A NORMATIVE ECONOMIC ANALYSIS OF COOPERATIVE BIODIESEL PRODUCTION USING SOYBEANS PRODUCED BY SMALLHOLDERS IN KWAZULU-NATAL, SOUTH AFRICA

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ABSTRACT

The South African biofuels industrial strategy promotes a development-oriented strategy with feedstock produced by smallholders and processed by traditional producer-owned cooperatives. This study examines a proposal to apply this strategy to small-scale farmers in KwaZulu-Natal (KZN), using soybeans as feedstock for biodiesel production. First, it is argued that value-adding cooperatives established under South Africa's current Cooperatives Act, No. 14 of 2005 (hereafter the Cooperatives Act) would fail to attract the capital and expertise needed to process biodiesel owing to ill-defined voting and benefit rights. Second, a mixed integer linear programming model is used to determine the viability of producing biodiesel from soybeans, viewed from the perspective of the smallholder as grower and co-owner of the processing plant. It is concluded that smallholder participation would require a rental market for cropland, co-ownership of the processing plant in a non-traditional cooperative or investor-owned firm, information and training, and a high level of government subsidy.

Keywords: biodiesel, rural development, South African biofuel industrial strategy, smallholder marketing cooperatives

1 INTRODUCTION

The South African government currently encourages the use of cooperatives as organisations that have the potential to promote the development of small-scale

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farmers and other local communities (Ortmann & King, 2007a, 2007b; Lyne & Collins, 2008). This is not necessarily a novel concept, however, as cooperatives have been endorsed in numerous developing nations as a means to stimulate agricultural growth and rural development (Chibanda *et al.*, 2009; Nganwa *et al.*, 2010), and are a prominent form of business organisation around the world (Cook & Iliopoulos, 2000). Since the primary objectives of the South African biofuels industrial strategy are poverty alleviation and the stimulation of economic activity in the former homelands (Funke *et al.*, 2009), it is not surprising that the biofuels industrial strategy explicitly states that the South African government intends using cooperatives as the preferred organisational vehicle to integrate smallholders into the domestic biofuels industry (DME, 2007).

Soybeans are the only potential biodiesel feedstock identified by the South African biofuels industrial strategy grown on a reasonable scale in the province of KwaZulu-Natal (KZN). Batch processors allow a quantity of biodiesel to be processed in separate consignments. Amigun *et al.* (2008) postulate that small, decentralised batch processors are likely to be well suited to small-scale biodiesel production operations on the African continent, due to comparatively lower capital requirements (relative to continuous flow biodiesel plants) and the ability to regulate production within demand. Moreover, these authors suggest that batch processors could represent a means of combating risk in biodiesel industries in response to uncertain and unpredictable government energy policies. The economic feasibility of on-farm biodiesel production using soybeans grown by large commercial farmers is explored by Sparks *et al.* (2011). Given recent criticisms of the South African biofuels industrial strategy (Meyer *et al.*, 2008; Funke *et al.*, 2009; Sparks & Ortmann, 2011; Sparks *et al.*, 2011), an analysis of the economic viability of producing biodiesel from soybeans grown by smallholders in KZN is well justified. This study uses a mixed integer linear programming model to examine this question from the perspective of the smallholder as grower and co-owner of a cooperative batch biodiesel processing plant.

Lyne and Collins (2008, p.180) suggest that agricultural cooperatives can be regarded as vehicles to "facilitate vertical coordination with, or horizontal integration between, small farmers who would otherwise be excluded from value-adding opportunities and discerning markets". With regard to biofuel production, the Worldwatch Institute postulates that cooperatives may "allow small- and medium-sized producers to share more in the economic gains of the biofuel industry and to negotiate on a more equal footing" (2007, p.322). Bender (1999) suggests that the processing of biodiesel by farmer cooperatives could potentially play an important role in the development of rural economies whilst using local renewable resources. However, this study argues that the type of cooperatives permitted by the Cooperatives Act will not attract the capital or expertise required by smallholders to establish and manage biofuel processing plant. This argument is based largely on theory drawn from the New Institutional Economics (NIE), and in particular the literature relating to ill-defined property rights in traditional cooperatives (e.g., Cook & Iliopoulos, 2000).

The primary objectives of this study are, therefore, twofold. First, it briefly seeks alternatives to the traditional cooperative model that would better serve the purpose of integrating smallholders into South Africa's biofuel industry. Second, it investigates the economic viability of producing biodiesel from soybeans grown by smallholders in KZN. While the mixed integer model used in this analysis explicitly accounts for size economies introduced by fixed processing costs, it is solved for different smallholder farm sizes in order to draw inferences about the adequacy of returns to individual growers.

The next section of this article provides relevant information about the Cooperatives Act and explains why cooperatives established under this legislation are unlikely to integrate smallholders into value-adding processing and marketing activities. This is followed by a brief description of small-scale agriculture in KZN and a section comparing the results of the programming model across large and small farm systems. The article concludes with some policy advice.

2 COOPERATIVE MODELS TO INTEGRATE SMALLHOLDERS INTO VALUE CHAINS

Ortmann and King (2007a) provide a detailed history of agricultural cooperatives, as well as their development and implementation in South African agriculture–which culminated in South Africa revising the Cooperatives Act in 2005. An explicit core purpose of the Cooperatives Act is to target and ensure the provision of support programmes for development-orientated cooperatives, established primarily to assist groups previously disadvantaged by the apartheid system (Ortmann & King, 2007a; Lyne & Collins, 2008). Importantly, however, Lyne and Collins (2008, p.193) and Nganwa *et al.* (2010, p.40) point out that the Cooperatives Act is counter-productive as it specifies institutional arrangements that are typical of so-called "traditional cooperatives".

Cook (1995) identifies five institutional problems of traditional cooperatives, arising primarily from poorly defined property rights (i.e., voting and benefit rights), namely: the free-rider, horizon, portfolio, control, and influence cost problems. The flawed property rights that cause these problems stem from the cooperative principles of Democratic Control, Member Economic Participation and Open Membership and, which legislators have generally interpreted as egalitarian voting rights, patronage-based returns and redeemable/non-tradable equity shares (Lyne & Collins, 2008; Nganwa *et al.*, 2010). Causal relationships between these rules of a traditional cooperative, the institutional problems identified by Cook (1995) and their detrimental effects on equity and debt capital have been well documented in the NIE literature and are not discussed here.[1]

Persistence with an organisational model that constrains access to capital will most likely limit the role of smallholder marketing cooperatives to one of contracting with a processor. This single contract would replace the numerous small contracts and high transaction costs that the processor would face if it attempted to deal with many individual small growers. Thus, establishment of a traditional cooperative (horizontal integration) could give smallholders access to processors via contractual arrangements (vertical coordination) but only in areas where processors operate. Elsewhere, these cooperatives will have to integrate vertically into processing but this will almost certainly require a shift away from traditional cooperative status in order to attract the capital needed to finance plant and equipment, and the expertise needed to manage it.

In a large-farmer setting, institutional changes that better align voting and benefit rights with levels of individual investment have strengthened incentives for patrons and banks to finance cooperative assets. Cases of cooperative laws being modified to permit "hybrid cooperatives" and of traditional cooperatives adopting non-traditional voting and benefit rights have been well-documented in recent literature from developed countries (Hendrikse & Veerman, 2001; Chaddad & Cook, 2004; Bekkum & Bijman, 2006; Lyne & Collins, 2008; Woodford, 2008). These institutional innovations are a response to increasingly competitive and discerning food markets where value must be added to products in order to maintain prices and market share. Value-adding requires substantial investment in plant, equipment, branding and promotion that traditional cooperatives struggle to finance.

Chaddad and Cook (2004) propose a typology in which traditional cooperatives and investment-owned firms (IOFs) are at two opposing extremes. They identify three cooperative models where ownership rights are limited to member-patrons, namely: proportional investment cooperatives (PICs); member-investor cooperatives (MICs); and new generation cooperatives (NGCs). All of these models alleviate the internal free-rider problem by strengthening proportionality between investment and returns. NGCs also alleviate horizon and control problems by selling tradable delivery rights to member patrons. This model is popular in the United States (US) where it is often used by farmers to establish cooperative processing plants for biofuel (Jensen *et al.*, 2004; Kenkel & Holcomb, 2009). These three organisational forms, however, explicitly maintain patron control of the cooperative at the cost of limiting access to external sources of capital. Importantly, a biodiesel production cooperative is likely to require significant contributions of both capital and expertise to establish and operate. Lyne and Collins point out that these are "factors of production that the community is sorely lacking but which could be acquired by taking on an experienced business partner" (2008, p.189).

Similarly, the Worldwatch Institute suggests that the most efficient means to accelerate an expansion of biofuel production "is for governments to create a policy environment that is conducive to private-sector investment in the development of these fuels" (2007, p.312). Gordon (2008) contends that if small-scale producers continue to lack the capital, infrastructure or economies of scale to access global biofuel markets, they may be able to participate in biofuel production only as suppliers of raw materials. This shifts attention to Chaddad and Cook's (2004) two remaining cooperative models, namely: cooperatives with capital seeking entities; and investor-share cooperatives (ISCs).

The "cooperative with capital seeking entities" or "Irish model" draws external capital into a subsidiary firm that is co-owned by the cooperative and the external investor(s) (Chaddad & Cook, 2004). However, creating a co-owned subsidiary does not address institutional problems within a traditional cooperative. Members still have little incentive to invest in their cooperative in order to increase or even maintain its shareholding in the subsidiary. Over time, control of the subsidiary may shift to the external investor(s), bringing investors and patrons into conflict over the distribution of benefits.

In contrast to the Irish model, ISCs issue "separate classes of equity shares in addition to the traditional cooperative ownership rights held by member-patrons" (Chaddad & Cook, 2004, p.357), although these ownership rights are typically distinct from those of member-patrons. Essentially, non-patron investors are permitted to purchase non-redeemable, tradable equity shares that provide market-related returns in dividends and capital gains, but which confer no or limited voting rights to ensure that control remains with patrons. While such arrangements can certainly improve a cooperative's access to capital and expertise, they sacrifice the advantage of inexpensive supply contracts (Sykuta & Cook, 2001) enjoyed by NGCs where investment is proportional to patronage (Bekkum & Bijman, 2006).

Lyne and Collins argue that cooperatives could exploit a provision made in the Cooperatives Act for "funds of members" and reorganise, initially, as an MIC (2008, p.192). Logically, the MIC could then convert to ISC status by extending membership to non-patron investors. However, the authors recognise that this will depend on how the definition of a patron is interpreted. The Cooperatives Act states that membership is "open to (natural and juristic) persons who can use the services of the cooperative". Thus, it could well be argued that a strategic partner with expertise in processing biofuels is utilising the services of the cooperative and, therefore, qualifies for membership and equity shares. From the specific standpoint of biofuel production, Kenkel and Holcomb (2009) conclude that hybrid cooperative models, which accommodate both patron and non-patron investor owners, will likely be required in order to access sufficient capital to develop and expand biofuel industries in the US. These authors, however, warn that the long-term success of these models has largely been unproven to date, and specific biofuel production issues involving feedstock pricing (the local monopoly problem), plant location, profit distribution and control may prove problematic in such ISCs.

A proactive response by the South African government to facilitate biodiesel production ventures that are aimed at stimulating economic activity in the former homelands would be to establish and nurture strategic equity-sharing joint ventures between previously disadvantaged smallholders and business partners in the private sector. In this regard, however, Lyne and Collins conclude that:

> Unfortunately, South Africa's new Cooperatives Act prevents prospective partners from taking up equity in a development-oriented cooperative, and the idea of using a cooperative to warehouse members' shares in an investor-owned firm does not free its members from the problems created by ill-defined property rights. A unitised trust would better serve this purpose (2008, p.193).

Although the term "patron" is loosely defined in the Cooperatives Act and could be interpreted as including strategic partners, a proactive strategy would amend the Act, making explicit provision for ISCs in order to encourage equity-sharing arrangements between smallholders and strategic partners. Kenkel and Holcomb (2009) report a trend in US ethanol industries where producers have moved progressively away from the NGC model toward those that more closely resemble ISCs. More specifically, they suggest that "as the industry developed, and investors' understanding of the grain marketing system improved, project developers shifted toward business models which could access non-producer capital while relying on open market purchases for the grain supply" (Kenkel & Holcomb, 2009, p.462).

Another proactive strategy would be to extend public support, currently offered only to cooperatives, to development-oriented IOFs (Lyne & Collins, 2008). Whereas, both the ISC and IOF can alleviate free-rider, horizon, control and portfolio problems, the IOF can also combat the influence cost problem by assigning all voting rights in proportion to investment. In South Africa, however, the IOF alternative may have little political appeal as smallholders could be distanced from control by a majority investor.

3 CHARACTERISTICS OF SMALL-SCALE AGRICULTURE IN KWAZULU-NATAL

Subsistence farming has historically been a feature of poor households in South Africa, including KZN, as a means to ensure their livelihoods. While the vast majority of rural households derive a relatively small proportion of their total income from agriculture, a significant number are highly dependent on farming activities, as well as attaching a relatively high value to land as a form of social security (Lyne *et al.*, 1996). Farmland is seldom privately owned in South Africa's former homelands, and is administered by tribal authorities who allocate land to household heads and settle boundary disputes. These land allocations confer use rights but households are not permitted to sell the land (Lyne & Nieuwoudt, 1991; Kille & Lyne, 1993).

The rural areas of the former KwaZulu homeland (hereafter referred to as Ngonyama Trust land) are characterised by both high population pressure and uniformly small farm sizes (Lyne *et al.*, 1996; Crookes & Lyne, 2001). The vast majority of these land allotments are less than two hectares in size (Lyne, 1989; Nieuwoudt, 1990; Thompson, 1996; Hendriks *et al.*, 2009). Nevertheless, it is "patently obvious" that the land is not farmed intensively (Thompson & Lyne, 1991, p.288). Nieuwoudt (1990) contends that these small farm sizes imply that profits from agriculture, even under optimal technological conditions, are likely to be unattractive when compared to potential wage employment.

Given the relatively specific nature of this analysis, it is important to consider some key aspects of crop farming in Ngonyama Trust land. Widespread under-utilisation of land in an area where land is scarce and labour is abundant has been explained by the absence of an efficient rental market for cropland (Lyne, 1989; Thompson, 1996). When a household (i) values land for the social security that it provides and (ii) earns more from off-farm wage work than it can from cultivating a very small farm and (iii) cannot lease land to other households that do rely on farming, it will tend to leave cropland idle as there is no opportunity cost attached to under-utilisation. Lyne (1989) estimates that 22 per cent of arable Ngonyama Trust land is left idle. Consequently, average crop yields are typically very low (Thompson & Lyne, 1991), and are cultivated primarily for home consumption. Staples, such as maize, dry beans and potatoes, feature prominently (Hendriks *et al.*, 2009). However, Whitehead (2010) notes that smallholders in KZN have little or no experience in cultivating soybeans – the biodiesel feedstock considered in this analysis. Moreover, the map in Appendix A shows that the vast majority of Ngonyama Trust land falls outside the regions of high soybean production potential.

Poverty has been regarded as "the outstanding characteristic of traditional agriculture" (Ghatak & Ingersent, 1984, p.23), and is severe in Ngonyama Trust land. In their recent study of the Embo community, Hendriks *et al.* conclude that "these rural households have very small farms, produce food largely for subsistence purposes, and have per capita cash incomes less than US$2.00 per day – most of which comes directly or indirectly from wage earnings, state pensions and welfare grants" (2009, p.27). Therefore, given that limited access to capital is a considerable constraint to rural development in South Africa (Ortmann & King, 2007b), even a large group of smallholders willing to invest in a producer-owned firm would struggle to finance oil extrusion and/or biodiesel plants. The following sections present an empirical assessment of the economics of biodiesel production using soybeans grown by smallholders in KZN when it is assumed that there are sufficient smallholders willing and able to grow enough feedstock to supply a co-owned processing ISC or IOF.

4 THE MODEL

The Department of Minerals and Energy's (DME) criteria for licences to manufacture biofuels require that "the production of feedstock under irrigation will only be allowed in exceptional circumstances and a detailed motivation will have to be provided" (2009, p.2). It further advocates that feedstock must be cultivated and/or sourced from the former homelands, which is consistent with the primary objectives of the South African biofuels industrial strategy of poverty alleviation and the stimulation of economic activity in the previously disadvantaged regions.

From a crop farming perspective, Brink and McCarl (1978, p.259) suggest that crop-planning models can be used for at least three purposes: (i) to aid farmers in planning their land allocations; (ii) to help farmers budget returns to investments; and (iii) to assist policy makers predict farmer responses to policy decisions. Sparks *et al.* (2011) developed a mixed integer linear programming model to evaluate the economic feasibility of soybean-based biodiesel production on commercial farms in KZN. The model incorporated 10 years of production data for various crops and tillage practices, as well as possible risk-averse behaviour of farmers by maximising the criterion $E-\theta\sigma$, where E is the expected farm gross margin, θ is an aggregate risk-aversion parameter, and σ is the standard deviation of farm gross margin (Baumol, 1963; Hazell & Norton, 1986, pp.91–93).

The basic inclusion of risk as a cost factor can thus be illustrated as follows:

$$\text{Max } L = [P'YX - C'X - \theta\,(X'\Omega\,X)^{1/2}] \qquad [1]$$

where P'YX is crop income, P being a vector of product prices, Y a diagonal matrix of yields per hectare, and X a vector of crop areas; C'X is total production costs, C representing a vector of production costs per hectare; θ is a farmer's risk aversion coefficient; Ω is a variance-covariance matrix of gross margins per hectare; and $(X'\Omega\,X)$ represents variance in gross margins.

The standard deviation estimate can, therefore, be calculated in the following manner:

$$\text{Est } (X'\Omega\,X)^{1/2} = \frac{\sqrt{\Delta}}{T} \qquad [2]$$

where $\Delta = T\Pi / 2(T-1)$, which is regarded as a "correction factor to convert the square of the mean absolute deviation to an estimate of the population variance (assuming the population is normally distributed)" (Simmons & Pomareda, 1975, p.473). In the above specification, T is the total number of periods considered, and Π is the mathematical constant.

When using cropping models which incorporate risk by maximising the criterion $E-\theta\sigma$, Ortmann and Nieuwoudt (1987) note that the sensitivity of the model can be determined by testing various values of θ in successive optimisations. The fact that θ values can be easily manipulated when using this criterion provides the modeller with a relative degree of flexibility. Thus, Ortmann and Nieuwoudt (1987) conclude that the θ coefficient can essentially be regarded as a fine-tuning device, with θ also capturing other effects, including data errors and model misspecifications.

The model also included data on the associated average capital and operating expenses for five batch processing biodiesel plants of differing capacity and quality (see Table 1). Integer activities ensured that soybeans would not be processed on-farm if the quantity produced did not warrant the variable and fixed annual costs of the processing plant. The model could select from plants of different size, and permitted market purchases of soybeans to make full use of processing capacity. The model was validated both in terms of simulating observed enterprise mixes and the rental rate of cropland in KZN. It was determined that the solution with $\theta = 2$ best simulated observed rental rates (at 4.48 per cent of the market value of cropland). All data were adjusted to a real 2009/10 basis using the South African Consumer Price Index (CPI).

Table 1: Summary of key plant assumptions in the baseline model

	Oil Extrusion Plant 1	Oil Extrusion Plant 2	Biodiesel Plant 1 (Low-Tech)	Biodiesel Plant 2 (Low-Tech)	Biodiesel Plant 3 (High-Tech)	Biodiesel Plant 4 (High-Tech)	Biodiesel Plant 5 (High-Tech)
Annual Capacity (Litres)	90 720	259 200	48 000	96 000	360 000	960 000	1 920 000
Annualised Fixed Cost (Rand)	59428	158475	21656	36752	61309	108099	187966
Variable Cost / Litre Product (Rand)	3.75	3.75	2	2	2	2	2

Source: Sparks *et al.* (2011)

The large (440 ha) commercial farm "baseline" model developed by Sparks *et al.* (2011) was modified to represent a KZN smallholder system (Appendix A indicates those areas of Ngonyama Trust land that have significant agronomic potential for soybean production and to which this analysis applied). The smallholder model initially assumed that each farmer operated no more than one hectare of land for grain production. Irrigated land was excluded from the model in view of DME policy requirements. In reality, very few smallholders have access to irrigated land

and – if they do – tend to use it for vegetable crops rather than grain crops. As in the large farm model, soybeans were not permitted to exceed the area planted to maize. This constraint provides for necessary crop rotation and a degree of food security on small farms. Smallholders were also assumed to face the same prices (R3 738/ton and R8.44/litre for soybean oilcake and soybean oil, respectively), use the same technology, achieve the same yields and display the same level of risk aversion as the large commercial farmer modelled by Sparks *et al.* (2011). On the processing front, it was assumed that smallholders would supply a processing plant that they co-owned as an ISC or IOF, and that (as shown by the large, commercial farm model) a total arable area of 440 hectares would be sufficient to warrant a small processing plant – provided that the solution allocated more than one-third of this land to soybean production.[2]

5 ECONOMIC ANALYSIS OF COOPERATIVE SMALLHOLDER BIODIESEL PRODUCTION

The smallholder ISC/IOF model was solved iteratively to find the soybean price at which a co-owned processing plant would become viable. This occurred at a price of R3 800 per ton of soybeans, *ceteris paribus*, and the solution for each (1 ha) farmer included maize (0.47 ha) and drybeans (0.2 ha) as its main food crops. Figure 1 compares minimum levels of government subsidy needed to draw soybeans (as feedstock for biodiesel) into the linear programming solutions computed for the large commercial farm (Sparks *et al.*, 2011) and smallholder ISC/IOF models. Under the more realistic baseline conversion ratio, the minimum level of government intervention needed to produce biodiesel from soybean cultivated by smallholders in the ISC/IOF model is estimated at R12.14 per litre. This is nearly three times as much as the minimum subsidy estimated for the commercial farm model (R4.37/litre). A similar situation exists under an optimistic conversion ratio, where the levels of subsidy are estimated to be R7.22 and R3.64 per litre for the ISC/IOF and large commercial farmer models, respectively.

The higher levels of subsidy required for the smallholder system reflect the exclusion of irrigated land and a greater proportion of the arable area cropped to drybeans for food security purposes. It could, however, be argued that the level of subsidy estimated for smallholders is understated because dryland crop yields observed on small-scale farms in KZN tend to be much lower than those observed on large commercial farms (Lyne, 1989, p.9; Whitehead, 2010). More fundamentally, the expected annual gross margin net of fixed processing costs (E) generated by one hectare amounts to just R3 159 per annum[3] – despite the government subsidy. It seems unlikely that this level of earnings would be attractive to small farmers as they could earn substantially more by working as unskilled labourers on a large commercial farm. In addition, the costs of developing ISCs or

IOFs with large numbers of resource-poor shareholder-patrons (upwards of 400) may be prohibitively high. The largest of the cooperatives studied by Nganwa *et al.* (2010) in KZN had a total of 105 members.

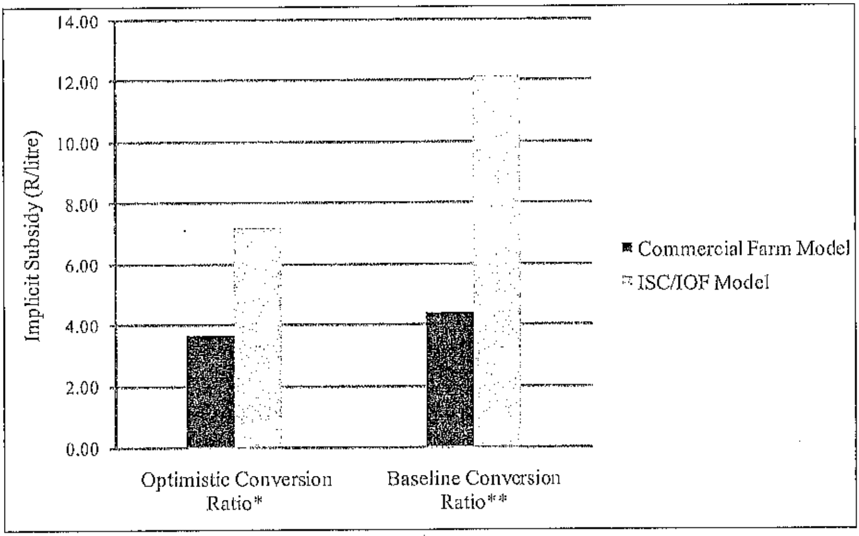

Figure 1: Minimum levels of subsidy estimated for large and very small farmers growing soybean for biodiesel production in KwaZulu-Natal (2009/10 = 100)

Note:* and ** assume yields of 180 and 120 litres of soybean oil per ton of soybeans, respectively.

It has long been argued that a rental market for Ngonyama Trust lands would encourage voluntary transfers of use rights from non-farming households to emerging farmers, with positive outcomes for equity, income and the adoption of land-saving farm technology (Nieuwoudt, 1990; Kille & Lyne, 1993; Lyne *et al.*, 1996). Empirical studies and "action research" conducted in various wards have shown that rental markets for cropland can be activated with only small adaptations to existing tenure arrangements, and that these markets allowed emerging farmers to grow their operations while generating rental income for other households too poor to farm (Thompson, 1996; Crookes & Lyne, 2001). Figure 2 compares the earlier smallholder ISC/IOF results with those estimated for a similar ISC/IOF model where emerging farmers have hired idle land from neighbours and increased their arable areas operated from one to 10 hectares.

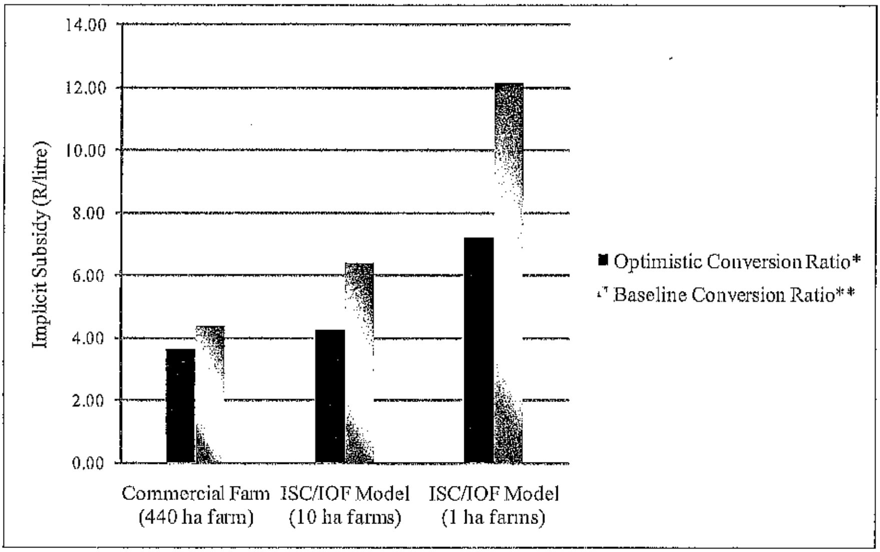

Figure 2: Minimum levels of subsidy estimated for large, emerging and very small farmers growing soybeans for biodiesel production in KwaZulu-Natal (2009/10 = 100)

Note: * and ** assume yields of 180 and 120 litres of soybean oil per ton of soybeans, respectively.

In this case, expected annual gross margin net of fixed processing costs (E) increases from R3 159 to a meaningful R29 838 per annum, and the number of shareholder-patrons declines to a much more manageable number (44). The required level of subsidy is estimated to fall almost to the level required for the large commercial farmer, the remaining difference reflecting mainly the absence of irrigation land.

6 CONCLUSION

While the South African government has undoubtedly recognised the need for and importance of promoting rural development in the former homelands, the current Cooperatives Act stipulates conditions which are typical of traditional cooperatives. Consequently, they are likely to suffer from a myriad institutional problems associated with inadequately defined property rights. Moreover, contrary to the international trend of amending cooperative legislation in order to permit and encourage investment by patron and non-patron members, the Cooperatives Act essentially denies development-orientated cooperatives access to the complementary capital and expertise that strategic equity partners could provide. Access to external sources of financial and human capital is expected to play an important role in the successful and sustainable development of biofuel industries, both globally and in South Africa.

This issue is particularly pertinent if smallholders are to engage in the biofuel industry as more than just feedstock producers, which – it could be argued – should be the policy objective if government is serious about maximising the benefits for poor rural communities. The South African government should not underestimate the importance of appropriate business models in achieving this objective and this research supports recent calls for the current Cooperatives Act to be amended in order to give cooperatives a higher degree of flexibility in their choice of institutional arrangements. It follows that the industrial biofuel strategy proposed for South Africa should be amended to recognise smallholder ISC or IOF biodiesel processing models, and that government support dedicated to traditional smallholder cooperatives should also be used to establish and nurture these alternative forms of business organisation. In addition, more general problems constraining economic development in Ngonyama Trust land need to be addressed if cooperatives (or other forms of business organisation) are to play an important role in pro-poor development initiatives. These problems include uncertain property rights and poor physical infrastructure that limit access to information and markets, including land rental markets.

With specific regard to the production of soybeans in KZN as feedstock for biodiesel, the results of this study have shown that local processing would require on-going subsidies–regardless of whether the soybeans are grown on large or small farms, or whether irrigated land is used or not. Pro-poor rural development might be better served by promoting smallholder soybean oil extrusion ventures that are expected to require less subsidy and which maintain the advantage (as for biodiesel production) of producing oilcake that can be used as a high protein input in animal feeds. South Africa has consistently been a net importer of both soybean oil and oilcake. The results also suggest that smallholder participation is unlikely in the absence of a rental market for cropland as prevailing farm sizes are too small to make commercial production of soybeans a worthwhile proposition – even with high levels of subsidy. Preconditions, therefore, include a rental market for cropland, support for smallholder organisations like ISCs or IOFs that encourage investment by patrons and strategic equity partners in processing plants, and extension and training for small farmers who typically have little experience in the production of soybeans.

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NOTES

1 Ortmann and King (2007a) provide a comprehensive review of this literature, while Nganwa *et al.* (2010) examine these relationships in case studies of development-oriented cooperatives in KZN.

2 See Sparks *et al.* (2011) for comprehensive details on management assumptions, plant specifications, soybean conversion ratios and costs, etc. for the respective equipment and processes.

3 This estimate ignores dividends diverted to third party investors. It also ignores capital gains.

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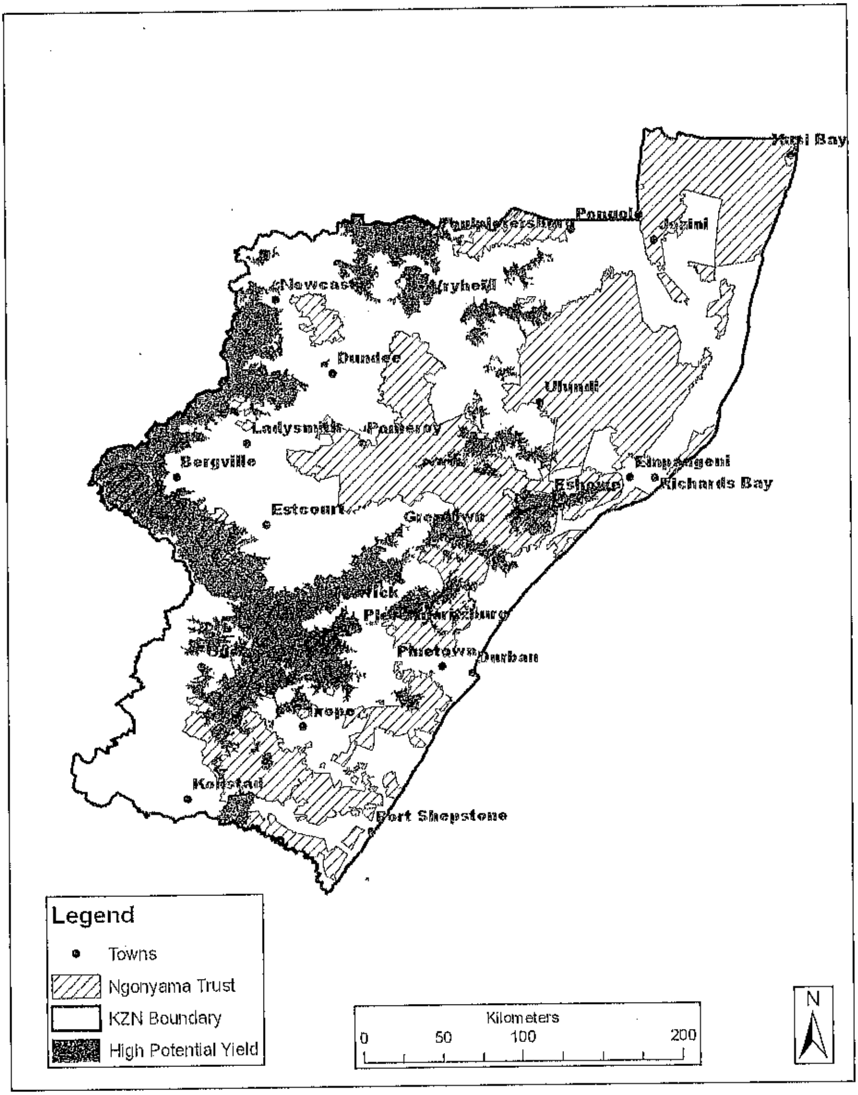
APPENDIX A

Regions of the Ngonyama Trust lands which coincide with areas of historically high soybean production and significant cropping potential for future expansion of soybeans in KwaZulu-Natal



Source: KZNDAEARD (2010)