22.4% | \$21,069 | 4.4 | 14.7% | 43.1% | 33.0% |
| HEARD | 1 | 11,012 | 27.6% | 21.0% | 10.8% | 65.9 | 37.0% | \$17,583 | 5.5 | 16.6% | 50.9% | 32.9% |
| * HENRY | 4 | 119,341 | 103.2% | 649.4% | 14.7% | 57.7 | 11.9% | \$22,630 | 2.1 | 6.0% | 27.1% | 20.5% |
| * HOUSTON | 3 | 110,765 | 24.2% | 882.0% | 24.8% | 59.9 | 12.1% | \$22,913 | 3.3 | 11.6% | 20.5% | 34.7% |
| IRWIN | 2 | 9,931 | 14.8% | -18.6% | 25.9% | 75.0 | 22.6% | \$20,832 | 5.7 | 21.6% | 46.9% | 40.0% |
| JACKSON | 3 | 41,589 | 38.6% | 92.5% | 7.8% | 58.8 | 32.1% | \$23,095 | 2.7 | 13.8% | 45.5% | 28.8% |
| JASPER | 3 | 11,426 | 35.2% | 33.0% | 27.3% | 64.1 | 22.8% | \$21,590 | 3.9 | 16.5% | 35.4% | 40.7% |
| JEFF DAVIS | 1 | 12,684 | 5.4% | 56.2% | 15.1% | 64.4 | 26.7% | \$18,311 | 6.1 | 18.8% | 44.8% | 43.1% |
| JEFFERSON | 1 | 17,266 | -0.8% | -16.7% | 56.3% | 72.6 | 25.2% | \$17,673 | 9.2 | 25.2% | 50.3% | 60.8% |
| JENKINS | 1 | 8,575 | 4.0% | -33.6% | 40.5% | 72.6 | 25.2% | \$18,174 | 6.0 | 25.0% | 50.1% | 57.6% |
| JOHNSON | 1 | 8,560 | 2.8% | -32.5% | 37.0% | 84.3 | 25.1% | \$18,845 | 7.1 | 24.3% | 48.0% | 58.7% |
| * JONES | 3 | 23,639 | 14.0% | 162.9% | 23.3% | 59.9 | 30.6% | \$22,118 | 4.1 | 10.8% | 29.8% | 38.3% |
| LAMAR | 2 | 15,912 | 22.0% | 63.3% | 30.4% | 58.9 | 18.7% | \$18,852 | 6.4 | 16.6% | 42.0% | 43.6% |
| LANIER | 1 | 7,241 | 30.9% | 39.5% | 25.6% | 61.4 | 33.3% | \$17,675 | 5.7 | 21.2% | 48.8% | 39.0% |
| LAURENS | 1 | 44,874 | 12.2% | 37.3% | 34.5% | 67.0 | 22.0% | \$20,920 | 5.9 | 20.0% | 39.0% | 43.2% |
| * LEE | 3 | 24,757 | 52.4% | 197.3% | 15.5% | 58.7 | 27.4% | \$20,013 | 4.0 | 10.5% | 30.2% | 29.1% |
| LIBERTY | 2 | 61,610 | 16.8% | 655.7% | 42.8% | 56.0 | 27.1% | \$16,116 | 5.9 | 21.5% | 17.9% | 24.5% |
| LINCOLN | 1 | 8,348 | 12.2% | 6.4% | 34.4% | 63.9 | 36.4% | \$18,992 | 9.4 | 17.7% | 40.8% | 47.1% |
| LONG | 1 | 10,304 | 66.1% | 146.5% | 24.3% | 63.6 | 55.6% | \$13,819 | 3.4 | 20.3% | 36.4% | 25.9% |
| LOWNDES | 2 | 92,115 | 21.2% | 207.1% | 34.0% | 54.3 | 14.7% | \$22,760 | 5.6 | 19.6% | 30.2% | 40.8% |
| LUMPKIN | 3 | 21,016 | 44.2% | 326.5% | 1.5% | 51.5 | 32.2% | \$22,455 | 1.8 | 13.6% | 39.8% | 22.9% |
| MACON | 1 | 14,074 | 7.3% | -15.4% | 59.5% | 67.6 | 18.8% | \$19,927 | 9.6 | 26.4% | 46.3% | 62.7% |
| * MADISON | 3 | 25,730 | 22.2% | 72.4% | 8.5% | 59.4 | 36.6% | \$21,260 | 2.6 | 14.3% | 40.3% | 27.7% |
| MARION | 1 | 7,144 | 27.8% | 2.5% | 34.1% | 63.6 | 31.9% | \$16,481 | 4.5 | 20.3% | 45.5% | 44.4% |
| * MCDUFFIE | 1 | 21,231 | 5.5% | 135.5% | 37.5% | 66.0 | 24.7% | \$20,764 | 5.7 | 19.7% | 43.9% | 58.3% |
| MCINTOSH | 1 | 10,847 | 25.6% | 88.2% | 36.8% | 66.2 | 40.6% | \$16,450 | 5.1 | 21.6% | 43.1% | 49.7% |
| MERIWETHER | 1 | 22,534 | 0.5% | 0.4% | 42.2% | 67.3 | 25.1% | \$19,403 | 6.0 | 19.2% | 48.4% | 53.4% |
| MILLER | 2 | 6,383 | 1.6% | -29.7% | 28.9% | 76.7 | 18.6% | \$22,270 | 5.4 | 23.0% | 42.6% | 52.8% |
| MITCHELL | 1 | 23,932 | 18.0% | 1.3% | 47.9% | 64.1 | 20.7% | \$21,392 | 6.1 | 25.0% | 45.1% | 57.0% |
| MONROE | 2 | 21,757 | 27.1% | 87.5% | 27.9% | 57.7 | 23.7% | \$21,662 | 5.1 | 14.0% | 33.8% | 40.2% |
| MONTGOMERY | 1 | 8,270 | 12.1% | -17.5% | 27.2% | 55.4 | 29.8% | \$18,478 | 9.2 | 23.3% | 42.6% | 45.9% |
| MORGAN | 3 | 15,457 | 20.0% | 23.8% | 28.5% | 64.1 | 23.0% | \$23,373 | 4.1 | 14.6% | 40.4% | 46.9% |
| MURRAY | 3 | 36,506 | 39.6% | 296.2% | 0.6% | 56.1 | 35.6% | \$18,098 | 3.7 | 11.4% | 47.9% | 33.0% |
| * MUSCOGEE | 2 | 186,291 | 3.9% | 223.7% | 43.7% | 62.7 | 4.1% | \$24,947 | 5.0 | 19.1% | 28.5% | 44.5% |





POPULATION

| County | Tier | 2000 | Percent Change | | 2000 | Total | 1990 | 1999 | 2000 | 1998 | 1990 | 1999 |
|--------|------|------|----------------|---------|------|-------|------|------|------|------|------|------|
| | | | 1990-00 | 1930-00 | | | | | | | | |

| | | | | | | | | | | | | |
|------------|---|---------|-------|--------|-------|------|-------|----------|------|-------|-------|-------|
| * NEWTON | 3 | 62,001 | 48.3% | 258.6% | 22.2% | 60.1 | 12.4% | \$20,737 | 3.3 | 12.5% | 40.3% | 30.6% |
| * OCONEE | 4 | 26,225 | 48.9% | 224.5% | 6.4% | 63.3 | 16.2% | \$26,261 | 1.4 | 7.6% | 22.9% | 14.5% |
| OGLETHORPE | 3 | 12,635 | 29.4% | -2.3% | 19.8% | 61.8 | 31.5% | \$20,257 | 2.6 | 14.9% | 38.2% | 37.3% |
| * PAULDING | 3 | 81,678 | 96.3% | 562.6% | 7.0% | 57.8 | 14.4% | \$16,505 | 2.2 | 7.0% | 35.9% | 13.5% |
| * PEACH | 1 | 23,668 | 11.7% | 130.5% | 45.4% | 56.0 | 17.3% | \$21,028 | 5.1 | 22.5% | 32.5% | 46.9% |
| * PICKENS | 4 | 22,983 | 59.3% | 137.3% | 1.3% | 58.1 | 23.4% | \$25,541 | 2.7 | 11.8% | 43.2% | 22.9% |
| PIERCE | 2 | 15,636 | 17.3% | 24.9% | 10.9% | 63.5 | 28.6% | \$19,534 | 4.6 | 18.5% | 40.0% | 34.2% |
| PIKE | 3 | 13,688 | 33.9% | 26.1% | 14.8% | 62.5 | 23.9% | \$20,188 | 4.3 | 12.1% | 35.1% | 29.1% |
| POLK | 2 | 38,127 | 12.8% | 51.7% | 13.3% | 64.6 | 13.4% | \$19,990 | 4.3 | 15.4% | 48.2% | 39.0% |
| PULASKI | 2 | 9,588 | 18.3% | 6.5% | 34.3% | 57.2 | 16.7% | \$23,202 | 4.3 | 20.2% | 39.4% | 53.9% |
| PUTNAM | 3 | 18,812 | 33.1% | 124.8% | 29.9% | 59.6 | 35.1% | \$22,108 | 3.2 | 15.4% | 38.2% | 48.3% |
| QUITMAN | 1 | 2,598 | 17.6% | -32.0% | 46.9% | 78.1 | 49.5% | \$18,223 | 5.5 | 26.3% | 50.5% | 63.6% |
| RABUN | 4 | 15,050 | 29.2% | 137.7% | 0.8% | 66.6 | 16.7% | \$22,185 | 1.8 | 13.5% | 37.3% | 26.2% |
| RANDOLPH | 1 | 7,791 | -2.9% | -54.6% | 59.5% | 75.1 | 17.2% | \$18,298 | 7.4 | 30.9% | 50.7% | 57.3% |
| * RICHMOND | 2 | 199,775 | 5.3% | 173.7% | 49.8% | 60.4 | 8.4% | \$23,980 | 5.8 | 21.7% | 29.1% | 52.4% |
| * ROCKDALE | 4 | 70,111 | 29.6% | 867.4% | 18.2% | 58.0 | 5.9% | \$25,477 | 2.6 | 8.3% | 22.3% | 31.2% |
| SCHLEY | 2 | 3,766 | 4.9% | -29.6% | 31.3% | 67.8 | 28.4% | \$18,905 | 4.5 | 20.3% | 43.6% | 40.4% |
| SCREVEN | 1 | 15,374 | 11.1% | -25.0% | 45.3% | 72.2 | 28.6% | \$19,181 | 6.8 | 21.9% | 41.1% | 55.3% |
| SEMINOLE | 1 | 9,369 | 4.0% | 26.8% | 34.7% | 72.2 | 26.0% | \$19,247 | 5.0 | 24.1% | 47.3% | 49.7% |
| * SPALDING | 2 | 58,417 | 7.3% | 148.6% | 31.1% | 63.9 | 11.9% | \$22,354 | 4.9 | 16.5% | 40.0% | 49.0% |
| STEPHENS | 2 | 25,435 | 8.5% | 116.7% | 12.0% | 64.1 | 20.0% | \$21,461 | 3.6 | 16.1% | 39.9% | 34.6% |
| STEWART | 1 | 5,252 | -7.1% | -52.7% | 61.5% | 76.7 | 25.2% | \$18,744 | 6.0 | 26.2% | 48.6% | 70.6% |
| SUMTER | 1 | 33,200 | 9.8% | 23.9% | 49.0% | 67.1 | 18.1% | \$22,246 | 5.0 | 24.4% | 37.2% | 52.3% |
| TALBOT | 1 | 6,498 | -0.4% | -23.2% | 61.6% | 62.8 | 27.1% | \$15,385 | 6.5 | 19.1% | 43.8% | 48.8% |
| TALIAFERRO | 1 | 2,077 | 8.5% | -66.3% | 60.3% | 75.4 | 25.1% | \$17,383 | 5.2 | 27.0% | 51.4% | 67.9% |
| TATTNALL | 1 | 22,305 | 25.9% | 44.7% | 31.4% | 51.8 | 24.0% | \$19,943 | 7.9 | 23.8% | 42.6% | 44.3% |
| TAYLOR | 1 | 8,815 | 15.3% | -17.0% | 42.6% | 67.0 | 29.2% | \$18,774 | 5.6 | 24.9% | 48.8% | 47.7% |
| TELFAIR | 1 | 11,794 | 7.2% | -21.4% | 38.4% | 59.7 | 22.8% | \$18,477 | 10.2 | 25.3% | 47.9% | 45.3% |
| TERRELL | 1 | 10,970 | 3.0% | -40.0% | 60.7% | 70.6 | 13.7% | \$16,153 | 8.4 | 27.1% | 47.6% | 65.9% |
| THOMAS | 2 | 42,737 | 9.7% | 31.0% | 38.9% | 69.1 | 19.5% | \$23,237 | 4.8 | 19.0% | 36.7% | 50.3% |
| TIFT | 2 | 38,407 | 9.7% | 139.0% | 28.0% | 63.8 | 22.9% | \$22,837 | 4.6 | 21.0% | 38.7% | 50.1% |
| TOOMBS | 1 | 26,067 | 8.3% | 51.9% | 24.2% | 68.8 | 20.6% | \$19,304 | 10.4 | 23.5% | 41.0% | 44.6% |
| TOWNS | 3 | 9,319 | 38.0% | 114.4% | 0.1% | 72.8 | 28.4% | \$22,174 | 3.4 | 13.3% | 41.8% | 20.6% |
| TREUTLEN | 1 | 6,854 | 14.3% | -8.5% | 33.1% | 64.6 | 19.8% | \$16,499 | 9.8 | 25.1% | 47.3% | 47.1% |
| TROUP | 3 | 58,779 | 5.8% | 59.9% | 31.9% | 67.9 | 11.1% | \$24,306 | 4.1 | 15.5% | 39.2% | 48.7% |
| TURNER | 1 | 9,504 | 9.2% | -15.1% | 41.0% | 73.5 | 18.6% | \$17,831 | 8.8 | 28.1% | 44.7% | 53.5% |
| * TWIGGS | 1 | 10,590 | 8.0% | 26.5% | 43.7% | 62.1 | 33.7% | \$16,576 | 5.3 | 19.7% | 51.6% | 50.7% |





POPULATION

| County | Tier | 2000 | Percent Change | | 2000 | Total Dependent Ratio | 1990 Percent Mobile Homes | 1999 Per Capita Income | 2000 Unemp Rate | 1998 Percent Living in Poverty | 1990 Percent Without H.S. Diploma | 1999 Percent Unwed Births |
|-------------------|----------|---------------|----------------|---------------|--------------|-----------------------------|---------------------------------|------------------------------|-----------------------|---|--|------------------------------------|
| | | | 1990-00 | 1930-00 | | | | | | | | |
| UNION | 3 | 17,289 | 44.2% | 172.7% | 0.6% | 71.1 | 19.2% | \$20,152 | 3.4 | 13.9% | 41.3% | 23.3% |
| UPSON | 1 | 27,597 | 4.9% | 41.5% | 27.9% | 67.8 | 16.1% | \$20,366 | 6.4 | 16.3% | 45.4% | 46.3% |
| * WALKER | 3 | 61,053 | 4.7% | 133.0% | 3.8% | 62.8 | 15.1% | \$19,532 | 3.5 | 12.9% | 41.7% | 32.7% |
| * WALTON | 3 | 60,687 | 57.3% | 187.4% | 14.4% | 61.3 | 16.2% | \$19,136 | 3.0 | 11.7% | 42.1% | 26.9% |
| WARE | 1 | 35,483 | 0.0% | 33.6% | 28.0% | 67.3 | 17.1% | \$19,738 | 5.4 | 22.5% | 38.9% | 45.2% |
| WARREN | 1 | 6,336 | 4.2% | -43.3% | 59.5% | 73.6 | 24.4% | \$17,664 | 7.2 | 26.3% | 57.2% | 69.7% |
| WASHINGTON | 1 | 21,176 | 10.8% | -15.4% | 53.2% | 65.4 | 22.3% | \$23,332 | 5.0 | 21.6% | 41.9% | 54.1% |
| WAYNE | 1 | 26,565 | 18.8% | 110.0% | 20.3% | 59.5 | 22.5% | \$19,483 | 6.0 | 21.0% | 37.1% | 38.5% |
| WEBSTER | 2 | 2,390 | 5.6% | -52.5% | 47.0% | 66.7 | 32.3% | \$20,728 | 3.4 | 19.0% | 49.6% | 42.9% |
| WHEELER | 1 | 6,179 | 26.0% | -32.5% | 33.2% | 53.9 | 25.0% | \$18,864 | 9.4 | 24.3% | 43.3% | 32.5% |
| WHITE | 3 | 19,944 | 53.3% | 229.3% | 2.2% | 60.6 | 22.6% | \$22,598 | 3.7 | 12.4% | 37.1% | 24.7% |
| WHITFIELD | 4 | 83,525 | 15.3% | 301.4% | 3.8% | 60.3 | 16.2% | \$25,926 | 3.2 | 12.0% | 40.2% | 32.5% |
| WILCOX | 1 | 8,577 | 22.4% | -36.2% | 36.2% | 57.0 | 25.0% | \$19,834 | 5.1 | 25.6% | 47.2% | 51.2% |
| WILKES | 1 | 10,687 | 0.8% | -33.0% | 43.1% | 69.8 | 22.2% | \$21,565 | 5.5 | 20.0% | 43.4% | 50.8% |
| WILKINSON | 1 | 10,220 | -0.1% | -5.8% | 40.7% | 67.5 | 28.3% | \$19,614 | 5.2 | 16.1% | 38.0% | 45.7% |
| WORTH | 1 | 21,967 | 11.3% | 4.1% | 29.6% | 68.3 | 33.2% | \$18,896 | 6.2 | 20.2% | 41.9% | 45.1% |
| GEORGIA | | 8,186,451 | 26.4% | 181.5% | 28.7% | 56.5 | 11.6% | \$27,324 | 3.7 | 14.1% | 29.1% | 36.6% |

* Indicates county within a MSA.

Source: Boatright, S.R. & Bachtel, D.C. (2001).





APPENDIX E

PROPOSED OUTLINE FOR A SPECIALTY MUSHROOM SEMINAR

The following is a proposed outline for a Specialty Mushroom Seminar designed specifically for people interested in becoming involved with the Specialty Mushroom Industry in Georgia. The proposed one day seminar will include the following topics.

MUSHROOM BIOLOGY AND GROWTH

- How do mushrooms grow?
- What is a specialty mushroom?
- How does it differ from the common button mushroom?
- What are Portobellos and how are they grown?
- Care and feeding of mushrooms: substrate materials and environmental controls.
- Why does the industry need high tech buildings?
- Biological competition and the importance of clean practices.
- Quality control of the mushroom crop.
- Which mushroom is for me?

COMPONENTS OF THE INDUSTRY

- The continued need for research
- Spawn production
- Mushroom production
- Harvesting
- Distribution
- Warehousing
- Marketing
- The need for a Commodity commission
- On-line answers to problems/virtual consultation
- What are the chances of success for a Georgia grower?

MUSHROOM MARKET ECONOMICS

- Demographic components
- Capital costs
- On-going costs
- Cash flow
- Economy of scale

ENGINEERING ASPECTS (from spore to store)

- Environmental controls
- Automated systems for moving materials
- Schematic layout of growing houses
- Clean room technology
- Spawn

MISCELLANEOUS

- Testimonials from successful growers
- Cooking demonstration of selected specialty mushrooms and lunch
- The last word...One of the most comprehensive books about growing mushrooms is *Growing Gourmet and Medicinal Mushrooms* by Paul Stamets (2000).





APPENDIX F

COOPERATIVES

Cooperative businesses are special because they are owned by the consumers they serve and because guided by a set of principles they reflect the best interests of those consumers. More than 100 million people are members of 47,000 U.S. cooperatives, enabling consumers to secure a goods and services such as health care, insurance, housing, food, heating fuel, hardware, credit unions, utility service. (NRECA)

Marketing cooperatives handle, process and sell cotton, dairy products, fruits and vegetables, grains and oilseeds, livestock and poultry, nuts, rice, sugar and other agricultural commodities. Farm supply cooperatives provide farm chemical, feed, fertilizer, petroleum products, seed and other input items to producers. Farm service cooperatives operate cotton gins, provide trucking and artificial insemination services and store dry products. (Frederick, 1997).

An innovative producer cooperative called a "New Generation Cooperative (NGC)" or a "closed cooperative" that combines a solution to both financing and operations issues has received considerable attention due to its innovative approach. The formation of New Generation Cooperatives in the latter part of the twentieth century is the outcome of a complex set of pressures and forces that are both external and internal to co-ops. The external forces revolve around the changes occurring in the larger agriculture industry of which co-ops are a part. The internal forces hinge on the incentives created within co-op organizations and the effect these incentives have on the actions of co-op members and management.

Basically the producers of the commodity would raise an initial portion of the project's cost through stock or options on stock sales. Each share of stock would provide the right and obligation to market the product. The remaining capital could be raised through debt financing. The operation could remain with the producer/owner. The commodity could be priced to the producer through various arrangements including profit sharing of the final product. Any funds generated through an assessment of the crop or cut of the product would be used to retire debt and would increase the producer's equity in the operation.

Producers tend to take greater interest in operations developed as a producer cooperative since they are also investors. Many commercial banks are also funding cooperatives. The USDA also has numerous financial programs that can assist cooperatives that meet certain criteria. Credit unions and the Farm Credit System have also actively loaned funds to farmers to invest in new cooperatives. Other helpful support systems in the development of these new cooperatives include communities, regional economic development commissions, individual rural electric cooperatives, and university extension services.

New Generation Cooperatives retain many principles of traditional cooperatives such as democratic control through a one member, one vote policy; excess earnings are distributed among members as patronage refunds or dividends; and the board of directors is elected from the membership by the membership. The financing of New Generation Cooperatives allows for all, or almost all, net earnings to be returned to members at year end since the members invest capital up-front. Future expansion is financed in the same way as original equity: members invest through the purchase of shares. In some instances, preferred shares may be offered to the community or general public. This allows communities to support the project while keeping control in the hands of the members. Some of the advantages of the New Generation Cooperatives include the ability of producers to react quickly to opportunities, the collective response of members to problems or opportunities, the creation of wealth within a community and local ownership keeps it there, stability for producers and efficiency for the plant through the restricted membership, consideration of the interests of the community through a diverse set of stakeholders, and commitment to the quality of the product by both the producers and processor. (Ferland, et al, 2001)





APPENDIX G

GEORGIA POLL METHODS AND PROCEDURES

The design of the study called for conducting a total of 403 telephone interviews from a random-digit dialed sample of households in Georgia. The procedures utilized were intended to ensure that all adult residents in the sample had an equal (or near equal) chance of being selected for inclusion in the data collection. This provision of equal opportunity of selection is a necessary requirement if a probability sample is to be obtained. Bias in response is also minimized, and inferences about the general population can safely be made from the results obtained in the survey.

the sampling procedures outlined above produced a random sample of Georgia households the theoretical standard error can be used to estimate the sampling margin of error of the estimates within a 95 percent confidence interval. With a random sample size of 403 and a population proportion of 50 percent, the sampling error is no greater than +/- 4.9 percent. That is, if 50 percent of the sample gave a certain response to a question, we can be 95 percent certain that between 45.1 and 54.9 percent of each population as a whole would give the same response. The theoretical standard error, and thus the expected error, decreases as the population proportion approaches 0 or 100 from 50.





APPENDIX H

CROSS TAB ANALYSIS OF ATTITUDES TOWARD SPECIALTY MUSHROOMS BY SELECTED DEMOGRAPHIC CHARACTERISTICS

In general, the purpose of a cross tab analysis is to produce contingency tables showing the joint distribution of two or more variables. The frequency distribution of one variable is subdivided according to the values of one or more variables. The unique combination of values for two or more variables defines a cell. (SPSS Reference Manual, 1993.) In this instance, the age, race, gender, marital and residential status, educational attainment, and income variables were subdivided into the response categories for each "mushroom" variable. This will allow the frequencies and percentages presented in the text to vary by these characteristics. Tests for statistical significance between the variables were conducted for this report. [All tables referred to in this discussion are located at the end of this appendix.]

Information in Table H-1 shows the breakdown of the basic characteristics with regard to the question *"Have you ever prepared or eaten specialty mushrooms, like Shiitake, Portabello, or Chanterelles at home or in a restaurant?"*

Respondents in the 35 to 64 year old age range were more likely to have tried specialty mushrooms (53 percent) than those under 35 (41 percent) and those 65 years of age or older (33 percent). A larger proportion of male respondents (50 percent) reported that they have tried specialty mushrooms than females (44 percent). Whites were more likely (48 percent) to have eaten this product than non whites (41 percent).

A greater percentage of married respondents (53 percent) reported experience with mushrooms compared with non-married respondents (37 percent). This finding clearly indicates that an opportunity exists to create recognizable ready-to-serve products that would appeal to single people who may not have the time or desire to prepare specialty mushrooms. Metropolitan and non-metro residents were roughly equally likely to have had experience with the product.

Higher educated respondents had a greater likelihood of experience with specialty mushrooms than those with lower educational attainment levels; 69 percent of those with a graduate or professional degree, 47 percent of respondents with a bachelors degree, and only 33 percent of those with a high school degree or less. This is not surprising given the cost of the product plus the fact that more educated individuals have the necessary discretionary income to try the product in restaurants. Respondents reporting an income in the range of \$25,000 to \$49,999 (79 percent) were more likely to have tried the product than those with an annual income of less than \$25,000 (47 percent) and those with \$50,000 or more (55 percent).

The crosstab analysis regarding the question *"When was the last time you used specialty mushrooms?"* are reported in Table H-2.

Of respondents who have eaten specialty mushrooms, curiously, those under 35 and individuals surveyed 65 or older reported having recently (daily, last week, or last month) eaten specialty mushrooms. However, respondents in the age range of 55-64 were more likely to report daily use (26 percent) than all other age categories (approximately seven percent). Individuals with a graduate level education were more likely (77 percent) to have reported using the product more recently than the less educated; 68 percent for those with a high school diploma or less and 59 percent of college educated respondents. Respondents who reported an income of less than \$25,000 were more likely to have had mushrooms recently (85 percent) than those with higher incomes (approximately 63 percent). Those with the lower incomes, however, were more likely to have had the mushrooms last week or month, as opposed to daily. Daily use was more common among the more affluent. Although the young, old, less affluent and nonmetropolitan residents were less likely to have ever tried specialty mushrooms, of those that have, these same characteristics were more likely to accompany more recent use.

Information in Table H-3 reveals that when asked *"If specialty mushrooms were available at a quality price, would you use them more often?"*

Respondents in the age range of 35 to 64 were more likely (approximately 46 percent) to indicate they would use specialty mushrooms in this instance than those under 35 (37 percent) or those at least 65 years old (30 percent). More educated respondents were also more likely to use the product if it were available at a quality price; 37 percent for high school or less, 41 percent of those with a bachelors or some college, and 47 percent of respondents possessing a graduate or professional degree. Married respondents and those residing in a metropolitan area were more apt to say they would use the product if it were available at a quality price compared to non-married and non-metro residents, respectively. A competitive price of specialty mushrooms is important regardless of the level of income, or education. An escalation of quantity would affect the cost of specialty mushrooms as the movement toward economies of scale would reduce the cost of production.

Information in Table H-4 shows the crosstab analysis with regard to the question *"Are specialty mushrooms available where you routinely shop for groceries?"*





The information in the table shows that the largest differences can be seen in the education and residential status variables. Sixty-four percent of those with a high school diploma or less and 75 percent of college educated respondents indicated the product was already available in their usual shopping facilities. This proportion is much higher among those surveyed with a graduate or professional degree (90 percent). Nearly 80 percent of metropolitan residents shop where these mushrooms are sold, compared to 63 percent of those outside of a metropolitan area. Although mushrooms are not a new commodity to American consumers and are regularly eaten by a large number of individuals, (pizza being a case in point) specialty mushrooms may have a perceived gourmet quality an accompanying higher price tag. Thus, consumers from lower socio-economic classes do not shop in the stores that carry these products. It also reflects the lack of diversity in shopping and restaurant facilities that exist in many rural areas.

Information in Table H-5 shows the crosstab analysis concerning the question *"Would you be more likely to use quality Georgia-grown specialty mushrooms if they were available?"*

The analysis shows a large disparity in the proportion of respondents that indicated being more apt to buy the

Georgia grown mushrooms by education level. Nearly three fourths (74 percent) of those surveyed with a graduate degree responded positively, whereas, the proportion was approximately one-half (54 percent) for those with a high school education or less and about one-third (67 percent) among those with college level education. Middle aged respondents, 35-64 years old, were more receptive to purchasing Georgia grown mushrooms if they were available (approximately 69 percent) than their younger (59 percent) or older counterparts (58 percent). Married respondents were also more likely to respond favorably to the locally grown mushrooms than non-married, 69 percent and 57 percent, respectively.

Information in Table H-6 shows the question *"If you could buy a pre-marinated specialty mushroom in a heat-and-serve package would you be more likely to purchase this product over an unprepared product?"*

The analysis reveals there was not much difference in the percentage of respondents by race, gender, educational level, income, marital and residential status who responded yes, definitely or maybe. Respondents aged 65 years old or older were more likely (43 percent) than all other age groups (on average, 33 percent) to be favorable toward a ready to heat and serve specialty mushroom products.





| | Age | | | Race | | Gender | | Education | | | Income | | Marital status | | MSA/non MSA | | | |
|--|-------|-------|-------|-------|-----|--------|-----------|-----------|--------|-----------------|--------------------------------|------------------|----------------|--------------------|------------------|------|----------|-----|
| | 18-34 | 35-44 | 45-54 | 55-64 | 65+ | White | non-White | Male | Female | HS/Grad or Less | Some College, Bachelors degree | Post-grad/ Prof. | < \$25,000 | \$25,000- \$49,999 | \$50,000 or more | Marr | not Marr | MSA |

Table H-1—“Have you ever prepared or eaten specialty mushrooms, like Shiitake, Portobelo, or Chanterelle at home or at a restaurant?”

| | | | | | | | | | | | | | | | | | | | | |
|-------------------|---|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Yes, frequently | N | 14 | 17 | 14 | 6 | 4 | 44 | 13 | 25 | 33 | 10 | 28 | 20 | 4 | 17 | 26 | 42 | 16 | 48 | 10 |
| | % | 25.5 | 30.9 | 25.5 | 10.9 | 7.3 | 77.2 | 22.8 | 43.1 | 56.9 | 17.2 | 48.3 | 34.5 | 8.5 | 36.2 | 55.3 | 72.4 | 27.6 | 82.8 | 17.2 |
| Yes, occasionally | N | 37 | 32 | 28 | 14 | 16 | 103 | 22 | 50 | 78 | 26 | 76 | 25 | 10 | 28 | 63 | 82 | 46 | 96 | 32 |
| | % | 29.1 | 25.2 | 22.0 | 11.0 | 26.7 | 82.4 | 17.6 | 39.1 | 60.9 | 20.5 | 59.8 | 19.7 | 9.9 | 27.7 | 62.4 | 64.1 | 35.9 | 75.0 | 25.0 |
| No | N | 74 | 44 | 34 | 19 | 40 | 160 | 51 | 74 | 140 | 74 | 119 | 20 | 30 | 57 | 73 | 108 | 105 | 142 | 72 |
| | % | 35.1 | 20.9 | 16.1 | 9.0 | 19.0 | 75.8 | 24.2 | 34.6 | 65.4 | 34.7 | 55.9 | 9.4 | 18.8 | 35.6 | 45.6 | 50.7 | 49.3 | 66.4 | 33.6 |
| Total | N | 125 | 93 | 76 | 39 | 60 | 307 | 86 | 149 | 251 | 110 | 223 | 65 | 44 | 102 | 162 | 232 | 167 | 286 | 114 |
| | % | 59.2 | 47.3 | 44.7 | 48.7 | 66.7 | 52.1 | 59.3 | 49.7 | 55.8 | 67.3 | 53.4 | 30.8 | 68.2 | 55.9 | 45.1 | 46.6 | 62.9 | 49.7 | 63.2 |

Table H-2—“When was the last time you used them. Would you say daily, last week, last month, 6 months ago, or more than 6 months ago?”

| | | | | | | | | | | | | | | | | | | | |
|------------------------|---|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Daily | N | 3 | 3 | 5 | 5 | 0 | 13 | 2 | 6 | 10 | 4 | 10 | 2 | 0 | 4 | 7 | 12 | 4 | 13 |
| | % | 18.8 | 18.8 | 31.3 | 31.3 | 0.0 | 86.7 | 13.3 | 37.5 | 62.5 | 25.0 | 62.5 | 12.5 | 0.0 | 36.4 | 63.6 | 75.0 | 25.0 | 81.3 |
| Last week | N | 15 | 14 | 7 | 3 | 3 | 34 | 9 | 23 | 21 | 10 | 17 | 17 | 5 | 13 | 21 | 25 | 19 | 34 |
| | % | 35.7 | 33.3 | 16.7 | 7.1 | 7.1 | 79.1 | 20.9 | 52.3 | 47.7 | 22.7 | 38.6 | 38.6 | 12.8 | 33.3 | 53.8 | 56.8 | 43.2 | 77.3 |
| Last month | N | 18 | 11 | 9 | 3 | 13 | 42 | 11 | 16 | 39 | 9 | 31 | 14 | 6 | 12 | 24 | 37 | 18 | 39 |
| | % | 36.7 | 23.9 | 23.7 | 15.8 | 65 | 30.2 | 33.3 | 22.9 | 36.8 | 26.5 | 31.6 | 32.6 | 46.2 | 27.3 | 28.6 | 32.2 | 29.5 | 28.3 |
| 6 months ago | N | 6 | 10 | 9 | 5 | 4 | 27 | 8 | 18 | 17 | 6 | 22 | 7 | 2 | 10 | 19 | 24 | 11 | 31 |
| | % | 17.6 | 29.4 | 26.5 | 14.7 | 11.8 | 77.1 | 22.9 | 51.4 | 48.6 | 17.1 | 62.9 | 20.0 | 6.5 | 32.3 | 61.3 | 68.6 | 31.4 | 88.6 |
| More than 6 months ago | N | 7 | 8 | 8 | 3 | 0 | 23 | 3 | 7 | 19 | 5 | 18 | 3 | 0 | 5 | 13 | 17 | 9 | 21 |
| | % | 26.9 | 30.8 | 30.8 | 11.5 | 0.0 | 88.5 | 11.5 | 26.9 | 73.1 | 19.2 | 69.2 | 11.5 | 0.0 | 27.8 | 72.2 | 65.4 | 34.6 | 80.8 |
| Total | N | 49 | 46 | 38 | 19 | 20 | 139 | 33 | 70 | 106 | 34 | 98 | 43 | 13 | 44 | 84 | 115 | 61 | 138 |
| | % | 14.3 | 17.4 | 21.1 | 15.8 | 0.0 | 16.5 | 9.1 | 10.0 | 17.9 | 14.7 | 18.4 | 7.0 | 0.0 | 11.4 | 15.5 | 14.8 | 14.8 | 15.2 |





| | Age | | | | Race | | Gender | | Education | | | Income | | Marital status | | MSA/non MSA | | | | |
|---|-------|-------|-------|-------|------|-------|-----------|------|-----------|-----------------|--------------------------------|------------------|-----------|-------------------|------------------|-------------|----------|------|---------|--|
| | 18-34 | 35-44 | 45-54 | 55-64 | 65+ | White | non-White | Male | Female | HS Grad or Less | Some College, Bachelors degree | Post-Grad/ Prof. | <\$25,000 | \$25,000-\$49,999 | \$50,000 or more | Marr | not Marr | MSA | non-MSA | |
| | N | % | N | % | N | % | N | % | N | % | N | % | N | % | N | % | N | % | N | |
| Table H-3—"If specialty mushrooms were available at a quality price, would you use them more often?" | | | | | | | | | | | | | | | | | | | | |
| Yes, mush more | 14 | 18 | 15 | 8 | 5 | 48 | 11 | 26 | 35 | 14 | 36 | 11 | 4 | 14 | 33 | 40 | 21 | 44 | 17 | |
| % | 23.3 | 30.0 | 25.0 | 13.3 | 8.3 | 81.4 | 18.6 | 42.6 | 57.4 | 23.0 | 59.0 | 18.0 | 7.8 | 27.5 | 64.7 | 65.6 | 34.4 | 72.1 | 27.9 | |
| % | 11.4 | 20.2 | 20.0 | 21.1 | 8.8 | 16.1 | 13.1 | 17.9 | 14.3 | 13.2 | 16.6 | 17.2 | 9.8 | 14.3 | 20.6 | 17.6 | 13.0 | 16.0 | 14.9 | |
| Yes, a little more | 31 | 21 | 19 | 11 | 12 | 71 | 22 | 36 | 60 | 25 | 52 | 19 | 15 | 28 | 36 | 61 | 35 | 72 | 24 | |
| % | 33.0 | 22.3 | 20.2 | 11.7 | 12.8 | 76.3 | 23.7 | 37.5 | 62.5 | 26.0 | 54.2 | 19.8 | 19.0 | 35.4 | 45.6 | 63.5 | 36.5 | 75.0 | 25.0 | |
| % | 25.2 | 23.6 | 25.3 | 28.9 | 21.1 | 23.7 | 26.2 | 24.8 | 24.6 | 23.6 | 24.0 | 29.7 | 36.6 | 28.6 | 22.5 | 26.9 | 21.7 | 26.2 | 21.1 | |
| No | 78 | 50 | 41 | 19 | 40 | 180 | 51 | 83 | 149 | 67 | 129 | 34 | 22 | 56 | 91 | 126 | 105 | 159 | 73 | |
| % | 34.2 | 21.9 | 18.0 | 8.3 | 17.5 | 77.9 | 22.1 | 35.8 | 64.2 | 29.1 | 56.1 | 14.8 | 13.0 | 33.1 | 53.8 | 54.5 | 45.5 | 68.5 | 31.5 | |
| % | 63.4 | 56.2 | 54.7 | 50.0 | 70.2 | 60.2 | 60.7 | 57.2 | 61.1 | 63.2 | 59.4 | 53.1 | 53.7 | 57.1 | 56.9 | 55.5 | 65.2 | 57.8 | 64.0 | |
| Total | 123 | 89 | 75 | 38 | 57 | 299 | 84 | 145 | 244 | 106 | 217 | 64 | 41 | 98 | 160 | 227 | 161 | 275 | 114 | |

| | Age | | | | Race | | Gender | | Education | | | Income | | Marital status | | MSA/non MSA | | | | |
|--|-------|-------|-------|-------|------|-------|-----------|------|-----------|-----------------|--------------------------------|------------------|-----------|-------------------|------------------|-------------|----------|------|---------|--|
| | 18-34 | 35-44 | 45-54 | 55-64 | 65+ | White | non-White | Male | Female | HS Grad or Less | Some College, Bachelors degree | Post-Grad/ Prof. | <\$25,000 | \$25,000-\$49,999 | \$50,000 or more | Marr | not Marr | MSA | non-MSA | |
| | N | % | N | % | N | % | N | % | N | % | N | % | N | % | N | % | N | % | N | |
| Table H-4—"Are specialty mushrooms available where you routinely shop for groceries?" | | | | | | | | | | | | | | | | | | | | |
| Yes, most of the time | 60 | 45 | 31 | 16 | 19 | 136 | 37 | 66 | 109 | 38 | 97 | 39 | 17 | 46 | 76 | 103 | 72 | 134 | 41 | |
| % | 35.1 | 26.3 | 18.1 | 9.4 | 11.1 | 78.6 | 21.4 | 37.7 | 62.3 | 21.8 | 55.7 | 22.4 | 12.2 | 33.1 | 54.7 | 58.9 | 41.1 | 76.6 | 23.4 | |
| % | 56.6 | 56.3 | 48.4 | 47.1 | 42.2 | 52.7 | 52.9 | 53.7 | 51.4 | 44.7 | 50.8 | 68.4 | 53.1 | 52.9 | 55.1 | 52.0 | 52.9 | 55.6 | 43.6 | |
| Yes, sometimes | 17 | 18 | 17 | 8 | 15 | 58 | 13 | 32 | 43 | 16 | 47 | 12 | 8 | 22 | 28 | 40 | 35 | 57 | 18 | |
| % | 22.7 | 24.0 | 22.7 | 10.7 | 20.0 | 81.7 | 18.3 | 42.7 | 57.3 | 21.3 | 62.7 | 16.0 | 13.8 | 37.9 | 48.3 | 53.3 | 46.7 | 76.0 | 24.0 | |
| % | 16.0 | 22.5 | 26.6 | 23.5 | 33.3 | 22.5 | 18.6 | 26.0 | 20.3 | 18.8 | 24.6 | 21.1 | 25.0 | 25.3 | 20.3 | 20.2 | 25.7 | 23.7 | 19.1 | |
| No | 29 | 17 | 16 | 10 | 11 | 64 | 20 | 25 | 60 | 31 | 47 | 6 | 7 | 19 | 34 | 55 | 29 | 50 | 35 | |
| % | 34.9 | 20.5 | 19.3 | 12.0 | 13.3 | 76.2 | 23.8 | 29.4 | 70.6 | 36.9 | 56.0 | 7.1 | 11.7 | 31.7 | 56.7 | 65.5 | 34.5 | 58.8 | 41.2 | |
| % | 27.4 | 21.3 | 25.0 | 29.4 | 24.4 | 24.8 | 28.6 | 20.3 | 28.3 | 36.5 | 24.6 | 10.5 | 21.9 | 21.8 | 24.6 | 27.8 | 22.5 | 20.7 | 37.2 | |
| Total | 106 | 80 | 64 | 34 | 45 | 258 | 70 | 123 | 212 | 85 | 191 | 57 | 32 | 87 | 138 | 198 | 136 | 241 | 94 | |





| | Age | | | Race | | Gender | | Education | | | Income | | Marital status | | MSA/non MSA | | | | | |
|-------|--------|-------|-------|-------|------|--------|-----------|-----------|--------|-----------------|--------------------------------|------------------|----------------|--------------------|------------------|------|----------|------|---------|--|
| | 18-34 | 35-44 | 45-54 | 55-64 | 65+ | White | non-White | Male | Female | HS/Grad or Less | Some College, Bachelors degree | Post-Grad/ Prof. | < \$25,000 | \$25,000- \$49,999 | \$50,000 or more | Marr | not Marr | MSA | non-MSA | |
| | | | | | | | | | | | | | | | | | | | | |
| Yes | N 70 | 62 | 46 | 28 | 32 | 185 | 52 | 89 | 153 | 57 | 139 | 45 | 26 | 61 | 106 | 153 | 89 | 171 | 71 | |
| | % 29.4 | 26.1 | 19.3 | 11.8 | 13.4 | 78.1 | 21.9 | 36.8 | 63.2 | 23.7 | 57.7 | 18.7 | 13.5 | 31.6 | 54.9 | 63.2 | 36.8 | 70.7 | 29.3 | |
| | % 59.3 | 68.9 | 66.7 | 73.7 | 58.2 | 64.5 | 61.9 | 64.0 | 64.3 | 54.3 | 66.5 | 73.8 | 66.7 | 63.5 | 68.8 | 69.2 | 57.4 | 64.0 | 64.5 | |
| No | N 48 | 28 | 23 | 10 | 23 | 102 | 32 | 50 | 85 | 48 | 70 | 16 | 13 | 35 | 48 | 68 | 66 | 96 | 39 | |
| | % 36.4 | 21.2 | 17.4 | 7.6 | 17.4 | 76.1 | 23.9 | 37.0 | 63.0 | 35.8 | 52.2 | 11.9 | 13.5 | 36.5 | 50.0 | 50.7 | 49.3 | 71.1 | 28.9 | |
| | % 40.7 | 31.1 | 33.3 | 26.3 | 41.8 | 35.5 | 38.1 | 36.0 | 35.7 | 45.7 | 33.5 | 26.2 | 33.3 | 36.5 | 31.2 | 30.8 | 42.6 | 36.0 | 35.5 | |
| Total | N 118 | 90 | 69 | 38 | 55 | 287 | 84 | 139 | 238 | 105 | 209 | 61 | 39 | 96 | 154 | 221 | 155 | 267 | 110 | |

Table H-5—“Currently, most specialty mushrooms are imported. Would you be more likely to use quality Georgia grown mushrooms if they were available?”

| | Age | | | Race | | Gender | | Education | | | Income | | Marital status | | MSA/non MSA | | | | | |
|-----------------|--------|-------|-------|-------|------|--------|-----------|-----------|--------|-----------------|--------------------------------|------------------|----------------|--------------------|------------------|------|----------|-----|---------|--|
| | 18-34 | 35-44 | 45-54 | 55-64 | 65+ | White | non-White | Male | Female | HS/Grad or Less | Some College, Bachelors degree | Post-Grad/ Prof. | < \$25,000 | \$25,000- \$49,999 | \$50,000 or more | Marr | not Marr | MSA | non-MSA | |
| | | | | | | | | | | | | | | | | | | | | |
| Yes, definitely | N 22 | 9 | 12 | 5 | 9 | 40 | 16 | 19 | 38 | 16 | 31 | 10 | 6 | 17 | 28 | | | | | |
| | % 38.6 | 15.8 | 21.1 | 8.8 | 15.8 | 71.4 | 28.6 | 33.3 | 66.7 | 28.1 | 54.4 | 17.5 | 11.8 | 33.3 | 54.9 | | | | | |
| | % 18.6 | 10.8 | 16.0 | 13.9 | 17.0 | 13.9 | 20.5 | 13.7 | 16.3 | 15.5 | 15.1 | 16.1 | 15.8 | 17.3 | 18.1 | | | | | |
| Yes, maybe | N 18 | 16 | 15 | 7 | 14 | 57 | 12 | 29 | 42 | 22 | 35 | 13 | 9 | 17 | 26 | | | | | |
| | % 25.7 | 22.9 | 21.4 | 10.0 | 20.0 | 82.6 | 17.4 | 40.8 | 59.2 | 31.4 | 50.0 | 18.6 | 17.3 | 32.7 | 50.0 | | | | | |
| | % 15.3 | 19.3 | 20.0 | 19.4 | 26.4 | 19.8 | 15.4 | 20.9 | 18.0 | 21.4 | 17.1 | 21.0 | 23.7 | 17.3 | 16.8 | | | | | |
| No | N 78 | 58 | 48 | 24 | 30 | 191 | 50 | 91 | 153 | 65 | 139 | 39 | 23 | 64 | 101 | | | | | |
| | % 32.8 | 24.4 | 20.2 | 10.1 | 12.6 | 79.3 | 20.7 | 37.3 | 62.7 | 26.7 | 57.2 | 16.0 | 12.2 | 34.0 | 53.7 | | | | | |
| | % 66.1 | 69.9 | 64.0 | 66.7 | 56.6 | 66.3 | 64.1 | 65.5 | 65.7 | 63.1 | 67.8 | 62.9 | 60.5 | 65.3 | 65.2 | | | | | |
| Total | N 118 | 83 | 75 | 36 | 53 | 288 | 78 | 139 | 233 | 103 | 205 | 62 | 38 | 98 | 155 | | | | | |

Table H-6—“If you could buy a pre-marinated specialty mushroom in a heat and serve package would you be more likely to purchase this product over an unprepared product?”





APPENDIX I

U.S. MUSHROOM COMPANIES AND SPAWN PRODUCERS

| Mushroom Company | Address | City | State | Zip | County | Phone |
|---------------------------------|---------------------------|-----------------|-------|-------|---------------|--------------|
| Alexander's Mushrooms, Inc. | 10215 PrtrVlle Famso Hwy | Delano | CA | 93215 | KERN | 661-721-1000 |
| Alpha Mushroom Farms Inc.* | 8839 Gap Newport Pike | Avondale | PA | 19311 | CHESTER | 610-268-2018 |
| Amadio Inc. | 1220 Beaumont Ave | Temple | PA | 19560 | BERKS | 610-921-3682 |
| Amycel Inc.* | 260 Westgate Drive | Watsonville | CA | 95076 | SANTA CRUZ | 831-623-4586 |
| Bald Eagle Co | 5 Conway Lane | Saint Louis | MO | 63124 | ST LOUIS | 314-994-9194 |
| Bartoli & Vattilano | Rr 41 | Avondale | PA | 19311 | CHESTER | 610-268-2295 |
| Blue Mountain Mushroom Co Inc. | 370 Clauss Raod | Lenhartsville | PA | 19534 | BERKS | 610-562-7505 |
| C & B Mushroom Co | 119 Sharp Road | Avondale | PA | 19311 | CHESTER | 610-268-2529 |
| C and C Carriage Mushroom Co | Bypass & Newark Rd Rr1 | Toughkenamon | PA | 19374 | CHESTER | 610-268-3773 |
| C P Yeatman & Sons Inc.* | 600 Baker Station Road | West Grove | PA | 19390 | CHESTER | 610-869-7211 |
| Cardile Mushrooms Inc. | 540 Church Raod | Avondale | PA | 19311 | CHESTER | 610-268-0629 |
| Charles C. Brosius Inc | 200 Clonmell Upland Road | West Grove | PA | 19390 | CHESTER | 610-869-8765 |
| Chen Ming-Hung & Tsui-Sun | 2 Noble Raod | Christiana | PA | 17509 | LANCASTER | 610-593-6093 |
| Concord Farms Inc. | 23270 Eichler Street | Hayward | CA | 94545 | ALAMEDA | 510-265-1122 |
| Creekside Mushrooms Ltd | 1 Moonlight Drive | Worthington | PA | 16262 | ARMSTRONG | 724-297-5491 |
| DiFrancesco & Sons Mushrooms | 110 Skyline Drive | Landenberg | PA | 19350 | CHESTER | 610-274-8498 |
| Dicarlo, Drew & Son Mushrooms | 1010 W. Baltimore Pike | Kennett Square | PA | 19348 | CHESTER | 610-444-8833 |
| Elite Mushroom Co Inc. | 1770 Baltimore Pike | Avondale | PA | 19311 | CHESTER | 610-268-3533 |
| Emidio Frezzo Jr Inc.* | Newark Road | Toughkenamon | PA | 19374 | CHESTER | 610-268-3111 |
| Four Star Mushroom Corp | 10770 Cypress Ave | Fontana | CA | 92337 | SAN BERNADINO | 909-823-6155 |
| Franklin Farms Inc. | 931 route 32 | North Franklin | CT | 06254 | NEW LONDON | 860-642-3000 |
| Frezzo Brothers Inc. | 8858 Gap Newport Pike | Avondale | PA | 19311 | CHESTER | 610-268-8259 |
| G&H Farms, Inc. | Rr 419 | Rehrrsburg | PA | 19550 | BERKS | 717-933-1400 |
| Gaspari Bros Inc. | 2103 Georgia Road | Temple | PA | 19560 | BERKS | 610-929-5775 |
| Giorgi Mushroom Co. | Park Road | Blandon | PA | 19510 | BERKS | 610-926-8811 |
| Gourmet's Delight Mushroom Co. | 704 Gardeb Station Raod | Avondale | PA | 19311 | CHESTER | 610-268-3578 |
| Growing Company, Inc.* | 814 Water Works Road | Crawford | GA | 30630 | OGLETHORPE | 706-743-3396 |
| Harvest Fresh Farms Inc. | 1021 Shoemakersville Rd | Shoemakersville | PA | 19555 | BERKS | 610-926-7044 |
| Harvest Fresh Mushroom Farm | 530 N. Walnut Street | Kennett Square | PA | 19348 | CHESTER | 610-444-0280 |
| Hazel Dell Mushrooms, Inc. | 1186 Trafton Road | Watsonville | CA | 95076 | SANTA CRUZ | 831-728-5469 |
| JD Mushrooms Inc. | 1703 Baltimore Pike | Avondale | PA | 19311 | CHESTER | 610-268-2049 |
| John C. Leo & Son | 8775 Rt 41 S | Avondale | PA | 19311 | CHESTER | 610-268-2300 |
| Joseph Silvestri & Sons Inc | 1168 Naamans Creek road | Marcus Hook | PA | 19061 | DELAWARE | 610-358-0330 |
| Kaolin Mushroom Farms Inc.* | 649 W. South Street | Kennett Swuare | PA | 19348 | CHESTER | 610-444-4800 |
| Kenneth Davis | 7 Penn Oak Lane | Kennett Square | PA | 19348 | CHESTER | 610-444-0292 |
| Kitchen Pride Mushroom Farm | County Road 348 Cannonade | Gonzales | TX | 78629 | GONZALES | 830-540-4517 |
| L & J Di Bartolomeo Jr. Inc | 421 Bucktoe Road | Avondale | PA | 19311 | CHESTER | 610-268-0127 |
| La Concah D'oro Inc. | Rr 419 box N | Rehrrsburg | PA | 19550 | BERKS | 717-933-4111 |
| Lambert L F Spawn Co Inc.* | 1449 Valley Road | Coatesville | PA | 19320 | CHESTER | 610-384-5031 |
| Laurel Highlands Mushroom Farm* | Alexandria Street | Bradenville | PA | 15620 | WESTMORELAND | 724-539-1444 |
| Laural Valley Famres Inc. | 705 Penn Green Road | Landenberg | PA | 19350 | CHESTER | 610-268-2075 |
| M & J Fragale Inc | 573 rosedale Road | Kennett Swaure | PA | 19348 | CHESTER | 610-444-1325 |
| Modern Mushroom Farms Inc | Bypass Newark Rd Rr 1 | Toughkenamon | PA | 19374 | CHESTER | 610-268-3535 |
| Monterey Mushrooms Inc. | 777 Maher Court | Watsonville | CA | 95076 | SANTA CRUZ | 831-728-8300 |
| Monterey Mushrooms Inc.* | 5816 Highway 75S | Madisonville | TX | 77864 | MADISON | 936-348-3511 |
| Monterey Mushrooms Inc. | 19748 Highway 72N | Loudon | TN | 37774 | LOUDON | 865-458-4611 |
| Monterey Mushrooms Inc. | 2 Hazel Street | Bonne Terre | MO | 63628 | ST. FRANCOIS | 573-358-3381 |





| Mushroom Company | Address | City | State | Zip | County | Phone |
|-------------------------------|--------------------------|--------------------|-------|-------|-------------|--------------|
| Monterey Mushrooms Inc. | 642 Hale Ave | Morgan Hill | CA | 95037 | SANTA CLARA | 408-779-4191 |
| Mountain Meadow Mushrooms Inc | 16948 N. Broadway | Escondido | CA | 92026 | SAN DIEGO | 760-749-1201 |
| Mushroom Central Supply Inc. | Old Rt 1 & Union Street | Toughkenamon | PA | 19374 | CHESTER | 610-268-2211 |
| Mushroom Spawning Services | 519 Hillendale Raod | Toughkenamon | PA | 19374 | CHESTER | 610-444-5592 |
| Needham's Mushroom Farms Inc. | 155 Valley Rd | West Grove | PA | 19390 | CHESTER | 610-869-9735 |
| Oakshire Mushroom Farm Inc | 295 Thompson Road | Kennett Square | PA | 19348 | CHESTER | 610-444-9600 |
| Ohio Valley Mushroom Farms | 12505 South Ave. | North Lima | OH | 44452 | MAHONING | 330-549-0568 |
| P & V D'amico Mushrooms | 1657 Baltimore Park | Kennett Square | PA | 19348 | CHESTER | 610-444-5773 |
| PA Lafferty & Sons Inc. | Old Limestone Rd | Toughkenamon | PA | 19374 | CHESTER | 610-268-8098 |
| Palumbo, Tonino | 1707 Mount Laurel Dr | Temple | PA | 19560 | BERKS | 610-929-2130 |
| Petaluma Muhsroom Farm Inc. | 782 Thompson Ln | Petaluma | CA | 94952 | SONOMA | 707-762-1280 |
| Phillips Mushroom Farms Inc.* | 124 Old Kennett Rd | Kennett Square | PA | 19348 | CHESTER | 610-444-4492 |
| Peitro Industries Inc. | 523 School House Rd | Kennett Square | PA | 19348 | CHESTER | 610-444-4222 |
| Rakhra Mushroom Farm Corp | 6 Foothill Ash | Littleton | CO | 80127 | JEFFERSON | 720-981-5699 |
| Rakhra Mushroom Farm Corp | 1000 Washington St. E | Vale | OR | 97918 | MALHEUR | 541-473-3103 |
| Robert J Fragale Inc | 157 E. Hillendale Rd. | Kennett Square | PA | 19348 | CHESTER | 610-444-3775 |
| Royal Oaks Enterprises Inc | 15480 Watsonville Rd | Morgan Hill | CA | 95037 | SANTA CLARA | 408-779-2362 |
| S Omura & Sons Inc | 1220 Diana Ave | Morgan Hill | CA | 95037 | SANTA CLARA | 408-779-2682 |
| Salinas Mushroom Inc. | 531 Eckhart Rd | Salinas | CA | 93908 | MONTEREY | 831-758-5544 |
| San martin Mushrooms, Inc | 12240 Foothill Ave | San martin | CA | 95046 | SANTA CLARA | 408-683-2548 |
| She Rockee Mushroom Farm | 170 Sherrockee Ln | Lincoln University | PA | 19352 | CHESTER | 610-869-8048 |
| Spawn Mate Inc | 260 Westgate Dr | Watsonville | CA | 95076 | SANTA CRUZ | 831-763-5300 |
| Springfield Mushroom Inc. | 1274 Salinas Rd | Watsonville | CA | 95076 | SANTA CRUZ | 831-722-2667 |
| Sunrise Mushrooms Inc. | 930 Freedom Blvd | Watsonville | CA | 95076 | SANTA CRUZ | 831-761-7666 |
| Sunrise Mushrooms Inc. | 231 Jensen Rd | Watsonville | CA | 95076 | SANTA CRUZ | 831-761-7660 |
| Sylvan America Inc | W. Hills Industrial Park | Kittanning | PA | 16201 | ARMSTRONG | 724-543-2242 |
| Sylvan Inc | 333 Main Street | Saxonburg | PA | 16056 | BUTLER | 724-352-7520 |
| The Ostrom Company | 7334 Goodwin Rd | Everson | WA | 98247 | WHATCOM | 360-966-5915 |
| United Canning Corp | 520 W. Pine Lake Rd | North Lima | OH | 44452 | MAHONING | 330-549-9807 |
| United Foods Inc. | 255 Cordon Rd Ne | Salem | OR | 97301 | MARION | 503-581-2471 |
| United Foods Inc. | 4440 Olivas Park Drive | Ventura | CA | 93001 | VENTURA | 805-642-3253 |
| United Foods Inc. | 400 S. Park Ave | Fillmore | UT | 84631 | MILLARD | 435-743-6817 |
| Versaglio Mushroom Company | 112 Ellicott Rd | Avondale | PA | 19311 | CHESTER | 610-268-3092 |
| Vlasic Farms Inc. | 8125 E. 600 N | Howe | IN | 46746 | LAGRANGE | 219-367-2112 |
| Yamhill County Mushrooms Inc | 7246 NW Lilac Hill Rd | Yamhill | OR | 97148 | YAMHILL | 503-662-4131 |

Note * Indicates the mushroom company is also a producer of spawn.





APPENDIX J

PORTABELLO MUSHROOMS

Portabello mushrooms have had a tremendous impact on the European and American mushroom markets. Although the transition into commercial production of these mushrooms was initially not too difficult, much work needs to be done to modernize production. Portobellos are produced very similarly to the common button mushroom, and the infrastructure for producing Portobellos is already in place in Kennet Square, Pennsylvania. Two key factors affecting the targeted market are:

- (1) Portabellas have to travel a very long way to get to the 500 mile radius south of Athens, and there is limited competition south of Athens, Georgia.
- (2) The northern production facilities are very old, and very low tech, giving Georgia a possibility to be innovative in both technology and marketing strategies for a fresh Georgia grown product.

Though these seem to be excellent possibilities to capture a large part of this market share, it would be more prudent to estimate very conservatively, structuring both a production and marketing goal of approximately 10% of the national Portabello market. Additionally, it must be observed that Portabello and Crimini production have grown by at least 20 million pounds per year, over the past four years consecutively. Though this trend may not continue indefinitely, it could make the estimations too conservative.

Many Northern competitors are entering the Southern market place because there is little production in the South, and the Southern market gives a better rate of return on investment for Northern farmers than for their own region. Even with additional associated costs of shipping, transportation vehicles, and warehousing distribution hubs, Northern farm-

ers are finding nothing to impede them from setting up satellite markets here. However, this creates an opportunity for Southern farmers to make a more competitively priced product by eliminating a shipping cost usually valued at \$100 per skid of 500-600 pounds of Portabello. Because they would be produced closer to their final destination, it is obvious that if grown in better facilities, and with better quality control technologies, a fresher product at a cheaper or competitive cost would rein supreme. The fact that the Northern farmers are spending the initial money to educate Southerners to these products and their availability should only make it easier for Southern farmers to enter a ready made market.

In addition, the systems used for Portabello production are under examination and redefinition. Production methods as well as production substrates are being evaluated. This in and of itself presents an opportunity for Georgian engineers and biological researchers. The fact that these mushrooms can be grown using poultry litter coupled with the tightening of legislation regarding this potential substrate, offers Georgia an opportunity to provide a clean and regenerative agricultural industry.

The principal cultivation systems employed are Bed, Tray, and Bag; however, there is no published study documenting a comparative overview of the most cost effective system. Therefore, because of the obvious economic opportunities presented by developing a Portabello production facility in Georgia it is strongly recommended a thorough study be conducted next year on Portabello production. The study should include quality observations correlating to specific cultivating systems as well as their respective costs of production.





APPENDIX K

ADVANTAGES / DISADVANTAGES OF GROWING / SELLING SPECIALTY MUSHROOMS BY TYPE

| Mushroom type | Advantages | Disadvantages |
|---------------------------------------|--|--|
| Snow Crab (Pom Pom) | <ul style="list-style-type: none"> • Longer shelf life and thus increased transportation radius than many varieties. • In Georgia specifically, it is a unique, recognized product by upscale restaurants due to the marketing efforts of The Growing Company. • Wide consumer appeal due to the sweet taste and distinct appearance. Offers a possible vegetarian alternative to seafood. • Flavor goes well with the Vidalia onion. • Prepared well using numerous cooking techniques. • Compared with the oak mushroom, for example, the production cycle is shorter. • Does not require labor intensive production techniques and therefore production costs are reduced. | <ul style="list-style-type: none"> • Lack of general consumer knowledge. • It is exclusively a "cooking" mushroom. • Yellows if improperly stored. |
| Oysters | <ul style="list-style-type: none"> • Grows on numerous cellulosic substrates. • Easy to grow. • Short production cycle. • The diversity of attractive color varieties, (golden, blue, pink) has a broad consumer appeal. | <ul style="list-style-type: none"> • Short shelf life which causes a problem for distribution and handling. • The spore load generated within the growing room can become a potential health hazard to workers. |
| Enokitake (Winter mushroom) | <ul style="list-style-type: none"> • Easy to grow and prolific. • Tastes good. • Broad appeal in the Asian market. • Can be eaten cooked or raw. | <ul style="list-style-type: none"> • American consumers are less familiar with this mushroom. [Therefore increased marketing is needed for a commodity level]. • Improper packaging may cause health risks to consumers. |
| Froncosa | <ul style="list-style-type: none"> • Of all mushrooms it is the most flavorful. • It has known documented health benefits. • Easy to transport long distances. • The commercial value is significantly higher than most specialty mushrooms. | <ul style="list-style-type: none"> • There are additional production costs due to variable mushroom yield. [Therefore additional research is needed until it can be economically reliable]. • Long production cycle. |
| Velvet Ear | <ul style="list-style-type: none"> • Very specialized market because of its flavor, texture, and taste as a result it may just appeal to niche (Asian) markets. • Relatively easy to grow and prolific. • Can be dried / preserved easily. | <ul style="list-style-type: none"> • Lack of general consumer knowledge. • Packaging improvements must be made in order to sell this mushroom. • Quality may be affected if improperly stored. |
| Oak mushroom (Shiitake) | <ul style="list-style-type: none"> • A very well known commodity with wide consumer appeal. • It has known documented health benefits. • There exists a well-defined cultivation protocol for producing these mushrooms. • Long shelf life and easily transported. • Firm texture and rich flavor. | <ul style="list-style-type: none"> • To reach a profitable production level multiple handling of the spawn blocks is required. • Compared to other mushrooms it has a relatively long cycle. • Relatively expensive to produce. |
| Portabello | <ul style="list-style-type: none"> • A very well known commodity with wide consumer appeal. • Its larger size significantly contributes to the increased appeal and use of this mushroom. • Good flavor and texture. • Variety of cooking applications. • It is a nice vegetarian alternative. • The retail cost makes it affordable. • There exists a wide value added arena. | <ul style="list-style-type: none"> • There exists competition from imports. • Competition exists from the established Pennsylvania mushroom industry. • There is no established infrastructure for premium composting. • Short shelf life. • Susceptible to disease. • Handling and packaging problems. • No known significant health benefits. |

