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I am submitting herewith a thesis written by Yu Zhang entitled "Comparison of Potential Business Structures for a Biodiesel Production Facility and Analysis of Tennessee Soybean Producers' willingness to join a New Generation Cooperative to Produce Biodiesel." I have examined the final paper copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

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COMPARISON OF POTENTIAL BUSINESS STRUCTURES FOR A BIODIESEL PRODUCTION FACILITY AND ANALYSIS OF TENNESSEE SOYBEAN PRODUCERS' WILLINGNESS TO JOIN A NEW GENERATION COOPERATIVE TO PRODUCE BIODIESEL

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DEDICATION

This thesis is dedicated to my family -- my parents and sister

for always sharing happiness and bitterness with me.

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ABSTRACT

In 2002, a study of the economic feasibility of producing biodiesel in Tennessee was conducted. As a follow-up to the feasibility study, potential business structures for a biodiesel production facility was compared and information regarding soybean producers' interest and willingness to invest in a New Generation Cooperative (NGC) to produce biodiesel was examined.

The similarities and differences between a Traditional Cooperative (TC) and an NGC and between an NGC and a Limited Liability Company (LLC) were investigated from legal and practical perspectives. After evaluating the advantages of an NGC versus the other two business structures, an NGC appeared to be the most suitable business format for farmers to build a soybean biodiesel processing plant in Tennessee.

This thesis used data from a mail survey conducted in 2003 and employed probit and tobit models to investigate whether the soybean producers in West Tennessee had enough interest in forming an NGC to produce biodiesel, and if so, how many shares they were willing to invest in the cooperative.

The results showed a 74.78 percent participation rate for joining an NGC to produce biodiesel, indicating a considerable interest among Tennessee soybean producers. The participant profile would be a farmer optimistic about the U.S. biodiesel market growth in the next 10 years. The farmer would also have more than 1,000 acres of soybean production, on-farm storage, a net income more than $75,000 from farming per year and a debt rate of $20-$39.99 or $3-$9.99 per $100 of farm assets. The farmer would be of a younger age (i.e. 35), and would not be a current member of any

agricultural cooperative, and would have earned at least a four year college degree. Producers of this profile were estimated to have an as high as 99.68 percent probability to join an NGC to produce biodiesel.

Among those farmers who were willing to join an NGC to produce biodiesel and purchase the minimal 2,500 shares, or an equivalent of $5,625, they would purchase an average of 4,048 shares, or an equivalent of $9,108, from an NGC.

A farmer who would buy more shares in an NGC to produce biodiesel would be optimistic about the U.S. biodiesl market growth in the next decade. This person would also have more than 1,000 acres of soybean, without on-farm storage capacity. The farmer's net income would be above $15,000 from farming per year, with less than 60 percent of the household's income from off-farm sources and without debt for farm assets. The farmer would also have four years of college education or higher. Producers with this profile were estimated to invest as many as 12,028 shares, or an equivalent of $27,063, into an NGC to produce biodiesel.

Given a participation rate of 74.78 percent and a purchase of 4,048 shares per farm in the sample, a total of 7,419,984 shares, or an equivalent of $16,694,964 could be financed by the producers from the sample, which represented 82.44 percent of total soybeans and 44.43 percent of total capital needed. If adjusted for the population, a total of 10,577,244 shares which represented 117.52 percent of the total soybean needed, or an equivalent of $23,798,799 which represented 63.34 percent of the total investment needed, could be raised from the equity of an NGC to produce biodiesel.

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CHAPTER I

INTRODUCTION AND OBJECTIVES

Alternative Fuel Markets

As the largest petroleum consumer in the world, the U.S. consumed over 7,212,765 thousand barrels of petroleum, including 1,412,920 thousand barrels of diesel in 2002 (DOE/EIA, 2002). Due to the fast increasing demand for energy, the current restrictive energy regulatory structure, and the mature nature of its oil fields, the U.S. has become more and more dependent on foreign oil supply. In 2002, the U.S.'s field production of crude oil reached 2,809,770 thousand barrels while its net imports amounted to 3,787,970 thousand barrels, which accounted for 57.4 percent of the total crude oil supply (DOE/EIA, 2002). At the same time, the U.S. accounted for more than 7 percent of worldwide CO_2 emissions and produced more than 1.5 million tons of sulfur dioxide from its production and consumption of petroleum fuels for vehicles (Higgins, 2001).

On the other hand, more and more environmental regulations have been passed, and others have been proposed to reduce air pollution from vehicles. The U.S. Environmental Protection Agency (EPA) has recently set Tier 2 Standards. For instance, the sulfur reduction program requires that most refiners and importers meet a corporate average gasoline sulfur standard of 120 ppm and a cap of 300 ppm beginning in 2004. By 2006, the cap will be reduced to 80 ppm and most refineries must produce gasoline averaging no more than 30 ppm sulfur (DOE/EPA, 2000).

Therefore, with a growing global concern to protect and sustain the environment and to decrease dependence on foreign oil, the U.S. has put forward initiatives to develop alternative energy sources that meet more stringent emission regulations with the same efficiency as conventional fuels, and require minimal modification to current engines.

Biodiesel is a clean-burning fuel made from soybean oil or other vegetable oils or animal fats. In this study, only biodiesel made from soybean oil, the most commonly used feedstock is examined. Soy-based biodiesel can be used in its pure form, known as B100 or neat biodiesel. In addition, it can be used in various blends with diesel. One common blend is 2 percent biodiesel and 98 percent diesel, which is known as B2. In 2000, biodiesel became the only alternative fuel in the U.S. to have successfully completed the EPA-required Tier 1 and Tier 2 health effects testing under the Clean Air Act (National Biodiesel Board, 2004).

Benefits of Biodiesel

Biodiesel has many benefits as a renewable energy source. The most significant benefit is environmental protection. Biodiesel is free from sulfur and aromatic compounds. A survey of the emissions, averaged with other major studies, is provided in the Table 1-1 below. These results show that biodiesel significantly reduces almost all the harmful materials, especially sulfates. However, emission of NOx has increased 10 percent and 2 percent respectively for B100 and B20. But overall, the improvement to air quality obviously outweighs its negative effects. Biodiesel is also biodegradable. It degrades about four times faster than petroleum diesel. Even if it is spilled or partially burned, this fuel would not cause the serious ecological problems that petroleum

Table1-1: Average Percentage Differences of Biodiesel Emissions Compared to Conventional Diesel [a]

Emission Type	B100	B20
Regulated		
Total Unburned Hydrocarbons	-67%	-20%
Carbon Monoxide	-48%	-12%
Particulate Matter	-47%	-12%
NOx	10%	2%
Non-Regulated		
Sulfates	-100%	-20%
PAH (Polycyclic Aromatic Hydrocarbons) **	-80%	-13%
nPAH (nitrated PAH's) **	-90%	-50% ***
Ozone Potential of Speciated HC	-50%	-10%

* Estimated from B100 result
** Average percentage reduction across all compounds measured
*** 2-nitroflourine results were within test method variability
[a] Biodiesel Emissions, National Biodiesel Board, http://www.nbb.org last accessed 04/07/04.

normally poses (Higgins, 2001). Biodiesel also exhibits the most efficient energy balance of any liquid fuel. Every unit of energy needed to produce biodiesel results in 3.24 units of fuel energy (Higgins, 2001).

Biodiesel has energy security benefits. It relieves U.S. dependence on foreign oil and creates diversity within the U. S. oil supply.

The use of biodiesel also produces many economic benefits. First, biodiesel substitution for diesel helps a balance of trade for petroleum to some extent. Second, the production of biodiesel will increase the domestic demand for soybeans and reduce the government burden of subsidy. In order to sell surplus soy products, the U.S. paid 2.84 billion dollars to compensate farmers for the loss of profit due to lower international prices (USDA, 2004). Third, it enhances rural revitalization. More job opportunities will be created in rural areas, and residents' direct incomes, along with local tax revenues, will increase. Finally, production of this fuel may also attract other related businesses, such as meat raising and processing because of the resulting cheaper soybean meal.

However, biodiesel does have some disadvantages. First, the blend is about one cent per gallon more expensive than standard diesel fuel for each one percent of biodiesel added into it. So for B20, the cost will be 20 cents per gallon more than standard diesel fuel. But compared to other forms of alternative energies that could be used for vehicles, biodiesel is still cheaper, because it does not require engine modifications; in addition, it also provides extra qualities, such as lubricity. Second, biodiesel gels faster than most No.2 diesel, and the higher the concentration of biodiesel, the sooner the fuel will gel. However, the cold flow properties of blends below 20 percent are very similar to those of the petroleum diesel base, and blends below 5 percent are indistinguishable (Howell,

2001). Last, B100 emits 10 percent and B20 2 percent more NOx than the conventional diesel. But compared with other emission reductions, the NOx emission increase is much smaller. As the technology develops, however, these disadvantages may disappear.

Demand for Diesel Fuel and Potential Biodiesel Market

In 2002, a total of 57,884,652 thousand gallons of diesel were consumed in the U.S. and 1,243,109 thousand gallons in Tennessee (Table 1-2) (DOE/EIA, 2003). In nationwide, on-highway, residential and farm were the top three diesel consumption sectors which used a total of 43,416,265 thousand gallons of diesel and accounted for 75 percent of that year's total diesel consumption. In Tennessee, 903,682 thousand gallons of diesel were used in the highway, which accounted for 73 percent of the state's total diesel consumption. The vessel bunkering sector and the railroad sector used 112,364 thousand gallons and 81,222 thousand gallons of diesel respectively, which accounted for 9 percent and 7 percent of the total diesel consumption in Tennessee. Therefore, these three sectors used 1,097,268 thousand gallons of diesel and consisted of 89 percent of the total diesel consumption in Tennessee. In addition, the farm sector consumed 28,161 thousand of gallons of diesel and accounted for about 2 percent of the total diesel consumption in Tennessee. These four sectors provide a great potential market for biodiesel.

Therefore, biodiesel market caters to heavy-duty delivery vehicles on highways, farm facilities and machinery, and possibly railroad use and vessel bunkering. Since biodiesel involves the use of soybeans, it is reasonable to include farmers as potential customers of their own products.

Table 1-2: Diesel End-Uses in the U.S. and Tennessee, 2002 (Thousand Gallons) [a]

Diesel End-Use	U.S.	Tennessee
On-Highway	34,308,885	903,682
Vessel Bunkering	2,069,514	112,364
Railroad	3,080,831	81,222
Commercial Use	3,065,777	40,046
Off-Highway	2,224,086	33,062
Farm	3,179,309	28,161
Industrial Use	2,238,458	24,633
Electric Power	633,714	15,354
Residential	5,928,071	4,445
Military	330,542	139
Oil Company	825,464	N.A.
Total	57,884,652	1,243,109

[a] DOE/EIA, 2002

Emergence of Alternative Fuel Vehicles

Recently, alternative fuel vehicles (AFVs), which operate on fuels other than gasoline, are developing quickly as a niche market. Since biodiesel can run on existing vehicles without any modification, there is no special AFV corresponding to biodiesel. One example of AFV is the flexible fuel vehicle (FFV), which could run on E85, gasoline or any mixture of the two. One advantage of FFVs is that drivers can fuel them with regular gasoline when E85 is not available. Today, the Ford Motor Company, General Motors and DaimlerChrysler offer FFVs. So far, more than three million FFVs have already been sold in the U. S. and there are approximately 200 E-85 fueling stations across the country, most of which are located in the Midwest (DOE/AFDC, 2004). However, FFVs are usually light-duty vehicles, and are mostly used in the Midwest area, especially Minnesota.

Another commercially available choice is hybrid electric vehicles (HEVs). HEVs combine the battery and electric motor of an electric vehicle with the internal combustion engine of a conventional vehicle. Therefore, oil is still an imperative energy to run HEVs. So far, the big motor companies like General Motors, Daimler Chrysler, and Ford have been developing a variety of HEVs. But now the only HEVs in the U. S. market are Toyota's Prius, Honda's Insight and Civic Hybrid. In 2002, the sales of HEVs in the U. S. reached approximately 38,000, and sales are expected to increase to 54,000 vehicles in 2003 (International Energy Agency, 2004).

However, HEVs still face some drawbacks. The most important one is the cost. On average, they are $1,000-$5,000 more than conventional vehicles, which could offset the fuel-cost savings even with the $2,000 tax break in the U.S. Also, battery issues

could impact warranty costs and vehicle residual values (Winter and Kelly, 2003). In addition, HEVs are light vehicles such as cars and light trucks because of the current technology limit.

Other close AFVs to HEVs are the fuel cell vehicles (FCVs) which directly convert fuels to electricity. Now, they are still in the test stage.

Therefore, judging from the current technology development, transferring to the hydrogen vehicle era seems both technically and economically infeasible for a relatively long period of time.

The Growth of the Biodiesel Market

Since Congress' approval of biodiesel as an alternative energy in 1997 for compliance with the Energy Policy Act, biodiesel is gaining more and more awareness from consumers and favorable policies from governments. Consequently, the biodiesel market has begun to grow dramatically. In 1999, just over two million gallons of biodiesel were used in the United States. Two years later, in 2001, that number increased six-fold to 15 million gallons, with the expansion of biodiesel users from the U. S. Postal Service and the U.S. Departments of Defense, Energy and Agriculture (United Soybean Board, 2004).

Furthermore, both Ford and Chrysler have begun biodiesel research initiatives, and the use of B20 in existing diesel engines does not void parts and materials workmanship warranties of any major engine manufacturers (Lang, 2001). In addition, on January 9, 2001, the Biodiesel Fuel Use Credit Interim Final Rule became effective. According to that regulation, every purchase of 450 gallons of B100 after November 13,

1998, for vehicles with a gross vehicle weight rating of greater than 8,500 lbs, can be counted as one biodiesel fuel use credit, and for B20, only the biodiesel portion of the blend can be counted for biodiesel fuel use credit. To enjoy the credit, the biodiesel fuel purchased should not be blended with less than 20 percent biodiesel, nor required by the federal or state government, nor claimed as credits in an Energy Policy Act AFV acquisition before. In addition, the credits are not tradable or bankable. The Biodiesel tax incentive will provide a one cent reduction in the diesel fuel excise tax for each percent of biodiesel blended with petroleum diesel, up to 20 percent total content (De Guzman, 2003).

Objectives

In 2003, a study of the economic feasibility of producing biodiesel in Tennessee was conducted. As a follow-up to the feasibility study, information regarding soybean producers' interest and willingness to invest in a New Generation Cooperative (NGC) to produce biodiesel was needed. The objectives of this study are (1) to summarize differences and similarities between an NGC and a Traditional Cooperative (TC) and an NGC and a Limited Liability Company (LLC) from legal and financial perspectives, and recommend which business structure would be the "best" for a biodiesel processing plant in Tennessee (2) assess Tennessee soybean producers' views on and interest in involving in an NGC to produce biodiesel. The analytical methods included an econometric model of producers' willingness to invest in an NGC to produce biodiesel. A Tobit model was used to estimate inference of farm characteristics and farmers' demographics on shares producers would invest in an NGC.

CHAPTER II

LITERATURE REVIEW

Traditional versus New Generation Cooperatives

Several studies have compared between NGCs and TCs. Katz and Boland (2002) concluded as NGCs focusing on adding values to commodities and being interested in niche markets for their value added products. By contrast, TCs focused on marketing commodity products and were interested in selling raw materials to other members of the supply chain. Furthermore, NGCs were closed to general membership by allowing only certain producers, but TCs were open to general membership. NGCs also focused on productive efficiency by predetermining the required level of raw materials needed then selling "delivery rights" to ensure plant capacity was maximized. TCs were open to all producers interested in marketing raw commodities, often resulting in slack productive capacity as members chose to market their products through other means as prices for commodities changed. Moreover, members of NGCs did not need to own the same number of shares, and members of TCs were democratically owned by one member one vote. But in a TC, members can also deliver different numbers of shares to their cooperative, and an NGC is also democratically operated by one member one vote. In addition, Katz and Boland did not discuss the important differences in cooperatives' financing methods and their ways of allocating profits and losses.

Fulton (1999) traced the differences between a Traditional and a New Generation Cooperative from the external and internal pressure, where the external pressure had to

Table 2-1: Differences between Traditional and New Generation Cooperatives

Traditional Cooperatives	New Generation Cooperatives
Sell generic products to members on demand	Contractual relationship with members
Multi-purpose co-ops serving diverse members	Greater specialization; focus on niche products
Co-ops concentrated near the farm level	Device for farmers to network with rest of system
Major supporters of government price supports	Vehicle for farmers to avoid relationship risk
Competitive yardstick; co-ops source of countervailing power	More attention paid to providing farmers with information
Investment in physical capital; little investment in intellectual capital	More attention paid to using the information farmers possess

do with the restructuring of agriculture, and the internal pressure had to do with the need for cooperatives to provide a different incentive structure for their members' dealings with the cooperatives. The differences are summarized in the Table 2-1.

TCs sold generic products to members on demand whenever farmers wanted them. They had multiple activities and served a diverse membership by offering a wide variety of crop inputs and handling or processing a wide variety of farm products. They also were concentrated at the input supply and first-handler level. They were one of the mechanisms by which greater competition was introduced into the market and hence had often been deemed as the "competitive yardstick". TCs were in favor of government price supports and provided countervailing power by investing heavily in storage,

handling and processing facilities. Little attention was paid to investing in intellectual capital.

On the other hand, the vertical integration inherited in NGCs made them focus more on the system rather than each separate link in the chain and on one niche product rather than many products. Therefore, farmers in more stages of the value chain were connected. The up-front purchase of delivery shares provided a high degree of commitment by both the co-op and each member, thus reducing concerns about opportunistic behavior and relationship risk. The NGCs provided and used information to and from farmers.

The similarities between these two types of cooperatives were also studied. Stefanson, Fulton and Harris (1995) stated that Traditional and New Generation Cooperatives were similar in that 1) democratic tradition was maintained through a policy of one member, one vote; 2) excess earnings were distributed among the members as dividends; 3) the board of directors was elected form the membership by the membership.

Hanson (2001) summarized that all cooperatives generally adhered to the following three principals: 1) democratic control—one member/one vote, or at least a voting system that was not based upon capital investment; 2) subordination of capital—co-op profits were not paid back based on the amount of investment, but rather on the amount of patronage or business done for or with the co-op; 3) preferences in liquidation—this was based on patronage rather than investment.

New Generation Cooperatives versus Limited Liability Companies

Some studies have discussed the similarities and differences between NGCs and LLCs. Brown and Merrett (2000) compared them in several attributes (Table 2-2).

In terms of membership vote, membership size, single taxation and liability, Brown and Merrett believed that an LLC and NGC were similar. Both entities operated by one vote per share or per member, had unlimited membership size, enjoyed single taxation, and had limited liability. However, they were different in distribution of profits. While an LLC distributed its profits based on shares owned, an NGC distributed its profits based on patronage of the co-op. But in Tennessee, profits are equally distributed among members in an LLC, and only distribution to patron members in an NGC is based on patronage. Brown and Merrett also stated that in an LLC, membership was not restricted, but in an NGC, it was restricted to material participants or nonvoting preferred stock holders. This is partly true. In Tennessee, an NGC also has nonpatron members with voting rights. In terms of annual profit restrictions, Brown and Merrett thought an LLC had no limit, but an NGC had an upper limit of 8 percent on equity investment, or through percentage of patronage. The transfer of interest in an LLC was via an operating agreement and, in an NGC, needed to have the consent of the board.

Frederick (1997) argued that one of the differences between an LLC and a cooperative was that the former could not delay the pass-through of earnings to its members, so there was no equivalent to "non-qualified" retains for an LLC. However, an LLC could allocate earnings and losses and assign votes among themselves as they needed them.

Table 2-2: Comparison of Limited Liability Companies and New Generation Cooperatives

Attributes	LLCs	NGCs
Membership vote	One vote per share owned	One vote per member
Membership size	Unlimited	Unlimited
Single taxation	Yes	Yes (need to confirm with state)
Distribution of profits	Based on shares owned	Based on patronage of co-op
Ownership	Open to the community	Restricted to farmer patrons
Membership restrictions	None	Restricted to material participants or nonvoting preferred
Annual profit restrictions	Unlimited	8% of equity invested or through percent of patronage (or added price to raw sales)
Liability	Limited	Limited
Transfer of interest	Via operating agreement	Consent of board

Consumers Attitudes toward Biodiesel

So far, few studies have investigated in detail whether the consumers are willing to pay a higher price for biodiesel. It is partly because the present major users of biodiesel are public organizations rather than private consumers. However, there have been some simple surveys of consumers' general attitudes toward biodiesel.

The National Biodiesel Board (2002) conducted more than 1,000 telephone interviews nationwide in October 2002. This public opinion survey found that 54 percent of the sample thought it very important and 31 percent thought it somewhat important for schools to receive incentives to help pay for biodiesel. Both households with children and those without showed a willingness to provide financial incentives for schools to use biodiesel. It also found that 77 percent of the participants would be willing to pay 10 cents a gallon more for renewable fuels like biodiesel if they were available in their area. The limitation of the survey is that it only investigated people's attitudes toward the use of biodiesel for school buses but not as direct consumers themselves in other uses.

The National Biodiesel Board (2003) also conducted a commercial business survey among major diesel-powered truck fleet operators and found that 91 percent of the fleets surveyed had positive attitudes concerning biodiesel, and 51 percent would definitely consider support for biodiesel use from OEM/engine manufacturers in their future purchase decisions. The limitation of this survey, as pointed out in the article, is that the survey sample is not a random sample of all fleets, and the results cannot be served as representative of all diesel users.

No studies have attempted to identify profiles of those who are most likely to buy biodiesel and how much premium they would like to pay through drawing statistical inferences.

Producers' Attitudes toward Biodiesel

Few previous studies have focused on the profiles of soybean producers who were willing to join an NGC to produce biodiesel. Walzer and Holmes (1999) found that about 54 percent of farmer-producers indicated an interest in becoming members of an NGC to produce biodiesel. Those producers typically had larger than average farm size. A majority of the members would purchase one or two shares per year with 1,300 bushels of soybeans per share.

Since recently, biodiesel production has undergone fast development; there are few studies done on the producers' side. However, even though NGCs produce a variety of products, the producers who are interested in joining NGCs share some common characteristics, because NGCs themselves have distinctive features to attract a certain group of producers. A few studies investigated the features of producers who join an NGC to produce some other products, such as wheat. Puaha and Tilley (2003) compared members who invested in an NGC to process wheat and those who did not by examining several demographic characteristics: gender, age, education, farm experience, farm size, farmland rented from others, wheat production, percentage of income from wheat, level of familiarity with NGCs, and recognition of risk associated to the investment in NGCs. The findings suggested that compared with nonmembers, members who invested in an NGC to process wheat consisted of a higher percentage of females, had received higher

education, were relatively younger, had fewer years in farming, had much higher wheat production and higher percentage of income from wheat, had less farmland rented from others, were more familiar with NGCs and had more recognition of risk. However, all of these were based only on a mean comparison without statistically examining the relationship among the willingness to join and producers' demographic characteristics.

A tobit model was also run to find out the factors that affected the number of shares invested by members. The result showed that a member who believed that the NGC generated social benefits for the local community, whose farm was close to the NGC, who was more familiar with the NGC was more likely to invest more in the NGC. This member was also a full-time farmer and not very risk averse. The Oklahoma Agricultural Producer income tax credit also had a positive impact on the member's investment decision. However, the average ages of the member and nonmember groups were 56.86 and 58.16 respectively, which might lead to suspicions that the sample was biased toward older producers.

The study also examined how many shares these members were willing to purchase. The result suggested that 68 percent of members purchased between 1,000 and 3,000 shares, with the minimal ownership of 1,000 shares.

CHAPTER III

NEW GENERATION COOPERATIVES

Restructure of Agriculture

The processing of farmers' own commodities for niche markets to capture more value down through the value chain has become a strategy that modern farmers may adopt. Key elements of this transformation are as follows: (1) markets are less commodity driven and more product driven, (2) production is more capital intensive, (3) decisions made by firms at all levels of the market are increasingly interdependent, (4) price and production risks are replaced with risks surrounding relationships, food health and food safety, and (5) information becomes a prime source of control and power. These changes have resulted in increased vertical coordination and integration; in addition, firms are being asked more and more to deliver products of a consistent quality at the appropriate time (Fulton, 1999).

However, in order to process and market their products, farmers may need large sums of funds to start their own business. This is often beyond the financial capability of individual farmers or even small groups of them. In addition, to make processing feasible, a steady input supply likely need to be assumed. TCs are unable to adapt to this new development in agriculture due to their business structure limitations. NGCs offer a business structure as an alternative to the traditional cooperative structure that mitigates these issues.

Some new organizational forms have emerged to adjust to this new demand and trend in agriculture. One of them is valued-added, closed-membership cooperatives that are referred to as New Generation Cooperatives. Another is Limited Liability Companies, a hybrid business structure that combines the benefits of a partnership with those of a corporation. NGCs gained popularity first in North Dakota and Minnesota in the last decade of the 20th century and then quickly spread to other states in the U. S. and in Canada. They not only meet the high risk challenge of the new agriculture but also solve most of the structural limitations of the TCs. LLCs have also been adopted in the agricultural field more and more. In 1994, Tennessee passed the Tennessee Limited Liability Company Act.

Traditional Versus New Generation Cooperatives

According to the Capper-Volstead Act, any cooperative must meet the following conditions to be qualified for the limited antitrust exemption (Volkin, 1985).

1) It must be operated for the mutual benefit of its members thereof, as such agricultural producers.
2) No member of an association is allowed more than one vote regardless of the membership or stock capital invested.

In addition to the foregoing requirements, an association has a choice of conforming to one or both of the following requirements:

1) It must not deal in the products of nonmembers in an amount greater in value than those handled by it for its members.

2) The association does not pay dividends on stock or membership capital in excess of 8 percent per year.

This Act permits less competition for a group of farmers to enter and act in the market place than for a single farmer.

In 2004, the Tennessee legislature passed the Tennessee Processing Cooperative Law to facilitate the initiation of NGCs in Tennessee. Compared to the previous Cooperative Marketing Law, there are some similarities and differences between Traditional and New Generation Cooperatives from the legal perspective.

Definition

According to the Cooperative Marketing Law, a TC is defined as a nonprofit association engaged in the production of agricultural products and organized not to make profit for itself or for its members but only for its members as producers. It is defined in the Cooperative Marketing Law as

> "The association may be organized to engage in any activity in connection with the marketing or selling of the agricultural products of its members, or with the harvesting, preserving, drying, processing, canning, packing, grading, storing, handling, shipping or utilization of such products, or the manufacturing, or marketing of the by-products of such products; in connecting with the manufacturing, selling, or supplying to its members of machinery, equipment, or supplies" (Cooperative Marketing Law, 43-16-105).

An NGC is defined in the Tennessee Processing Cooperative Law as an association that

> "may be formed and organized on a cooperative plan as provided under this title to market, process, or otherwise change the form or marketability of crops, livestock and other agricultural products, including manufacturing and further processing of these products and other purposes that are necessary or convenient to facilitate the production or marketing of agricultural products by patron members and other purposes that are related to the business of the cooperative; to provide supplies and services to its members; and for purposes that cooperatives are authorized by law" (Tennessee Processing Cooperative Law, 43-41-101).

In the Tennessee Processing Cooperative Law, an NGC is still restricted to agricultural activities, but not to its nonprofit requirement.

Tax Practice

Both the Traditional and New Generation Cooperatives are exempt from taxation at the entity level, so profits can be passed on to members without being taxed at the cooperative level. The Tennessee Processing Cooperative Law prescribes that "cooperatives created pursuant to this act shall be subject to the same fees and taxed in the same manner as nonprofit cooperative associations" (Tennessee Processing Cooperative Law, 43-47-101).

Membership

1) Number of members

The NGC has fewer restrictions on its member size. In the Tennessee Processing Cooperative Law, "one or more individuals who shall be adult natural persons, who may act for themselves as individuals or as the agents of other entities" can organize a cooperative (Tennessee Processing Cooperative Law, 43-41-102.). The Cooperative Marketing Law restricts a TC to have eleven or more members.

2) Qualifications

In the Tennessee Processing Cooperative Law, members of an NGC are not limited to agricultural producers or individuals employed in an agriculture-related field. In addition, the organizers forming the cooperative need not be members of the cooperative. Therefore, the membership can encompass other people in the community. Hence financial support may be broadened.

In the Cooperative Marketing Law, members of a TC are restricted to "only persons engaged in the production of the agricultural products to be handled by or through the association, including the lessees and tenants of land used for the production of such products and any lesser and landlords who receive as rent all or any part of the crop raised on the leased premises" (Cooperative Marketing Law, 43-16-109). A nonstock association other than a natural person is also allowed to be a member or stockholder of a cooperative.

3) Categories

In the Tennessee Processing Cooperative Law, there are two types of members in an NGC: patron and nonpatron members. Both members have financial rights to share in

profits, losses and distributions, and governance rights to vote on one or more matters along with all other rights, excluding financial.

In the Cooperative Marketing Law, members in a TC are composed of "actual members of associations without capital" and "holders of common stock in associations organized with capital stock" (Cooperative Marketing Law, 43-16-103).

4) Liability

Both the Traditional and New Generation Cooperatives are limited in terms of liabilities. A member's total liability may not exceed the total amount of assets distributed to that member.

5) Democratic Control

Both laws prescribe one member/one vote regardless of capital investment. Likewise, they prescribe that cooperatives be governed by its board of directors. In an NGC, "a patron member of a cooperative is only entitled to one vote on an issue to be voted upon by members holding patron membership interests" and "a nonpatron member has the voting rights in accordance to his nonpatron membership interests as granted in the bylaws" (Tennessee Processing Cooperative Law, 43-59-103).

An NGC requires a lower minimal number of board directors and fewer limits on the composition of board directors. The Tennessee Processing Cooperative Law states that "the board shall have not less than three directors" and "a majority of the directors shall be members and at least one director shall be elected exclusively by the members holding patron membership interests" (Tennessee Processing Cooperative Law, 43-62-164).

In the Cooperative Marketing Law, the number of directors for a TC must be a minimum of five and one or more directors, but no more than one fifth of the entire number of directors may be appointed by any public official or commission or by the other directors selected by the members or their delegates. Such directors shall represent primarily the interest of the general public in such associations. They also do not need to be members or stockholders of the association, but shall have the same powers and rights as other directors.

Member Equity

Cooperatives derive capital to finance assets and operations from two sources--ownership capital and debt capital, in which ownership capital is often referred to as member equity. There are three basic ways to acquire member equity—capital stock purchase, retained patronage refunds, and per-unit retains.

Capital stock purchase is a direct cash investment in stock or other equity of the cooperatives. With the exception of a nominal membership fee, TCs do not require up-front investment; any producer can join simply by selling some or all of his products to the cooperatives or by buying inputs from the cooperatives. There is no obligation for members to deliver a specified amount of products to the cooperative if they cannot make the delivery. The farmers are usually not committed to further patronizing the cooperative. In this sense, TCs are open cooperatives. Supply or service cooperatives are usually capitalized through retained patronage refunds that withhold a portion of the net income allocated to members during the year. The amount of patronage refunds retained is determined on the basis of the members' use of the cooperative. Marketing

cooperatives are typically financed by using per-unit retains, which are based on physical units handled by them, or as a percentage of sales or market value of the products.

NGCs, in particular processing cooperatives, are typically capitalized by capital stock purchases to reach the optimal processing capacity. The usual practice is to finance 50 percent by member equity and the other 50 percent by debt. Once the level of the optimal capacity is determined, the amount of products that members must deliver is fixed. The NGC then issues stocks to entitle and obligate the owners to deliver one unit of product to the cooperative until enough delivery rights are allocated to cover the predetermined optimal processing capacity. At this point in time, the membership is closed, and nonmember producers who do not participate will not be allowed to deliver products to the cooperative unless they purchase shares from existing members or the cooperative expands its processing capacity later.

In the NGC, the delivery rights are dual contracts between members and the cooperative. The members are obligated to deliver a unit of certain quality for each share purchased even if they do not have sufficient commodities to make delivery, and the cooperative must accept and compensate the members for each unit delivered. In the Tennessee Processing Cooperative Law, this dual contract is prescribed as "a cooperative and its patron member or patron may make and execute a marketing contract, requiring the patron member or patron to sell a specified portion of the patron member's or patron's agricultural product or specified commodity produced from a certain area exclusively to or through the cooperative or facility established by the cooperative" (Tennessee Processing Cooperative Law, 43-49-101). In case the members can not make enough delivery, they have to make up the shortfalls from other sources, and if not, the

cooperative can purchase the amount of products needed from other member producers. If purchased from nonmembers, the cooperative is obligated to pay patronage to them in the same amount as it pays to its members. The Tennessee Processing Cooperative Law prescribes that

> "the bylaws or the marketing contract, or both, may set a specific sum as liquidated damages to be paid by the patron member or patron to the cooperative for breach of any provision of the marketing contract regarding the sale or delivery or withholding of a product and may provide that the member or patron shall pay the costs, premiums for the bonds, expenses and fees if an action is brought on the contract by the cooperative. The remedies for the breach of contract are valid and enforceable in the courts of this state. The provisions shall be enforced as liquidated damages and are not to be considered or regarded as a penalty" (Tennessee Processing Cooperative Law, 43-49-101).

There have been similar provisions in the Cooperative Marketing Law. However, in practice, TCs do not make such marketing contracts. Both laws also authorize the imposition of penalties against any person or entity who attempts to dissuade members from delivering their products to the cooperative under the marketing contract.

Transferability of Interests

1) Membership Interests

NGCs have closed membership, so members have a strong commitment to their membership and membership interests are transferable only with the approval of the

board. In addition, "the cooperative or the patron members, individually or collectively, have the first privilege of purchasing the membership interests of any class of membership interests offered for sale" (Tennessee Processing Cooperative Law, 43-51-101).

The law also prescribes that a member's financial rights be transferable in whole or in part. The assignee can only receive the assigned financial rights to the shares of profits and losses and the distributions to which the assignor would otherwise be entitled. Moreover, a member's governance rights are not assignable in part but are only assignable fully when all of the member's financial rights are coupled with the governance rights to the same assignee. A member may, without the consent of any other member, assign governance rights to another member.

A member always has the power to terminate membership by withdrawing at any time and may not be expelled. However, if the member has wrongfully withdrawn, the member forfeits his governance rights in the termination process or in the continued business. The member is also liable to the damage and the loss of profits caused by his wrongful withdrawal to all the other members and the cooperative. However, the member is entitled to receive the lesser the fair market value of his membership interests determined on a going concern basis or on a liquidated basis.

Since TCs have open membership, farmers could enter into and withdraw from TCs without restrictions, there are no specific provisions about the transferability of membership interests.

2) Common Stock and Preferred Stock

Both TCs and NGCs can issue common stocks and preferred stocks. Usually, the preferred stocks have no voting rights attached to them, which keeps the control of the cooperatives in the hands of their members. In NGCs, common and preferred stocks are part of members' financial rights and hence can be transferred in whole or in part only with the approval of the board. They can also appreciate or depreciate according to the market value. Based on the Capper-Volstead Act, the dividend rate on the preferred stocks can not exceed 8 percent.

In the Cooperative Marketing Law, the preferred stocks of TCs may be sold to any person, member or nonmember, and may be redeemable or retireable by the association. But the common stocks of TCs are prohibited from transferring to persons not engaged in the production of agricultural products handled by the cooperatives.

Allocation of Profits and Losses

Both TCs and NGCs distribute their profits on the basis of patronage or business done for or with the cooperatives, rather than on the capital investment. The Tennessee Processing Cooperative Law provides that "net income allocated to patron members in excess of dividends on equity and additions to reserves shall be distributed to patron members on the basis of patronage" (Tennessee Processing Cooperative Law, 43-42-101).

Since TCs are financed through retained earnings or the unit retains, they usually set aside most of the profits within the cooperatives for future development, and give very limited proportions of profits in cash to their members annually. Each year, the cash

profits returned to their members are only enough for them to pay taxes on the profits earned during the year. Usually, TCs pay back the equity at the face dollar value after a period of years or at a certain retirement age, such as 65.

NGCs are financed by capital stock purchases, and if the cooperatives wish to finance an expansion, capital is not acquired from previous years' profits, but from an offering of additional delivery shares. Therefore, NGCs usually keep only a small portion of their profits as capital retains to retire debt and grow cooperatives, but return most of them in cash each year. As prescribed in the Tennessee Processing Cooperative Law,

> "the bylaws shall prescribe the allocation of profits and losses between patron membership interests collectively and other membership interests. If the bylaws do not otherwise provide, the profits and losses between patron membership interests collectively and other membership interests shall be allocated on the basis of the value of contributions to capital made by the patron membership interests collectively and other membership interests and accepted by the cooperative. The allocation of profits to the patron membership interests collectively shall not be less than fifteen percent (15%) of the total profits in any fiscal year. Distribution of net income shall be made at least annually" (Tennessee Processing Cooperative Law, 43-65-101).

Liquidation

Both Traditional and New Generation Cooperatives set preferences in liquidation on the basis of patronage rather than capital investment. Even though it is not clearly prescribed in both laws, it is the rule in practice.

Advantages of New Generation Cooperatives over Traditional Cooperatives

The financing method of capital stock purchases through strict delivery rights attached to the patron membership enables NGCs to obtain a stable and adequate quantity and quality of raw products for processing, which reduces most of the input risk problem and the huge start-up fund problem. In addition, the delivery rights prevent surplus commodities delivered to NGCs and hence avoid extra storage expenditures when there is an oversupply of commodities in the market. At the same time, the substantial investments and closed membership bring a strong commitment to the members of NGCs, which solves the free-rider problem that members in a TC only want to use its service but are reluctant to invest.

NGCs' way of returning most of their profits in cash each year also gives more incentives for their members to invest and take an active role in the cooperative activities.

The tradability of delivery rights at market value also solves the horizon problem that members tend to support activities maximizing short-term rather than long-term returns, and partly solves the portfolio problem that members can not adjust their portfolio to reflect their risk-return tradeoff preferences.

New Generation Cooperatives versus Limited Liability Companies

LLCs have drawn more and more attention recently due to their advantages of flexibility and informality from a sole proprietorship or partnership and a limited liability shield from corporation. Like a sole proprietorship, partnership or Subchapter "S" corporation, the LLC is taxed at the ownership level. Unlike a corporation, the LLC does not require the business to have directors or officers, nor adhere to corporate meeting or governing formalities. However, this new business structure was not originally designed for agriculture and, as a result, also has some disadvantages when serving agricultural business.

According to the Tennessee Limited Liability Company Act, there are several ways of categorizing LLCs. In terms of its legal basis, the LLC can be a Domestic Limited Liability Company if incorporated under the laws of Tennessee. Or otherwise, it is classified as a Foreign Limited Liability Company. In terms of its governing structure, it can be a Board-managed Limited Liability Company if the LLC has a board of governors. If this board does not exist, it should be considered as a Member-managed Limited Liability Company. In terms of services provided, an LLC can be a Professional Limited Liability Company provided it renders professional services.

Comparing the Tennessee Processing Cooperative Law with the Tennessee Limited Liability Company Act, there are some similarities and differences between an NGC and LLC from the legal perspective.

Definition

Unlike an NGC, which is restricted to agricultural activities and hence aims at better serving new agriculture, an LLC is not constrained to agriculture and hence may lack some specific agricultural characteristics.

Tax Practice

Like the NGC, an LLC is also exempted from taxation at the entity level and only taxed at the ownership level. In the Tennessee Limited Liability Company Act, "the members of a domestic Limited Liability Company are subject to all state and local Tennessee taxes in the same manner and extent as partners in a domestic partnership" (Tennessee Limited Liability Company Act, 48-211-101).

Membership

1) Number of members

Both an NGC and an LLC can form a single member entity. In an NGC, one or more adult natural persons as individuals or as agents of other entities can organize a cooperative. In an LLC, one or more individuals as organizers can form an LLC and admit initial members.

2) Qualifications

Members of an NGC are not limited to agricultural producers. However, since the NGC is restricted to agricultural activities, most of its members are either agricultural producers of the product the NGC processes or they are from rural communities. In

contrast, an LLC is designed for any business, not only agriculture. Therefore, its members are very diverse.

3) Categories

While an NGC has patron and nonpatron members, an LLC has no such concept. Its participants are referred to as members with some governance rights of membership interests. This causes the major difference between the functions of these two business entities. In an NGC, most members are also its patrons, while members of an LLC may never patronize their LLC. The patron members in an NGC guarantee a large quantity of stable input at a certain quality in which the cooperative needs to process. As a result, the NGC provides a sales channel for the raw materials that its members grow, and it creates additional profit from selling the processed product. Therefore, an NGC provides a double function as an investment maker and service provider, while an LLC usually focuses only on investments. More importantly, if the formation of a large processing plant requires huge input supplies, an LLC may not reduce production risk as much as an NGC, especially during cycles of high commodity prices.

4) Liability

Both NGCs and LLCs are limited in members' liabilities. In an LLC, "a member, holder of financial interest, governor, manager, employee, or other agent of an LLC does not have any personal obligation and is not otherwise personally liable for the acts, debts, liabilities, or obligations of the LLC whether such arise in contract, tort or otherwise" (Tennessee Limited Liability Company Act, 48-217-101).

5) Democratic Control

In an NGC, one member has one vote regardless of capital investment, and the cooperative is governed by its board of directors. Voting rights are not exclusive to patron members; nonpatron members also have voting rights in accordance to their nonpatron membership interests.

In an LLC, "Unless otherwise provided in the articles or operating agreement, each member shall have equal voting power per capita with each other member" (Tennessee Limited Liability Company Act, 48-224-101). Only a Board-managed LLC has a board of governors and "all powers shall be exercised by or under the authority of, and the business and affairs of the LLC shall be managed by or under the direction of the board of governors" (Tennessee Limited Liability Company Act, 48-238-101). A Member-managed Limited Liability Company has no board of governors and is managed by its members. In this case, decisions are made and actions are taken by a majority vote of its members. However, both types of the LLCs must have individuals to exercise the functions of the offices, such as chief manager and secretary. Similar to an NGC, managers in an LLC need not be residents of Tennessee.

Member Equity

An NGC is financed by capital stock purchases to meet the optimal processing capacity. It issues delivery rights to its patron members which entitle and obligate them to deliver one unit of product to the cooperative until the predetermined optimal processing capacity is covered. Until then the membership is closed. Delivery rights are dual contracts between members and the cooperative. The members are obligated to

deliver a certain number of shares to the cooperative, even if they do not have a sufficient amount of commodities. The cooperative must accept and compensate its patron members for each unit delivered.

In an LLC, there are two types of contribution agreements in which the contributions of a member to an LLC may be in cash, property, or services rendered, or a promissory note (Tennessee Limited Liability Company Act, 48-202-101). One is a Contribution Agreement, which means "a binding agreement between a person and an LLC under which a) the person has an obligation to make a contribution to the LLC in the future; and b) the LLC agrees that, if the person makes the specified contribution at the time and in the manner specified for the contribution in the future, the LLC will accept the contribution, and reflect the contribution in the required records" (Tennessee Limited Liability Company Act, 48-202-101). If a member or a party cannot make the required contribution, that person is obligated at the option of the LLC to contribute cash equal to the value of the unfulfilled contribution. The obligation to a contribution agreement may be compromised only by consent of all the members of the board of governors (if the LLC is board-managed). The default member is subject to specified penalties for, or specified consequences of, such failure.

> "Such penalty or consequence may take the form of: 1) reducing or eliminating the defaulting member's proportional interest the LLC; 2) rubordination the member's membership interest to that of non-defaulting members; 3) a forced sale of the member's membership interest; 4) forfeiture of the member's membership interest; 5) the lending by other members of the amount necessary to meet the member's commitment and

the charging of interest thereon of up to the highest rate allowed by law with the repayments of such made from the first distributions from the member's interest; 6) a fixing of the value of the member's membership interest by appraisal or by formula and redemption or sale of the member's membership interest at such value; or 7) other penalty or consequence" (Tennessee Limited Liability Act, 48-232-101).

This contribution agreement is similar to the marketing contract used in an NGC, except that all the provisions dealing with default in an NGC are treated as liquidated damages, not as penalties. Since the only goal of these provisions is to ensure a stable supply of commodities for processing, there is only one way to punish the defaulting patron member and make up the resulting shortfalls. The cooperative may purchase the amount of commodities needed from other producers, but the defaulting patron member will have to pay cash equal to the value purchased, which is possibly higher than the amount specified in the marketing contract plus all the expenses and fees brought from the cooperative's purchase. Also, the default will never endanger the defaulting patron member's membership interests. While the marketing contract only applies to patron members in an NGC, the contribution agreement applies to all members in an LLC.

The other contribution agreement is Contribution Allowance Agreement, which "means an agreement between a person and an LLC under which a) the person has the right, but not the obligation, to make a contribution to the LLC in the future; and b) the LLC agrees that, if the person makes the specified contribution at the time and in the manner specified for the contribution in the future, the LLC will accept the contribution, and reflect

the contribution in the required records" (Tennessee Limited Liability Company Act, 48-202-101).

Transferability of Interests

1) Membership Interests

Unlike closed membership in an NGC, an LLC can admit a new member if all existing members approve the admission of the new person or entity as a member. (Tennessee Limited Liability Company Act, 48-232-102).

Similar to an NGC, membership interests in an LLC consist of a member's financial rights, ability to assign those financial rights, governance rights, and ability to assign those governance rights, where the financial rights and governance rights are similar to those of an NGC.

Exactly like an NGC, a member's financial rights are transferable in whole or in part. An assignment of a member's financial rights entitles the assignee to receive only the share of profits and losses and the distributions to which the assignor would otherwise be entitled. An assignment of a member's financial rights does not dissolve the LLC and does not entitle or empower the assignee to become a member, cause a dissolution, or to exercise any governance rights. Also, a current member assigns his full membership interest only by assigning all of his governance rights coupled with an assignment to the same assignee of all his financial rights. Only in this case, can a member's governance rights be assigned. A member may, without the consent of any other member, assign governance rights to another member (Tennessee Limited Liability Company Act, 48-218-101).

However, there is no such provision in an LLC entitling its members to the first privilege of purchasing the membership interests for sale, as in an NGC.

Similarly, a member in an LLC always has the power, though not necessarily the right, to terminate membership by withdrawing at any time (Tennessee Limited Liability Company Act, 48-216-101). All the compensation rules for the withdrawing member are the same as those of an NGC. In addition, members in both business entities have the power to dissent from the entity.

2) Common Stock and Preferred Stock

Like a corporation, an LLC has no restriction on the transfer of common stocks and preferred stocks, nor the dividend rate. In an NGC, the transfer of common stocks and preferred stocks must be approved by the board, and the dividend rate must not exceed 8 percent. Without the upper limit, an LLC can attract preferred stock capital more easily. In both business entities, common stocks and preferred stocks can appreciate or depreciate according to their market value, and preferred stocks have no voting rights.

Allocation of Profits and Losses

An NGC collectively allocates its profits and losses to patron members, and other members on the basis of the value of the contributions to capital made and accepted by the cooperative. However, distributions of cash or other assets of an LLC, including distributions on termination of the LLC, must be allocated equally among the members (Tennessee Limited Liability Company Act, 48-236-101). In addition, except as provided in the articles or an operating agreement, a member, regardless of the nature of

the member's contribution, has no right to demand and receive any distribution from an LLC in any form other than cash (Tennessee Limited Liability Company Act, 48-236-103.). In contrast, an NGC may distribute net income to patron members in cash, capital credits, allocated patronage equities revolving fund certificates, or its own or other securities (Tennessee Processing Cooperative Law, 43-65-102). Both entities can distribute most of the profits in cash annually.

Liquidation

While an NGC sets preferences in liquidation based on patronage rather than investment, an LLC distributes cash or other assets equally among its members upon termination.

Advantages of New Generation Cooperatives over Limited Liability Companies

An NGC has some advantages over an LLC in forming a large processing plant. First of all, the favorable legal environment makes an NGC extraordinarily attractive to Tennessee farmers. The limited antitrust protection provided by the Capper-Volstead Act makes the cooperative more competitive in the market. More importantly, the newly passed Tennessee Processing Cooperative Law, which specifically focuses on facilitating the establishment of an agricultural processing cooperative, offers no better legal support and convenience in forming a processing plant in Tennessee. Comparatively speaking, the Tennessee Limited Liability Company Act, which does not specially aim at agriculture, cannot provide as much support and favor as the former to an agricultural processing plant. Second, an NGC provides a good guarantee on the stable supply of

commodities to process which is crucial for a large processing plant, especially in a period of high commodity prices. Also, an NGC prevents over-delivery of input and extra storage burden that results from a period of surplus commodities in the market. An LLC can also use contribution agreements to ensure a certain amount of input. However, since there is no separation of patron and nonpatron members in an LLC, the use of contribution agreement will apply to all members. In this way, the previous benefit of an LLC to attract capital from more sources disappears and even becomes a disadvantage because it is not possible for people who only want to invest capital other than commodities to be a member. In contrast, an NGC's non-patron members absorb capital from these people. Therefore, an NGC is a preferred business structure for those large-scale processing plants. An NGC provides a way of investment and patronage service. For those very small scale processing plants, a member-managed LLC will be a better choice because the amount of commodity input will be easily met without patronage, and a small number of members without board governors can enjoy more flexibility in management. Third, an NGC can better serve the rural community. Being in the cooperative system, an NGC can get more favorable terms from other cooperatives and retain more profits in the local area. Since there is no upper limit for the preferred stock dividends issued by an LLC, it will attract more people from outside areas and as a result, take more profits out of the local area. Fourth, an NGC can delay the pass-through of earnings to its members to reduce tax. Finally, the business form of an NGC has been used much more frequently than an LLC, so much more on-hand experience for building an NGC is available.

CHAPTER IV

METHODOLOGY

Survey Data

In order to investigate whether the soybean producers in West Tennessee have enough interest in forming an NGC to produce biodiesel, a mail survey was conducted in February of 2003 (English, Jensen, and Menard, 2004). A total of 2,452 soybean producers whose names and addresses were provided by the Tennessee Agricultural Statistics Services (TASS) were surveyed. All of the 1,977 producers with equal to or more than 100 acres of soybeans in Tennessee were surveyed, and one fifth of the producers with less than 100 acres were randomly selected to form the rest of the 475 target sample. So the sample was the representative of the population given the way it was drawn. About 2 weeks after the initial mailing, a second copy of the survey was mailed to all producers who did not respond to the first mailing. Of the 2,452 producers, 40 could not be reached due to undeliverable addresses. The number of completed surveys was 673, providing a response rate of 27.45 percent.

Producers with a larger farm size ($\geq$ 100 acres) had a response rate of 18.92 percent, which is 10.40 percent higher than the 8.52 percent response rate of producers with a smaller farm size (<100 acres). Excluding those counties with only one or two farmers being surveyed, almost all the response rates of different counties clustered in the range of 20 percent to 40 percent, with the exception of Warren County, which had a

much lower response rate of 6.67 percent. Therefore, there was no obvious correlation between response rates and counties.

Survey Method

The survey was composed of three parts. The first section investigated soybean producers' attitudes toward the biodiesel market. Questions included: whether the U.S. biodiesel market would grow rapidly, whether biodiesel production would provide an important national market for soybean producers, whether production of biodiesel would be profitable in West Tennessee, and whether the farmers were willing to buy biodiesel given its competitive price with conventional diesel. This section also asked questions concerning their participation in the biodiesel production, such as farmers' willingness to sell some or all of their soybeans directly to a biodiesel processing plant, their preferences on the ownership of the cooperative (privately owned, cooperatively owned or no preference), and the number of bushels of soybeans the farmers were willing to sell to a plant through a marketing contract and on a spot basis.

The second section focused on the producers who were willing to produce biodiesel through a cooperative processing plant. The questions investigated producers' interest in joining an NGC to produce biodiesel, the acceptable minimal rate of return, and the number of additional shares they were willing to sell to the cooperative at this indicated minimal rate of return.

The third section explored the characteristics of farms and the demographics of producers. The questions asked were: did they belong to any agricultural cooperative currently; how many acres of soybeans were harvested in 2001, how much on-farm

storage capacity was available; how many percent of soybeans were typically sold through contracts; what other acreage was harvested or used on the farm in 2001; and how many livestock were raised on the farm? Questions also asked about farmers' personal backgrounds such as their age, their farm experiences, their ownership of the farms, their net income for 2001, their debt rate per every 100 dollars of assets, their percentage of off-farm income in 2001, and their education level. A copy of the survey is attached in the Appendix.

Analysis Methods

Probit Model

A probit model was estimated to find out the profile of those farmers who were most likely to be willing to join an NGC to produce biodiesel.

The dependent variable *Join* was a dichotomous variable, representing whether the respondents were willing to join an NGC to produce biodiesel. If the respondents were willing to join, *Join*=1, otherwise *Join*=0. The possible outcome and its probability could be expressed as $\Pr(Join=1) = \int_{-\infty}^{x\beta} \phi(t)dt = \Phi(\beta' x)$ where ϕ was standard normal probability density function calculated at the sample means, Φ was the cumulative standard normal distribution, β was a vector of parameters for the independent variables, X was a matrix of explanatory variables, including farmers' attitudes toward biodiesel markets, farm characteristics and farmers' demographics (Greene, 2003). Since the magnitudes on coefficients from the probit model could not be interpreted directly, their signs and marginal effects and different profiles of farmers were examined. The marginal

effects for continuous variables could be expressed as $\frac{\partial \text{pr}(Join = 1)}{\partial x} = \phi(\beta' x)^* \beta$ (Greene 2003). For discrete variables, the marginal effects were calculated by taking the difference of probabilities at variable level 1 and 0 with all continuous variables at their means and the other dummy variables at their modes. The different profiles of farmers who were most likely, moderately likely and least likely to join an NGC to produce biodiesel were calculated by pr (*Join*=1) = Φ ($\beta' x$). Limdep version 8.0 was used to obtain the estimates of the probit model.

Variable Definitions and Expected Coefficient Signs of the Probit Model

In order to estimate the probit model, the information collected in the survey was tried as explanatory variables to find out the factors that might influence a producer's participation behavior.

Attitudes toward the growth of the U. S. biodiesel market in the next decade (Question 1a), views on whether biodiesel production would provide an important national market for soybeans in the next decade (Question 1b), and willingness in using B20 if competitively priced with conventional diesel (Question 1c) were coded as three dummy variables, where "strongly agree" was one, and "strongly disagree" was five. All of the three dummy variables were expected to take a negative sign, because the more optimistic the farmers were about the biodiesel market and production, and the more acceptable they were in using biodesel, the more likely they were to participate in biodiesel production.

Whether the biodiesel could be profitably produced in West Tennessee (Question 2) was coded as zero if a "no" response was assigned, and one if a "yes" was assigned. The variable was assumed to have a positive sign, because people usually produce when they think the production is profitable.

Willingness to sell soybeans directly to a biodiesel processing plant (Question 3) was coded as zero if the answer was "no", and one if "yes". Obviously, it was anticipated to carry a positive sign.

The type of the processing plant that a producer preferred to sell his soybeans (Question 4) was coded as one if "a privately owned plant" was chosen and two if "a cooperatively owned plant" or "no preference" was chosen. The reason to group "no preference" with "a cooperatively owned plant" was that those people who chose no preference were potential participants of a cooperatively owned plant. The variable was expected to take a positive sign because those who chose a cooperatively owned plant were more likely to accept an NGC.

Question 11 asked whether the respondent was a current member of an agricultural cooperative. It was coded as a binary variable, where "no" was zero, and "yes" was one. It was expected to take a positive sign because being a member of an agricultural cooperative currently indicated a stronger interest in cooperatives than that of others who were not. So the respondent was more likely to accept the business form of an NGC to produce biodiesel.

Acres of soybeans harvested in 2001 (Question 12) was coded as one if the soybean acreage was greater than 1,000, and zero otherwise. As pointed out in Walzer and Holmes (1999) and Puaha and Tilley (2003) those producers who indicated an

interest in joining an NGC to produce biodiesel or wheat typically had larger than average farm sizes. In addition, producers who had more soybean production were more likely to explore other profitable ways of selling their products. Therefore this dummy variable was assumed to have a positive influence on *Join*.

The on-farm storage capacity (Question 13) was coded as a dummy variable: one if on-farm storage was greater than 0 and zero otherwise. It was expected to take a positive sign, because those farmers with on-farm storage tended to have larger production and yield.

The percentage of soybeans typically sold through contracts (Question 14) was coded as zero if 0 percent, and one if greater than 0 percent. It was anticipated to carry a positive sign because an NGC does business through contracts.

Age (Question 17a) and farming experience (Question 17b) were continuous variables that were anticipated to take a negative sign, because, in Puaha and Tilley's study, producers at a relatively younger age or with fewer years in farming were more likely to join an NGC. Square of farmers' age was also used to find out whether there was a nonlinear relationship between farmers' age and their willingness to join an NGC to produce biodiesel.

Ownership of farms (Question 18) was coded as a dummy variable, where "a full owner" was one, "a part owner" was two, "other" was three, and "a renter" was four. Almost all those respondents who chose "other" specified "other" as a combination of a full owner and renter. This variable was expected to have a negative sign because the less ownership the producer had on his farm, the less rich he would be, which contradicted the requirement of a huge upfront investment for participating in an NGC.

In addition, Pauha and Tilley found that farmers with less farmland rented from others were more likely to join an NGC.

Net income categories (Question 19) were transformed into seven dummy variables, where one represented presence of the income category and zero denoted its absence. This transformation allowed different effects among the income categories and provided more accurate information. It was expected that the higher the income group, the higher the willingness to join an NGC, because an NGC requires a lot of start-up investment.

Debt for every $100 of farm assets (Question 20) was coded as seven dummy variables, where one represented presence of the debt category and zero denoted its absence. Debt effects on the participation behavior change as debt gets larger. For debt less than $3, its impact can be either positive or negative. One possibility is that respondents who have debt less than $3 per $100 of farm assets are very risk averse or are approaching retirement, so they will not invest in any new project. In this case, the coefficient of variable debt is negative. Alternatively, debt of less than $3 per $100 of farm assets can have a positive effect on participation, if respondents with almost no debt are in very good financial standing and can borrow external capital easily. For moderate debt from $3 to $40, the variable debt can have a positive sign, because respondents in this category are not extremely risk averse and could have resources to make loans. For a high debt rate of more than $40, the variable of debt can have a negative effect on participation, because those respondents may lack additional resources to leverage.

The percentage of household's income from off-farm sources in 2001 (Question 21) was coded as a binary dummy variable, where one was assigned if the percentage was

higher than 60 and zero otherwise. As was indicated in Pauha and Tilley's study, in which producers with a higher percentage of income from wheat were more likely to join an NGC to produce wheat, this variable was expected to take a negative sign.

Education (Question 22) was coded as zero if the respondent's education level was lower than a college graduate and one if the respondent was at least a college graduate. Pauha and Tilley found that producers who were more likely to participate in an NGC had received a college education. Also producers with higher education levels tended to be more ready to accept new ideas, for instance, to explore new products like biodiesel. Therefore, this variable was anticipated to carry a positive sign.

The variables in the final probit model are presented in Table 4-1. Variables *Suplarge, Coopmeb, Store, Inc75150, Debt2040, Debt310* were expected to carry a positive sign, and variables *Market, Age* a negative sign.

Tobit Model

Among those farmers who were willing to join an NGC to produce biodiesel and to invest a minimum of 2,500 shares, a tobit model was estimated for the number of shares of soybeans they were willing to deliver to the cooperative. *Totalshare* was a limited dependent variable, representing the number of shares of soybeans the producers would deliver or invest in an NGC, given that they were willing to produce biodiesel and purchase the minimal requirement of 2,500 shares. Thirty-five respondents stated their interest in joining an NGC to produce biodiesel but were only interested in purchasing fewer than 2,500 shares. They were not included in the tobit model since they could not meet the minimal requirement to become members of the hypothetical NGC. Since the

Table 4-1: Variable Definitions, Expected Coefficient Signs and Means of the Probit Model

Variable Name	Definition	Expected Coefficient Sign	Mean
Join	1 if producer is willing to join an NGC to produce biodiesel, 0 otherwise		0.75
Suplarge	1 if acres of soybeans harvested in 2001 >1,000, 0 otherwise	(+)	0.18
Market	1 if strongly agree, 2 if agree, 3 if no opinion, 4 if disagree, 5 if strongly disagree that the U.S. markets for biodiesel will grow rapidly in the next 10 years	(-)	1.86
Coopmeb	1 if the producer belongs to an agricultural cooperative currently, 0 otherwise	(+)	0.28
Store	1 if the producer has on-farm storage capacity, 0 otherwise	(+)	0.71
Age	Age of the producer in years	(-)	50.89
Inc75150	1 if net income in 2001 is more than $75,000, 0 otherwise	(+)	0.14
Debt2040	1 if $20-$39.99 are debt per 100 dollars financed, 0 otherwise	(+)	0.12
Debt310	1 if $3-$9.99 are debt per 100 dollars financed, 0 otherwise	(+)	0.12
College	1 if the producer's education level is at least a college graduate, 0 otherwise	(+)	0.28

range of *Totalshare* was equal to or greater than 2,500, it was censored at a lower limit of 2,500. The possible outcome and its censored regression could be expressed as $Totalshare^{*}=\beta' x + \varepsilon$, where ε was normally distributed, and *Totalshare** was the latent variable of the number of shares those producers would purchase without the limit of the minimal 2,500 shares, and it was not directly observed. The observed variable *Totalshare* was censored with respect to *Totalshare** such that *Totalshare= Totalshare** if $Totalshare^{*} \geq 2{,}500$, *Totalshare*=2,500 if $Totalshare^{*} < 2{,}500$ (Limdep Manual, version 7.0). The X was a matrix of explanatory variables that includes farmers' attitudes toward biodiesel markets, farm characteristics and farmers' demographics. Since the magnitudes of coefficients from the tobit model could not be interpreted directly, their signs and marginal effects and different profiles of farmers were examined. The marginal effects could be expressed as $\frac{\partial E[Totalshare \mid \chi_i]}{\partial \chi_i} = \beta^{*}(1-\Phi \frac{2{,}500 - \beta' \chi_i}{\sigma})$, where Φ was the cumulative standard normal distribution, σ was the disturbance standard deviation and β was estimated parameter vector of χ_i. The expected total shares of soybeans that farmers of different profiles would purchase were calculated by the following equation:

$$E[Totalshare \mid \chi_i] = (1-\Phi(\frac{2{,}500 - \beta' \chi_i}{\sigma})) * \beta' \chi_i + \Phi(\frac{2{,}500 - \beta' \chi_i}{\sigma}) * (2{,}500 + \sigma \lambda_i),$$

where $\lambda_i = \frac{\phi(2{,}500 - \beta' \chi_i / \sigma)}{\Phi(2{,}500 - \beta' \chi_i / \sigma)}$ and ϕ was the standard normal probability density function (Greene, 2003). Limdep version 8.0 was also used to estimate the tobit model.

A sample selection model was also tried in case there was some correlation between the probit model and the tobit model. The results showed that there was no

significant correlation between the two models. Therefore, the tobit and probit models were estimated separately.

Variable Definitions and Expected Coefficient Signs of the Tobit Model

In order to estimate the tobit model, all the variables defined from the survey were tried to find out the factors that may influence a producer's amount of investment.

Besides all other variables discussed in the probit model, a minimal acceptable rate of return (Question 8) was also examined as a possible independent variable explaining *Totalshare.* It was a continuous variable and was expected to carry a negative sign, because the higher the minimal rate of return required, the pickier the respondent was about the investment.

The variables in the final tobit model are presented in Table 4-2. Variables *Suplarge, Store, College* were expected to carry a positive sign, and variables *Market, Inc014, Nonfarm* a negative sign. As analyzed before, the impact of variable *Debt0* could be either positive or negative.

Table 4-2: Variable Definitions, Expected Coefficients Signs and Means of the Tobit Model

Variable Name	Definition	Expected Coefficient Sign	Mean
Totalshare	Number of shares of soybeans the producer is willing to purchase, given that the producer is willing to join an NGC to produce biodiesel and to invest the minimum of 2,500 shares		4,209.50
Market	1 if strongly agree, 2 if agree, 3 if no opinion, 4 if disagree, 5 if strongly disagree that the U.S. markets for biodiesel will grow rapidly in the next 10 years	(-)	1.76
Suplarge	1 if acres of soybeans harvested in 2001 >1,000, 0 otherwise	(+)	0.24
Store	1 if the producer has on-farm storage capacity, 0 otherwise	(+)	0.81
Inc014	1 if net income from farming in 2001 is $0-$14,999, 0 otherwise	(-)	0.15
Debt0	1 if $0 is debt per $100 financed, 0 otherwise	(+) or (-)	0.23
Nonfarm	1 if more than 60 percent of household's income came from off-farm sources in 2001	(-)	0.21
College	1 if the producer's education level is at least a college graduate, 0 otherwise	(+)	0.29

CHAPTER V

RESULTS

Descriptive Statistics

Section I. Biodiesel Markets

Of the respondents, 85.45 percent felt optimistic about the growth of U.S. biodiesel market in the next 10 years (Table 5-1) (N=529). About 87.31 percent of the producers agreed or strongly agreed that the biodiesel production would provide an important national market for soybeans in the next decade (N=520). Moreover, as high as 95.21 percent of producers showed their interests in using biodiesel from soybeans in a 20 percent blend on their farming operation, given a competitive price with conventional diesel (N=522).

About 95.71 percent of the producers believed that biodiesel from soybeans could be profitably produced in West Tennessee (Table 5-2) (N=513). About 96.67 percent of the respondents were willing to sell some or all of their soybeans directly to a biodiesel processing plant (N=510).

About 6.29 percent of respondents had a strong preference to sell their soybeans to a privately owned processing plant; 35.70 percent of respondents would choose to sell to a cooperatively owned plant (Table 5-3) (N=493). The rest of the respondents, more than 50 percent, had no special preference for the business structure of the processing plant.

Table 5-1: Producers' Opinions on Biodiesel in the U.S.

	Percent of Response				
	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
The U.S. markets for biodiesel will grow rapidly in the next 10 years. (N=529)	30.06	55.39	10.02	3.59	0.95
Biodiesel production will provide an important national market for soybeans in the next 10 years. (N=520)	31.54	55.77	8.46	3.27	0.96
If priced competitively with conventional diesel, I would be interested in using biodiesel from soybeans in a 20 percent blend on my farming operation. (N=522)	60.54	34.67	3.26	0.38	1.15

Table 5-2: Views on Tennessee Biodiesel Market

	Percent of Response
Do you believe that biodiesel from soybeans could be profitably produced in West Tennessee? (N=513)	95.71
Would you be willing to sell some or all of your soybeans directly to a biodiesel processing plant? (N=510)	96.67

Table 5-3: Preferred Business Structure of a Processing Plant

	Percent of Response (N=493)
Prefer to sell soybeans to a privately owned plant	6.29
Prefer to sell soybeans to a cooperatively owned plant	35.70
No preference	58.01

Table5-4: Bushels of Soybeans Willing to Be Sold to a Plant

	Privately Owned Plant	Cooperatively Owned Plant or No Preference	Total	Average per Farm
Through a marketing contract	284,999.53 (N=29)	3,652,349.88 (N=404)	3,937,349.41 (N=433)	9,093.19
On a spot basis	97,800 (N=30)	2,315,137.41 (N=401)	2,412,937.41 (N=431)	5,598.46
Average per Farm	6,488.13	7,413.03	7,349.87	N.A.
Total	382,799.53	5,967,487.29	6,350,286.82	N.A.

Those respondents, who wished to sell to a privately owned processing plant, would sell a total of 284,999.53 bushels of soybeans through a marketing contract, and a total of 97,800 bushels on a spot basis (Table 5-4).

Those respondents who preferred a cooperatively owned processing plant or had no special preference would sell a total of 3,652,349.88 bushels of soybeans through a marketing contract and a total of 2,315,137.41 bushels on a spot basis. On average, the number of bushels per farm sold to any type of plant through a marketing contract would be 9,093.19-5,598.46=3,494.73 bushels more than the number of bushels per farm sold on a spot basis. All together, 6,350,286.82 bushels would be sold to any type of plant through both a marketing contract and on a spot basis.

Section II. Cooperative Production of Biodiesel

Three hundred out of 385 respondents indicated their interest in participating in an NGC to produce biodiesel, which accounted for 75.38 percent of respondents who answered this question (N=385). Among those who were interested in joining, the average minimal acceptable rate of return per year was 9.64 percent (N=270). About

81.60 percent of the respondents who would participate in biodiesel production through an NGC indicated that they were willing to purchase the minimum of 2,500 shares ($2.25* 2,500=$5,625 investment, one bushel of soybeans per share) (N=288). One hundred and fourteen respondents indicated that they would not purchase additional shares at their stated minimal acceptable rate of return. Ninety-six respondents indicated a total of 326,518 additional shares. Therefore, the total number of shares that could be raised by the respondents is 2,500*235+326,518=914,018 shares or $2,056,540.5.

Section III. Farming Operation and Producer Characteristics

Nearly 70 percent of respondents were currently members of an agricultural cooperative (N=519). About 28.71 percent of respondents had no on-farm storage (N=519). The respondents who had on-farm storage indicated a total of 8,995,418 bushels with an average of 24,311.94 bushels per respondent. On average, 42.01 percent of the respondents' soybeans were typically sold through contracts (N=508).

The respondents harvested an average of 732.58 acres of soybeans in 2001, and the total number of acres was 386,800 (N=528). Soybeans farmers also grew cotton, corn and wheat. On average, 201.38 acres of cotton, 987.81 acres of corn and 3,086.06 acres of wheat were harvested in 2001(Table 5-5).

Corn and wheat had large coefficient variations, which showed that there were few corn or wheat growers with a much larger production scale than the average farmers. Mostly, the other crops indicated were hay, milo and tobacco. On average, there were 98.72 acres of pasture, 79.61 acres of woodland. Most other land uses indicated were barn and homestead.

Table 5-5: Other Acreage Harvested or Used in 2001

Type of Acreage	Average Acres Harvested or Used	STD DEV	Coefficient Variation
a. Cotton (N=527)	201.38	628.46	3.12
b. Corn (N=514)	987.81	14,117.45	14.29
c. Wheat (N=513)	3,086.06	66,219.96	21.46
d. Other Corps (N=508)	25.74	88.63	3.44
e. Pasture (N=515)	98.72	203.52	2.06
f. Woodland (N=528)	79.61	548.59	6.89
g. Other (N=527)	15.47	147.44	9.53

*Other Crop: mostly hay, Milo, and tobacco; other: mostly barn and homestead

For farmers who also raised livestock, an average of 67.06 beef cows, 5.86 milk cows, 21.62 yearlings, 8.94 heifers, 3,143.40 broilers, 8.58 sows, 0.62 horses and 16.32 some other types of livestock were raised on farms in 2001(Table 5-6). Broilers and Sows revealed large coefficient variations, which indicated that there were few growers raising a much larger number of broilers or sows. The most common livestock indicated in "other" were hogs, steers, donkeys and quail.

As shown in Table 5-7, the average age of producers was 52.46 years (N=526), and the average farming experience was 33.98 years (N=509).

About 45.18 percent of producers were full owners of their farms, 24.95 percent were partners, 9.26 percent were renters and 20.60 percent belonged to another type of ownership, among which a part owner and part renter was most common (Table 5-8) (N=529).

The most common net incomes earned by the producers from farming in 2001 were in the $15,000-$74,999 range, which accounted for 54.13 percent of the respondents (Table 5-9) (N=473). Another relatively clustered group was in the range of $0-$9,999,

Table 5-6: Number of Livestock on Farming Operation

Type of Livestock	Average Number Raised on Farm	STD DEV	Coefficient Variation
a. Beef Cows (N=543)	67.06	654.85	9.77
b. Milk Cows (N=546)	5.86	33.67	5.75
c. Yearlings (N=545)	21.62	220.65	10.21
d. Heifers (N=543)	8.94	33.73	3.77
e. Broilers (N=545)	3,143.40	46,944.22	14.93
f. Sows (N=545)	8.58	118.51	13.81
g. Horses (N=546)	0.62	4.02	6.48
h. Other (N=543)	16.32	168.46	10.32

*Other: mostly hogs, steer, donkey and quail

Table 5-7: Producer's Age and Farming Experience

	Average Number of Years
Producer's Age in Years (N=526)	52.46
Years in Farming Experience (N=509)	33.98

Table 5-8: Farm Ownership

	Percent (N=529)
A full owner (sole proprietorship)	45.18
A part owner in a partnership	24.95
A renter	9.26
Other	20.60

*Other: mostly a part owner and a part renter

Table 5-9: Net Income from Farming in 2001 (After Taxes)

	Percent (N=473)
a. negative (less than $0)	5.29
b. $0-$9,999	15.43
c. $10,000-$14,999	8.88
d. $15,000-$24,999	14.59
e. $25,000-$34,999	13.11
f. $35,000-$49,999	16.07
g. $50,000-$74,999	10.36
h. $75,000-$99,999	4.02
i. $100,000-$149,999	4.86
j. Greater than or equal to $150,000	7.40

which accounted for 15.43 percent of the respondents.

Nearly 50 percent of the respondents had lower than $3 in debt per $100 of farm assets (Table 5-10) (N=473). About 14.01 percent of the respondents financed their farms by $20-$39.99 of debt per $100, which accounted for the second largest group.

An average of 38.10 percent of the household's income came from off-farm sources in 2001 (N=486). As shown in Table 5-11, the most common educational level of the respondents was 40.15 percent of high school graduates, followed by 24.09 percent of college graduates, and 22.75 percent with some college. Totally, 52 percent of the respondents received some college or higher education level.

Table 5-10: Debt Dollars per $100 of Farm Assets

	Percent (N=473)
a. $0	36.21
b. $1-$2.99	13.15
c. $3-$4.99	5.17
d. $5-$9.99	7.33
e. $10-$14.99	5.17
f. $15-$19.99	7.76
g. $20-$39.99	14.01
h. $40-$69.99	8.41
i. Greater than $70	2.80

Table 5-11: Education Level

	Percent (N=523)
Some high school or less	7.84
High school graduate	40.15
Some college	22.75
College graduate	24.09
Post graduate	5.16

Results from Probit Model

The estimated probit model for the willingness to join is displayed in Table 5-12. The model had a significant overall fit as shown by the Chi square from the Log-likelihood ratio test, and the McFadden R square. About 78.86 percent of the observations were predicted correctly, of which 79.65 percent of actual 1s were actually 1s and 70 percent of actual 0s were actually 0s. All the independent variables in the model were significant at a confidence level higher than 80 percent. As hypothesized, the variable *Suplarge* carried a positive sign, which indicated that producers with more than 1,000 acres of soybean were more likely to join an NGC to produce biodiesel. The variable *Store* also had the expected positive sign. The inference was that farmers with on-farm storage capacity would be more capable to supply soybean for the plant.

Table 5-12: Estimated Probit Model for Join an NGC (*Join*) [a]

Variable	Estimated Coefficient	Standard Error	Mean of X
Intercept	1.28578***	0.46103	N.A.
Suplarge	0.58806***	0.25401	0.17615
Market	-0.32197***	0.09772	1.86445
Coopmeb	-0.30187**	0.16789	0.28184
Store	0.47040***	0.16118	0.70732
Age	-0.00909*	0.00688	50.88618
Inc75150	0.38475*	0.26315	0.14092
Debt2040	0.40108**	0.26567	0.12466
Debt310	0.43452*	0.25862	0.12466
College	0.23498*	0.17578	0.28455
Number of Observations			369
% Correct Prediction			78.86
Log-likelihood			-179.12
Chi square			51.75***
McFadden R square			0.13

[a] * indicates significance at the 80 percent confidence level
** indicates significance at the 90 percent confidence level
***indicates significance at the 95 percent confidence level

Inc75150 also carried a hypothesized positive sign, which indicated farmers with a high net income were more likely to have financial capability to join an NGC. As expected, *College* had a positive effect on *Join*, which suggested that farmers with undergraduate education or higher were more likely to join an NGC and produce biodesel. The variable *Market* also took on a negative sign as anticipated, which indicated that the more optimistic farmers were about the U. S. biodiesel market growth for the next 10 years, the more likely they would engage in the biodiesel production. The variable *Age* carried an expected negative sign, which indicated that younger farmers were more likely to join an NGC to produce biodiesel. This could reflect greater risk aversion among older producers. It could also reflect older producers who might be looking forward to retirement rather than new farm investments. They might not have wanted to put money and energy toward a new product. Both variables *Debt2040*, *Debt 310* had positive signs, which indicated that farms with the debt rate of $20-$39.99 or $3-$9.99 per $100 of farm assets were more likely to join an NGC to produce biodiesel. The inference was that those farmers with a very low debt rate were very risk averse to make loans and invest in a new product, and those farmers with a high debt rate might lack additional resources to leverage.

In contrast to the previous hypotheses, variable *Coopmeb* had a negative sign. It indicated that farmers who belonged to some kind of cooperatives currently were less likely to join an NGC. The reason may be that current members in TCs may think NGCs as their competitors which may take many market shares in the future. Current members of TCs may also be unsatisfied with the performance of their cooperatives and hence take negative views on all of the cooperatives.

If profiles of farmers who are willing to join an NGC to produce biodiesel are based on the signs of the coefficients, a profile of a biodiesel producer through an NGC would be a farmer optimistic about the U.S. biodiesel market growth in the next 10 years. The farmer would also have more than 1,000 acres of soybean production, on-farm storage, a net income more than $75,000 from farming per year and a debt rate of $20-$39.99 or $3-$9.99 per $100 of farm assets. The farmer would also be of a younger age (i.e. 35), and would not be a current member of any agricultural cooperative, and would have received a bachelor's degree or higher. The profile of a farmer who is least likely to join an NGC to produce biodiesel would be a farmer pessimistic about the U.S. biodiesel market in the next 10 years. The farmer would also have less than 1,000 acres of soybean production, no on-farm storage, a net income less than $75,000 from farming per year, and no debt rate or a very high debt rate on farm assets. The farmer would be at his older age (i.e. 60), would be a current member of any agricultural cooperative, and would have received four years of college education. The profile of a farmer who is moderately likely to join an NGC to produce biodiesel is calculated at the sample means for continuous variables and at the modes for dummy variables. Of these three profiles, the respondent of the first profile has a 99.68 percent probability in joining an NGC to produce biodiesel, the second profile a 12.07 percent probability, and the third profile a 74.78 percent probability. The participation rate of 74.78 percent is higher than the 54 percent found out by Walzer and Holmes. The possible reason is that both biodiesel and the business structure of an NGC have gained much more attention and popularity among farmers now, compared to the year 1999 when their survey was done.

A summary of the marginal effects of the independent variables on joining an NGC to produce biodiesel is shown in Table 5-13. Because only two variables in the model are not binary (*Market* and *Age*), no elasticity is presented. Given that continuous variables stay at their means and the other dummy variables at their modes, changing dummy variable *Suplarge*, *Store*, *Inc75150*, *Debt310*, *Debt2040*, *College*, or *Coopmeb* separately from 0 to 1, the probability of a farmer joining an NGC would increase 14.40 percent, 16.78 percent, 10.36 percent, 11.44 percent, 10.72 percent, 6.74 percent or decrease 10.37 percent, respectively. If continuous variable *Market* increases by 1 unit, or *Age* increases by 1 year with other things being the same, the probability of a farmer to join an NGC would decrease 7.73 percent and 0.07 percent, respectively.

Results from Tobit Model

The estimated tobit model for the number of shares to invest in the biodiesel production is given in Table 5-14. The model had a significant overall fit as shown by the Chi-square from the Log-likelihood ratio test. Because the minimal number of

Table 5-13: Marginal Effects of the Independent Variables on *Join*

	Marginal Effect	Standard Error	Mean of X
Suplarge	0.14402	0.04976	0.17615
Market	-0.07730	0.02829	1.86450
Coopmeb	-0.10368	0.05337	0.28184
Store	0.16775	0.05282	0.70732
Age	-0.00070	0.00200	50.88618
Inc75150	0.10355	0.05854	0.14092
Debt310	0.11436	0.05468	0.12466
Debt2040	0.10717	0.05756	0.12466
College	0.06743	0.04663	0.28456

Table 5-14: Estimated Tobit Model for Number of Shares to Invest (*Totalshare*) [a]

Variable	Estimated Coefficient	Standard Error	Mean of X
Market	-1,316.25165*	899.47704	1.75676
Suplarge	3,092.25301***	1,367.18180	0.23784
Store	-2,409.36824*	1,532.53400	0.80541
Inc014	-6,980.66686***	2,129.94960	0.15135
Debt0	2,801.52984**	1,446.47150	0.22703
Nonfarm	-3,020.76896**	1,607.87350	0.20541
College	2,773.32379***	1,373.70330	0.29189
Number of Observations			185
Lower Limit			2,500
Log-likelihood			-984.23730
LM test for tobit (Chi square)			81.298***
Sigma			6,974.54347

[a] * indicates significance at the 80 percent confidence level
** indicates significance at the 90 percent confidence level
***indicates significance at the 95 percent confidence level

shares required to be purchased was 2,500, the tobit model was censored at a lower limit of 2,500 shares. All the independent variables in the tobit model were significant at a confidence level higher than 80 percent. As hypothesized, *Suplarge* had a positive effect on the number of shares to invest in the NGC, which indicated that farmers with more than 1,000 acres of soybean were more likely to deliver more soybeans to an NGC. *College* had an expected positive sign which meant that producers with a bachelor's degree or higher would be willing to purchase more shares in the biodiesel production. *Market* carried an expected negative sign, which indicated that farmers more optimistic about the prospect of the U. S. biodiesel market were willing to invest more shares in an NGC to produce biodiesel. *Inc014* also showed an expected negative effect on the number of shares to buy, indicating that farmers with a net income as low as $0-$14,999 from farming would invest less in the soybean and biodiesel production. *Nonfarm* took

an assumed negative sign, indicating that producers with more than 60 percent of household's income from off-farm sources in 2001 tended to invest less in biodiesel production.

Opposite to previous assumptions, the variable *Store* took on a negative sign, which indicated that producers with on-farm storage would invest fewer shares in an NGC. The possible reason could be that producers with on-farm storage capacity could store their soybeans for other uses, and those without on-farm storage capacity would prefer to sell as many soybeans as possible to an NGC at a time. Since the hypothetical processing plant only has 10 days on-site storage capacity, this may a pose storage problem. The storage limit of the hypothetical NGC was not mentioned in the mail survey.

The variable *Debt0* had a positive sign which suggested that producers without debt were more likely to purchase more shares in an NGC to produce biodiesel. The inference was that farmers without debt were able to invest in the biodiesel production by their internal capital or they might have great leverage capability to finance the production by loans.

Based on the signs of the coefficients, the profile of a farmer who would buy more shares in an NGC to produce biodiesel would be a farmer optimistic about the U.S. biodiesl market growth in the next decade. The farmer would also have more than 1,000 acres of soybean, without on-farm storage capacity. The farmer's net income would be more than $15,000 from farming per year, with less than 60 percent of the household's income from off-farm sources and without debt for farm assets. The farmer would also have four years of college education or higher. While a profile of a farmer who would

buy fewer shares in an NGC to produce biodiesel would be a farmer pessimistic about the U. S. biodiesel market growth in the next decade. The farmer would also have less than 1,000 acres of soybeans, on-farm storage capacity, a low net income of $0-$14,999 from farming per year and some debt for farm assets. The farmer would also have more than 60 percent of the household's income from off-farm sources and would not have received four years of college education. The profile of a farmer who would buy an average number of shares in an NGC to produce biodiesel is calculated at the sample mean for the continuous variable *Market* and at the modes for dummy variables. A typical respondent of the first profile will invest 12,028 shares or an equivalent of $ 27,063 in an NGC to produce biodiesel, while the respondent of the second profile will only buy 2,516 shares or an equivalent of $5,661 and the respondent of the third profile will buy 4,048 shares or an equivalent of $9,108 in an NGC to produce biodiesel. The average number of shares that a farmer will purchase is much higher than the 1,300 to 2,600 shares in the study of Walzer and Holmes and the 1,000 to 3,000 shares in the study of Puaha and Tilley. The possible reason is that in this study the participating producers are required to purchase 2,500 shares or more, but there is no such a requirement in Walzer and Holmes' study, and the limit of 1,000 shares in Puaha and Tilley's study is much lower. Also, the increasing popularity in biodiesel and the business structure of an NGC makes producers more confident about the profitability of future biodiesel market.

A summary of the marginal effects of the independent variables on *Totalshare* are shown in Table 5-15. Because only *Market* in the model is not binary, no elasticity is presented. If the continuous variable *Market* increases by 1 unit given all the other dummy variables staying at their modes, the number of shares that a farmer is willing to

Table 5-15: Marginal Effects of the Independent Variables on *Totalshare*

	Marginal Effect	Standard Error	Mean of X
Market	-449.59000	354.83921	1.75676
Suplarge	1,056.22000	535.34066	0.23784
Store	-822.96500	604.77203	0.80541
Inc014	-2,384.38000	820.41073	0.15135
Debt0	956.91500	573.84284	0.22703
Nonfarm	-1,031.80000	632.83760	0.20541
College	947.28100	542.41486	0.29189

invest in an NGC would decrease 449.59 shares. Given other things being equal, if dummy variable *Suplarge*, *Debt 0* or *College* changes from 0 to 1, the farmer will purchase 1,056.22 shares, 956.92 shares, and 947.28 shares more in an NGC to produce biodiesel respectively. If the dummy variable *Store*, *Inc014*, or *Nonfarm* changes from 0 to 1 with the continuous variable *Market* staying at its means, and the other dummy variables at their modes, the number of shares that a farmer is willing to invest in an NGC would decrease by 822.97 shares, 2,384.38 shares, and 1,031.80 shares respectively.

CHAPTER VI

CONCLUSIONS

Summary of Findings and Implications

After comparing of the three Tennessee laws on the business structures of a TC, an NGC and an LLC, and evaluating the advantages of an NGC over the other two business structures, an NGC appears to be the most suitable business format for farmers to build a soybean processing plant for biodiesel in Tennessee.

Both a TC and an NGC are under the limited antitrust protection provided by the Capper-Volstead Act. They enjoy the single tax treatment, and are designed specifically for the agricultural business. However, an NGC is not restricted to the nonprofit requirement. In terms of membership, the two types of cooperatives share a lot of similarities, such as one vote per member regardless of capital investment, governance by their board of directors, and limited liabilities. However, an NGC has more flexibility than a TC by releasing the restriction on the number of members from eleven or more in a TC to one or more. It also relieves the minimal number of board directors from no less than five in a TC to three, and expands the participants from only persons engaged in agriculture in a TC to nonagricultural persons. A TC is capitalized through retained patronage refunds or per-unit retains and has open membership in which members are only required to pay a nominal membership fee and are not obligated to deliver a specified amount of product to the cooperative if they can not make it. In contrast, an NGC is financed by capital stock purchases to meet the optimal processing capacity and

has closed membership in which members are required to pay a huge amount of up-front investment and are obligated to deliver a unit of certain quality for each share purchased, even if they do not have sufficient commodities to make delivery. Once enough delivery rights are allocated to cover the predetermined optimal processing capacity, the membership is closed. Transfer of membership is also allowed in an NGC.

Both cooperatives can issue common stocks and nonvoting preferred stocks. In a TC, preferred stocks are transferable, but common stocks are only transferable to persons engaged in the production of agricultural products handled by the cooperatives. Common and preferred stocks in an NGC are part of members' financial rights and hence can be transferred in whole or in part to any person only with the approval of the board. They can also appreciate or depreciate according to the market value. Both cooperatives distribute their profits and losses on the basis of patronage, or business done for or with the cooperatives, rather than on the capital investment. However, due to their different financing methods, a TC usually pays back the equity at the face dollar value after a period of years or at a certain retirement age, but an NGC returns most of its profits in cash each year. Both TCs and NGCs set their preferences in liquidation on the basis of patronage rather than capital investment.

An LLC also shares some similarities with an NGC. They are both taxed only at the ownership level, have limited liability, allow single member entity and nonagricultural members, require one member one vote, have the same rules on the transfer of membership interests, issue common stocks and nonvoting preferred stocks, and distribute most of their profits in cash annually.

In addition, an LLC and NGC have distinctive differences. While an LLC is open to any business and generally focuses on investment rather than patronage, an NGC is designed specifically for agriculture and focuses both on investment and patronage. An NGC has patron members, a board of directors and closed membership, but an LLC has no separate categories for patron and nonpatron members except a board-managed LLC, and the membership of an LLC is not closed. An NGC has a marketing contract to ensure the delivery of commodities from its patron members, and an LLC has a similar contribution agreement if the contribution is defined as commodities. While a marketing contract only applies to patron members in an NGC, a contribution agreement covers all of the members in an LLC. An NGC allocates its profits and losses and set its ordering in liquidation on the basis of patronage; an LLC distributes its profits and losses equally among members, including on termination.

The results from the survey investigating Tennessee soybean producers' views on biodiesel marketing suggested an average of 74.78 percent participation rate in joining an NGC to produce biodiesel. This percentage showed a considerable interest among Tennessee soybean producers in producing biodiesel through an NGC.

The participant profile would be a farmer optimistic about the U.S. biodiesel market growth in the next 10 years. The farmer would also have more than 1,000 acres of soybean production, on-farm storage, a net income more than $75,000 from farming per year and a debt rate of $20-$39.99 or $3-$9.99 per $100 of farm assets. The farmer would be of a younger age (i.e. 35), and would not be a current member of any agricultural cooperative, and would have received a bachelor's degree or higher.

Producers with this profile were estimated to have an as high as 99.68 percent probability to join an NGC to produce biodiesel.

Among those farmers who were willing to join an NGC to produce biodiesel and purchase the minimal 2,500 shares, or an equivalent of $5,625, they would purchase an average of 4,048 shares, or an equivalent of $9,108, from an NGC.

The profile of a farmer who would buy more shares in an NGC to produce biodiesel would be a farmer optimistic about the U.S. biodiesl market growth in the next decade. The farmer would have more than 1,000 acres of soybeans, without on-farm storage capacity. The farmer would also have more than $15,000 from farming per year, with less than 60 percent of the household's income from off-farm sources and without debt for farm assets. The farmer would also have four years of college education or higher. Producers of this profile were estimated to buy as many as 12,028 shares, or an equivalent investment of $ 27,063, to an NGC to produce biodiesel.

As conducted in the feasibility study (English, Jensen, and Menard, 2002), the optimal capacity of the processing plant in integrated option is 13,000,000 gallons of B100 biodiesel or $37.575 million investment, which requires 9,000,000 bushels of soybeans. If 50 percent is financed from equity and 50 percent from debt, 4,500,000 bushels of soybeans or $18.788 million need to be purchased by members in an NGC. Given a participation rate of 74.78 percent and a purchase of 4,048 shares per farmer in the sample, a total of 7,419,984 shares, or an equivalent of $16,694,964 can be financed by the producers from the sample, which represents 82.44 percent of total soybeans and 44.43 percent of total capital needed. If adjusted for the different composition rate of small farms between the sample of 2,452 producers and the population of about 4,352

producers in Tennessee, approximately 2,843 producers will join an NGC to produce biodiesel. Therefore, a total of 10,577,244 bushels which represents 117.52 percent of the total soybean needed, or an equivalent of $23,798,799 which represents 63.34 percent of the total investment needed, can be raised from the equity of an NGC. Projections suggest a sufficient interest in supplying and financing more than half the needs of an NGC to produce biodiesel among all soybean producers in Tennessee.

Limitations about the Study and Suggestions for Further Research

Several parts in the study should be treated cautiously when using the results to make prudent decisions.

First, producers with a larger farm size ($\geq$ 100 acres) had a response rate of 18.92 percent, which is 10.40 percent higher than the 8.52 percent response rate of producers with a smaller farm size (<100 acres). Since the response rate of producers with a smaller farm is about one half lower than that of producers with a larger farm size, caution should be taken in applying the survey results to the whole sample or the population.

Second, the survey design of first asking for minimal acceptable rates of return and then the extra number of shares producers would purchase on the basis of their indicated minimal acceptable rates of return may be misleading to some extent. Generally, people who tend to give a greater number of shares with a higher minimal acceptable rate of return are actually pickier about the investment and will invest fewer shares in reality.

Third, as often occurs in all kinds surveys, people tend to exaggerate more or less the number they will buy or invest, because it is much easier to say than to do. Therefore, this shrinkage should be taken into consideration.

During the survey, some respondents asked for more information about the biodiesel production through an NGC. So, it would be good to advertise more related information to producers in the future to facilitate and ensure the success at the implementation stage.

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APPENDIX-Survey Sample

GROWERS' VIEWS ON BIODIESEL PRODUCTION & MARKETING

The purpose of this study is to measure soybean producers' attitudes about biodiesel markets and formation of a cooperative to produce biodiesel from soybean oil in the West Tennessee area. Your response is important for obtaining an accurate measure of producers' views. Your participation is ***completely voluntary*** but will help us to serve you and other soybean growers. Only summaries of responses from the survey will be reported. Only researchers conducting the study will have direct access to the data. This questionnaire will take about 15 minutes to complete. You will be provided with an opportunity to request a copy of the study summary at the end of this questionnaire. We appreciate your participation.

Section I. Biodiesel Markets

Biodiesel is an alternative fuel that can be made from soybean oil. Blends of up to 20% biodiesel mixed with petroleum diesel fuels (B20) can be used in nearly all diesel equipment and are compatible with most storage and distribution equipment.

1. Please circle the rating that most closely matches your opinions on the following statements.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
a. The U.S. markets for biodiesel will grow rapidly in the next 10 years	1	2	3	4	5
b. Biodiesel production will provide an important national market for soybeans in the next 10 years	1	2	3	4	5
c. If priced competitively with conventional diesel, I would be interested in using biodiesel from soybeans in a 20 percent blend on my farming operation.	1	2	3	4	5

2. Do you believe that biodiesel from soybeans could be profitably produced in West Tennessee? (Circle the answer.)
   a. YES (Continue on to question 3.)
   b. NO Please indicate reasons why _____(Go to question 11)

3. Would you be willing to sell some or all of your soybeans directly to a biodiesel processing plant?
   a. YES (Continue on to question 4)
   b. NO (Go to question 11)

4. I would prefer to sell my soybeans to a processing plant that is (Please circle the answer):
   a. Privately owned (Continue on to question 5)
   b. Cooperatively owned (Go to question 6)
   c. No preference (Go to question 6)

5. Please indicate the number of bushels you (on an average year) would be willing to sell to a plant, then go to question 11.
   a. Through marketing contracts _____bushels
   b. On a spot basis (no contract) _____bushels

6. Please indicate the number of bushels you (on an average year) would be willing to sell to a plant (Continue on to question 7)

a. Through marketing contracts _____bushels
b. On a spot basis (no contract) _____bushels

Section II. Cooperative Production of Biodiesel

7. Would you be interested in participating in a new generation cooperative to produce biodiesel?
   a. YES (Continue on to question 8)
   b. NO Please indicate reasons why _____
   _____(Go to question 11)

8. What is the minimum percent per year you would find acceptable on any investment you made in a biodiesel production facility? _____% (for example, an 8% return would mean for every $100 invested, you would receive $8 per year). (Continue on to question 9)

9. At the rate you of return indicated above, and assuming a share price of $2.25 per bushel with minimum purchase of 2,500 shares or rights to deliver 2,500 bushels ($5,625 investment), would you be willing/able to purchase the minimum number of shares?
   a. YES (If Yes, continue on to question 10)
   b. NO (If No, go to question 11)

10. At the rate of return you stated in question 9, please indicate the number of additional shares you would be willing and able to purchase above the minimum of 2,500 (if none, indicate by answering '0')._____ additional shares (Continue on to question 11)

New Generation Cooperatives (NGC)
- Major focus is on "value-added" products, rather than commodities.
- Members sell raw products grown to their cooperatively-owned processing plant. Cooperative profits are then distributed back to members in proportion to raw product delivered.
- Shares allocate delivery rights so each share entitles & obligates a member to deliver soybeans to the cooperative
- Restricted or closed membership limits soybean deliveries to the amount the plant can absorb
- Investment may or may not include non-members. Investment by non-members is less than majority.

Section III. Farming Operation and Producer Characteristics

11. Are you currently a member of an agricultural cooperative?
    a. YES b. NO

12. Acres of soybeans harvested in 2001 _____.

13. Please indicate the number of soybean bushels you can store on-farm. _____ bushels.

14. What percent of your soybeans do you typically sell through contracts? _____%.

15. Other acreage harvested or used on the farm(s) you operate in 2001

a. Cotton	_____	e. Pasture	_____
b. Corn	_____	f. Woodland	_____
c. Wheat	_____	g. Other (Please describe)	_____
d. Other Crops Harvested (Please describe)	_____		_____

16. Number of livestock on your farming operation

a. Beef Cows	_____	e. Broilers	_____
b. Milk Cows	_____	f. Sows	_____

c. Yearlings	_____	g. Horses	_____
d. Heifers	_____	h. Other (Please describe)	_____

17. Your age in years _____.
Years experience farming _____.

18. For the farm(s) I operate, I am (Please circle the best answer)
a. A full owner (sole proprietorship)
b. A part owner in a partnership, family held corporation, or other corporation
c. A renter
d. Other (please describe): _____.

19. Net income from farming in 2001 (after taxes). (Please circle the best answer).
a. negative (less than $0)
b. $0-$9,999
c. $10,000-$14,999
d. $15,000-$24,999
e. $25,000-$34,999
f. $35,000-$49,999
g. $50,000-$74,999
h. $75,000-$99,999
i. $100,000-$149,999
j. Greater than or equal to $150,000

20. For every $100 of farm assets you have, how many dollars are financed with debt? (Please circle the answer).
a. $0
b. $1-$2.99
c. $3-$4.99
d. $5-$9.99
e. $10-$14.99
f. $15-$19.99
g. $20-$39.99
h. $40-$69.99
i. greater than $70

21. What percent of your household's income came from off-farm sources in 2001 _____%

22. What is the highest education level you attained? (Please circle the answer).
a. Some high school or less
b. High school graduate
c. Some college
d. College graduate
e. Post graduate

END OF QUESTIONNAIRE. THANK YOU FOR YOUR TIME AND EFFORT.

_____Yes, I would like to receive a copy of the summarized results

VITA

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