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IN THE FIELD

Land tenure and agricultural management: Soil conservation on rented and owned fields in southwest British Columbia

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Abstract. According to literature, insecure land tenure biases against soil conservation on farmland. However, there is little evidence to test whether farmers need to own their land to conserve it, or if long-term leases are adequate. One way to infer whether or not different land tenure arrangements promote long-term management is through analyzing the types of crops planted on fields with different land tenure arrangements. Perennials, forage legumes, grasslands, and grain are all important parts of sustainable crop rotation in southwest British Columbia but provide little cash return in the year they are planted. Annual crops provide a high cash return but create soil conservation problems if they are planted too often. A comparison of fields with different land tenures showed that farmers who own their land plant more perennials, grain, and forage legumes than farmers who rent fields. Few differences were observed on fields with different lease lengths. This study leads to three overall conclusions. First, although results confirm the literature, and insecure land tenure is a real obstacle to long-term soil conservation, it is not possible to assume that long-term leases will substitute for land ownership. Second, it is possible to use relatively easy-to-gather data on crop history to assess the impact of tenure on farming. Third, intervening variables, in this case a program that pays farmers to plant grasslands, over-rides the effect of insecure land tenure and creates incentives for owner-operators and tenant farmers alike to use crop management that protects soil fertility in the long term.

Key words: British Columbia, Canada, Land tenure, Public goods, Soil conservation

Abbreviations: ALR – Agricultural Land Reserve; DFWT – Delta Farmland and Wildlife Trust

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Introduction: The effect of land tenure on soil conservation

Secure land tenure is widely assumed to be important for good agricultural land management (Panayotou, 1993). Farmers who engage in long-term soil conservation may sacrifice immediate income for the promise of better soil fertility and enhanced production in the future. Since there are no guarantees that farmers who rent land will reap the benefits of long-term soil conservation, tenant farmers are expected to use management strategies that maximize short-term production even if this compromises future soil fertility. For example Gills et al. (1992: 494) argue that different land tenure agreements can have a major impact on farm productivity as "... an individual proprietor who owns land knows that increased effort or skill that leads to a rise in output will also improve income ..." Based on work in Thailand, Praneetvatakul et al. (2001: 103) conclude, "... insecure land tenure may result in reduced incentives to improve land productivity." Work in China points out that ambiguous property rights encourage short-sighted decisions and the "irresponsible use of land resources" (Hu, 1997: 175). Nowak and Korsching (1983) and Schertz and Wunderlich (1981) both present data that show farmers who own land use a broader number of management strategies and adopt best management practices earlier than farmers who rent. Ervin (1982) echoes this, illustrating that erosion rates for owner-operated cropland

are lower than rented cropland (however, it is unclear whether this decline is due to land tenure or intervening site-specific variables). Bomke and Temple (1990) use 30 years of data to show that organic matter in five rented fields declined. Although data do not allow comparisons with non-rented fields, the authors conclude that long-term improvements such as drainage tiles, laser leveling, and forage rotation crops are not feasible under the short-term leases offered to many farmers and that this results in declining organic matter on rented fields.

The effect of short tenure on soil conservation became the basis of public policy in southwestern British Columbia, Canada, where the government owns 23% of agricultural land (Klohn Leonoff Ltd., 1992). In 1993, the provincial government, concerned about the potential impact of insecure land tenure, promised to offer longer-term leases to farmers (Bellett, 1995). Specifically, in 1995, the government promised to remove a clause that allowed leases to be cancelled within 90 days, and to offer ten and twenty years leases instead of the much more common 1-year leases. This was, according to one commentator, because ". . . none of the farmers will invest any money into the property they are renting. They won't ditch it properly, make it level for drainage. They won't practice good stewardship and given these leases there is no reason why they should" (Bellett, 1995: B2).

This policy takes a commonly assumed position that long-leases will provide the same incentives for good management as land ownership. For example, Wilson (1990) cites the Saskatchewan Wheat Pool, the (Canadian) National Farmers Union, and the New Democratic Party of Canada who all favor a system of ". . . public land banking with an option for farmer purchase" where farmers would be able to work towards owning land that they have been working on long-term leases (Wilson, 1990: 76, 86). Such a system, these groups assume, would give farmers secure and long-term tenure (and the incentives to invest in soil conservation) without requiring ownership.

However, do long leases provide the same incentives to conserve the soil as land ownership? Some argue a myriad of factors, like urban development, farm income, or farm type will affect whether farmers plan into the future (Lee, 1980). If this is true, land ownership might not provide incentives for long-term soil conservation if farms can be sold for urban development. Alternatively, cultural/historical factors, such as the desire to own land, may mean that land ownership is psychologically necessary before some farmers will make long-term investments (Gar-on Yeh and Li, 1999; Lumley, 1997; Walters et al., 1999). At public hearings in British Columbia, farmers themselves referred to the fact that land ownership is much more important than simple land tenure. For example:

> As a farmer, the best way to control a piece of property is to own it. Then you have the long-term commitment to it, and you can manage the property in the way that you see fit. A lot of times, investments you make on land are long-term investments . . . . (L. Hunter, Farmer, Transcripts from The Province of British Columbia's Standing Committee on Agriculture, October 27, 1999)

As a result, the purpose of this research is to assess differences in crop management for fields where farmers rent and own their land and for fields with different lengths of leases.

Locale

The Municipality of Delta, in the Lower Fraser Valley of southwest British Columbia, Canada, was chosen as a study area for three reasons. First, farmland falls under several different land-ownership agreements that stem from 1968 when the provincial government expropriated 1641 ha to support the adjacent government-run coal port. However, the port did not attract the expected industrial development and this land has remained farmed by tenant farmers ever since. Traditionally, the government has offered only short-term, year-to-year, leases, and included a clause that the lease could be revoked with 90 days of notice. This was to ensure that the land could be developed as quickly as possible. As noted above, in the mid-1990s many of these leases were extended to 20 years. As of the 1996 census, 42% of the farmland in Delta was owner-operated, 36% was private land leased to farmers, and 23% was provincial land leased to farmers. As a result, Delta has the lowest percentage of land owned by farmer operators in southwestern British Columbia (Artemis Strategies Group, 2002). According to the Municipality of Delta's report on agriculture, 44% of the rented land was on year-to-year leases, while 31% is on long-term leases of 10 or more years (Klohn Leonoff Ltd., 1992).

The second reason to test the effect of land tenure in Delta is that provincial legislation prevents non-agricultural uses on farmed land. This reduces the effect of urban encroachment. In an effort to preserve local food production in the early 1970s, the province of British Columbia designated all high quality farmland in the province as an "agricultural land reserve" (ALR) where non-agricultural landuse would be strictly controlled:

> The ALR is a zone in favour of agriculture . . . that zone provides certainty for agriculture . . . to

> ensure that . . . [it] is there for today's needs and for future needs. (K. Miller, Agricultural Land Commission, Transcripts from The Province of British Columbia's Standing Committee on Agriculture, February 22, 1999)

This has the effect of reducing the chance that farms will be converted into residential or commercial buildings, thus providing the opportunity to test the impact of land tenure independent from urban pressures.

The third reason is that farms in Delta are homogenous, reducing the chance that farm size or type will confound the effect of land tenure. Although there are a number of different types of farms in southwestern British Columbia, the farming community around Delta, at the west end of the Fraser River, is made up of small vegetable farms. In Delta, the average field size is six hectares, the average farm size is 41 hectares, and average gross farm receipts is slightly above $50,000 (CAD)/a (Artemis Strategies Group, 2002). There is very little livestock production in this area (less than 20% of farms have livestock, representing less than 20% of gross farm receipts) and over 80% of farms produce field vegetables commodities like potatoes, corn, and peas (Artemis Strategies Group, 2002). These commodities are traded openly on un-regulated markets, and must compete with horticultural production from around the world (Government of Canada, 1995).

Methods

We can gain insight into land conservation by comparing the type and frequency of crops planted on fields with different forms of land tenure. Some crops (e.g., grasslands) are clearly good for soil conservation but do not provide an immediate financial return to farmers. Other crops (like potatoes) may create long-term problems yet offer immediate cash rewards. Hence, crop management data can provide a means of distinguishing between short-term profit-taking and long-term soil conservation practices. This provides a simple means of assessing how different forms of land tenure affect soil conservation. In this study, I used crop management and land tenure data to test two hypotheses: (1) Farmers who own the land they work will plant more crops that promote long-term soil conservation than farmers who rent land; (2) Farmers with long-term leases will plant more crops that promote long-term soil conservation than farmers with short-term leases. There were three steps in this research.

First, fields were identified as being owner-operated or rented. The length of lease further categorized fields that were owned by the government (lease categories were 1–5 years, 6–10 years, 11–15 years and 16+ years). Two data sources were used to identify land tenure agreements. A report on agriculture in Delta, authored by a private consulting firm, provided a map of the privately owned fields in Delta (Klohn Leonoff Ltd., 1992). The provincial ministry responsible for administering government owned ("Crown") land provided a map showing government owned land and the length of the leases for this land. Fields where land tenure could not be determined were not used in this analysis. Of the fields where land tenure could be identified, 333 were owner operated (average size 6 ha), 370 were rented from private landowners (average field size 6.5 ha), and 240 fields were rented from the government (average field size 8 ha).

The second step in this research was to divide crops into categories that represent short or long-term investments (see below for more details). Records of crops planted in every field in the municipality of Delta between 1996 and 1999 (inclusive) were collected and maintained by Dr R. Vernon from Agriculture and Agri-food Canada's Pacific Agricultural Research Centre in Agassiz, British Columbia. Crops were divided into six categories, reflecting long-term or short-term management strategies (note a few marginal crops such as sod farms, nurseries, and horse farms were excluded):

1. *Potatoes*. Potatoes, are a high-value cash crop that are often harvested using heavy machinery that compacts the soil and damages soil aggregate structure. This is especially the case for the compaction-prone Deltaic fields at the mouth of the Fraser River, where regular cultivation creates a "plow pan" or highly compacted region beneath the surface of the soil. Plow pans make fields prone to water-logging, inhibit root growth, and are very difficult to break apart once they form. In addition, pests can accumulate over time if potatoes are planted in adjacent fields or year after year in the same field (Kabaluk and Vernon, 1999; Umaerus, 1992; Scholte 1992).
2. *Other annuals*. In addition to the specific problems created by potatoes, annual crops in general require frequent cultivation (which compacts the finely textured and poorly drained soils that mark this agricultural area), are harvested every year, and leave fields bare in the winter and without a year-round root mass that helps prevent erosion. As a result, if planted too often, annual crops are an indicator that the farmer is using short-term management practices.
3. *Perennial cash crops*. Perennial cash crops, such as high bush blueberries and strawberries, provide

a good indicator of long-term management (as grasslands, and perennial legumes are not cash crops, they were not considered in this category). Perennial crops grow year after year and do not need seeding every spring. Although most perennials do not provide a harvestable yield in the year they are established, once they are mature they provide a return for a number of years. Perennial crops are important for soil conservation because they provide year round cover that protects the soil from wind and rain erosion. They are also less demanding on the soil because, unlike annual crops where the field must be ploughed every spring, perennials do not require as much cultivation. The roots from perennial crops stabilize soil aggregate structure all year-round and the action of the roots growing through the soil reduces compaction. A high proportion of fields with perennial crops indicates long-term farm management. However, raspberries are a perennial that does not provide these benefits. This common crop in the central and eastern part of the Fraser Valley (east of Delta), tends to be planted in large-scale monocultures. This creates two problems. (1) These genetically uniform fields are planted in long straight lines with tilled soil between rows. This is susceptible to pest outbreaks and, therefore, requires high pesticide costs. (2) Because the spaces between the raspberry rows are tilled, there is little to protect the soil from wind and rain erosion. As a result, while the frequency of perennial crops can be used as an indicator of sustainable farm management, in the area studied it is necessary to exclude raspberries from the analysis.

4. *Grain*. When planted as a component in a more complex crop rotation, grain crops can also be important for soil conservation in the Lower Fraser Valley of British Columbia. When a farmer harvests the grain, a crop residue rich in organic matter is left to be plowed into the field. More importantly, however, grain crops do not require the intensive cultivation (which damages soil structure) typical of other annuals. Hence, when used as one part of a crop rotation (as opposed to continual monocultures as on the Canadian prairies), grain can contribute to good soil management.
5. *Forage legumes*. Legumes fix atmospheric nitrogen, an essential and often limiting component of plant protein, so that it is available to other plants (Purves et al., 1992). Some legumes, such as clover, are usually not harvested, but are plowed down, thus increasing soil organic matter. Consequently, the number of times legumes are used in a crop rotation is an indicator that farmers are taking a long-term perspective. However, some legumes, such as peas and beans, are cash crops that farmers plant and harvest in the same year. These crops return very little organic matter to the soil, may require soil-damaging management, and provide an immediate cash return to farmers. It is important, therefore, to distinguish between these annual legumes, which return little organic matter to the soil, and legumes such as clover, which a farmer would plant as a forage crop or part of a grassland set-aside. Therefore, for this study, I did not include peas or beans in my analysis of legumes.
6. *Grasslands*. From the perspective of soil conservation, grasslands are probably the most important type of perennial crop. Although these crops offer no financial return to the farmer, turning a field into a grassland for two or three years helps build up organic matter, which buffers the soil against acidity, reduces any compaction that may have occurred when the field was cultivated, and provides year-round protection against wind and water erosion.

The third step in this research was to compare the frequency of each category of crop on fields of different land tenures. For each year of data, every field was scored based on which type of crop was planted. In the rare cases where fields had more than one crop type, the field was counted for each crop type. For each type of land tenure, I determined the percentage of fields for which each type of crop was planted. As these results are not drawn from a sample, and are determined using the entire population of fields where land tenure could be identified, it is not necessary or appropriate to use inferential statistics to test for significance in results.

Results

Grain, legumes (excluding peas and beans), and perennials crops (excluding raspberries) were planted more often on fields that were owner-operated, whereas potatoes and other annuals, were planted more often on rented fields (Figure 1). The relation is strongest for perennials, where roughly 21% of owned fields and less than 5% of rented fields had perennials planted on them for at least one year between 1996 and 1999. The relation was weakest for legumes, which occurred on 34% of owned fields and 28% of rented fields. Grasslands show no difference between rented and owned fields, and appears on roughly 39% of all fields regardless of land tenure.

Few differences were observed between the crops planted on fields with different lease lengths. Fields

Table 1. Percentage of fields planted to potatoes, other annuals, perennials (excluding raspberries), grain, forage legumes, and grasslands between 1996 and 1999, for government owned fields divided according to length of lease. (Crop data from Dr R. Vernon, Agriculture and Agri-Food Canada, Agassiz, BC. Data on length of lease from BC Government.)

Length of lease in years	Total number of fields	Percentage of fields between 1996 and 1999 in Delta, BC, planted to different crop categories in at least one year					
		Potatoes	Other annuals	Perennials	Grain	Legumes	Grasslands
1–5	31	32	64	3	25	3	22
6–10	25	46	68	0	16	4	61
11–15	25	30	52	4	28	8	54
16+	129	45	68	6	17	16	34

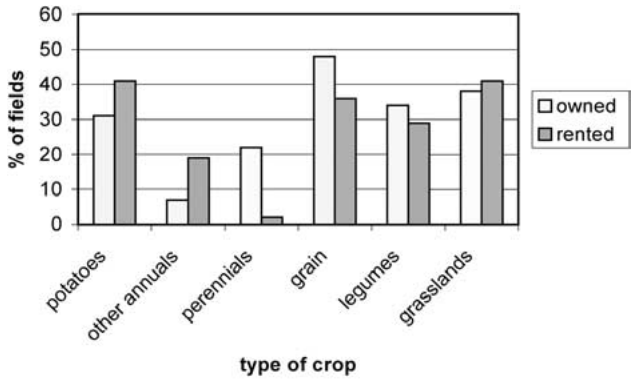

Figure 1. Percentage of owned and rented fields planted with potatoes, other annuals, perennials, grain, and legumes in at least one year between 1996 and 1999 in Delta BC. (Crop data from Dr R. Vernon, Agriculture and Agri-Food Canada, Agassiz, BC Data on crown land from BC Government. Data on private land from Klohn Leonoff Ltd., 1992.)

with long lease lengths had more legumes than fields with short lease length; however, no other categories of crops vary by lease length (Table 1). For example, whether a farmer had a short or long-term lease did not influence whether they established grasslands on their farms.

Discussion

Four primary conclusions can be drawn from this analysis. First, crop data appears to provide a feasible means of assessing how different policy or other measures may affect soil conservation. From simple agronomic features (resistance to erosion, contribution of nitrogen and organic matter, the need for tillage) we can divide crops into those that are better and worse for soil conservation. This should be done in a regionally sensitive manner; for example, grain on the prairies would not necessarily be considered an example of a "sustainable" crop rotation, while it is an important indicator of long-term management in the Lower Fraser Valley.

The second main point is that land ownership, as widely expected, affects crop choice in ways that are generally consistent with the hypothesis that secure land tenure leads to better soil conservation. Thus the higher use of annual crops on rented land confirms the view that farmers who rent fields will not have incentives to invest in long-term management. The greater use of perennials, and to a lesser extent grains and legumes, in owned fields, suggests that farmers who own their land are more frequently willing and able to sacrifice immediate income for soil conservation.

The third point is that the data provide must less evidence that longer leases have the same effects on crop choice as land-ownership. As a result, data presented here indicates that long-term leases should not be viewed as a substitute for land-ownership; hence the use of this assumption in policy (such as the Government of British Columbia's decision to offer long-term leases to farmers to create incentives for long-term management) may rest on a doubtful base.

The final point is that, in this study, grasslands were a significant exception to the hypothesis that land-tenure affects long-term soil conservation. Grasslands, perhaps the most important part of a sustainable crop rotation, were not more frequent on owned land or on fields farmed with long-term land tenure. However, grasslands do not provide an immediate cash-return and tend to represent a long-term investment to improve soil fertility. This unexpected result may be due to intervening economic incentives. In 1993, a coalition of farmers and conservationists formed the Delta Farmland and Wildlife Trust (DFWT) to "... provide a forum for implementing creative solutions that ensure habitat is provided for wildlife without causing excessive burdens on farmers within the Fraser delta" (Delta Farmland and Wildlife Trust, 2001). The coalition created a program that pays farmers to establish grasslands to provide habitat for raptors

and ground-dwelling mammals. This gives farmers an "... opportunity to improve soil structure and organic matter, while simultaneously providing habitat for wildlife" (Delta Farmland and Wildlife Trust, 2000).

Funded by a number of public and private sources, the DFWT pays farmers to establish a mix of native grasses and clover for one to five years. Farmers are paid $60.70/ha per year ($150 per acre) if they chose to cut the grass for hay or $121.41/ha per year ($300 per acre) if they leave the grass in the field. These grasslands have proven to be excellent habitat for a variety of species; in particular, shrews, deer mice, and voles that are valuable prey for raptors. Waterfowl also use the set-asides during their migration through the area. Hence, the DFWT has created a financial incentive to use farmland to provide wildlife habitat and overrides the effect of insecure land tenure.

Conclusion

Three main points can be drawn from this analysis. First, data analyzed here support the literature and confirm that farmers who do not own their land face a high discount rate and plant more crops that provide only short-term return. Farmers who own the land promote long-term management and plant crops that help maximize soil conservation. Long-term leases do not seem to provide the same incentives as land ownership. The second general point is that it is not necessary to collect decades of soil fertility data to understand the impact of such socio-economic factors as land tenure on soil conservation. Instead, it is possible to use much easier-to-collect crop history data to infer whether farmers use environmentally-beneficial or degrading practices.

Finally, the case of the DFWT's grassland program illustrates that intervening variables may counter the effect of land tenure. This program provides an example of how a public program can create incentives for farmers to invest in the long-term public goods their land provides even if they do not have the security to know that they will reap the benefits. By paying farmers yearly to establish grasslands, the setaside program has accomplished three things: (1) It provides an immediate return on what would otherwise be a long-term investment that would normally require secure land tenure to justify. (2) It has created a monetary value for wildlife habitat. (3) It provides an opportunity for farmers to provide wildlife habitat at the same time as they improve soil quality. As a result, this sort of program should be of considerable interest to policy makers as a method of promoting sound environmental management and soil conservation practices.

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