Effect of Urbanization on the Adoption of Environmental Management Systems in Canadian Agriculture

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Abstract: This study examines the extent to which farming practices have adjusted to the presence of urbanization in Canada. In particular, we compare the adoption rates for environmental management systems (EMSs) by farmers close to urbanized areas versus those in more rural, isolated regions. Using information from a national survey of 16,053 farmers, eight EMSs are considered. We find that farmers operating close to the urban milieu demonstrate strategic behavior by selecting more environmentally-friendly farm management practices to overcome social and regulatory pressures from such communities compared to those farmers that operate in rural communities.

1 Introduction

The relative proximity of urban populations to farming activities may be a root cause behind the factors that contribute to a farmer's decision to adopt environmental-friendly production practices. Farmers may act in response to new municipal regulations, concerns about due diligence, or, from social pressures, and these factors are all influenced by residents living in close proximity to farmers. Subsequently, farmers operating in an urban milieu may be more likely to adopt environmental-friendly systems than those farmers located in more remote rural areas. These direct and indirect pressures to adjust farmers' management practices may increase the cost structure of farms located in the urban milieu. As a result, regional competitive advantage may be affected and thereby, precipitate spatial changes in agriculture production.

An environmental management system (EMS) is an example of an environmental-friendly production practice and its adoption may be one means by which farmers adapt to operating in a relatively, densely-population region. An EMS documents a firm's activities that affect environmental performance but it does not generally measure actual effect of those practices on environmental quality. An EMS can involve a third party certifying organization, or be developed by trade associations, or be developed by the firm individually (Khanna, 2001). A farm's bottom line could be improved with an EMS through several avenues. Cost savings may result directly from efforts to conserve inputs and reduce waste but could also indirectly accrue to the firm in the process of thoroughly evaluating its management practices. Costs could be further reduced as an EMS may lower liability risks and subsequently lower premiums charged by insurance companies and interest rates charged by financial institutions. In addition to cost savings, the firm could increase revenues by either obtaining a premium for their product or increasing sales if the EMS represents a credible signal to customers of the firm that it is "environmentally-friendly". Aside from affecting financial performance directly, a farm may be motivated by a moral concern for environmental quality and can use an EMS as a guide to reducing its ecological impact.

While financial reasons may be a driver for some farms, the major reasons that farms in an urban milieu voluntarily adopt an EMS are associated with social and regulatory pressures. The use of an EMS may allow the adopting farm to improve its public image with the community. In addition, an EMS can be used as evidence of due diligence which is often the only acceptable defense in a legal challenge stemming from an environmental accident (Wall and Weersink 2001). Rather than being pulled to enhance its reputation as a socially responsible citizen, firms may be pushed to adopt an EMS as a measure of its commitment to a systematic approach to environmental improvement through public pressure. Such pressures from customers, shareholders, trade associations and community groups have all been found to increase the likelihood of EMS use (Khanna and Damon 1999; Henriques and Sadorsky 1996). These pressures for farms are likely to increase with population density.

The public pressures may eventually result in direct environmental regulations and this threat of mandatory regulation has been shown theoretically to increase the level of voluntary abatement effort (Segerson and Miceli, 1998). The threat of liability was found to be directly related to the adoption of voluntary management programs such as the US 33/50 program (Khanna and Anton 2002; Khanna and Damon 1999). A Canadian agricultural example is the Ontario Environmental Farm Plan which is a voluntary EMS developed by farm organizations in the early 1990s as a pro-active response to potentially tough regulation forthcoming from the newly-elected NDP government (Smithers and Furman 2003). Although it may not prevent environmental legislation, the use of an EMS may serve to influence the type and severity of future regulations (Lutz *et al.,* 2000). Finally, an EMS may not be voluntary. For example, nutrient management plans were required in many Ontario municipalities before a building permit was issued for the construction of new or expanded livestock facilities (Eveland et al 2004).

The purpose of this study is to examine the extent to which farming practices have adjusted to the presence of urbanization in Canada. In particular, we compare the adoption rates for environmental management systems (EMSs) by farmers close to urbanized areas versus those in more rural, isolated regions. Using information from the national survey on *Farm Environmental Management Practices* (FEMS), eight EMSs are considered. We hypothesize that farmers operating close to the urban milieu demonstrate strategic behavior by selecting more environmentally-friendly farm management practices to overcome social and regulatory pressures from such communities compared to those farmers that operate in rural communities

2 Overall EMS Adoption by Farmers

The adoption rates for the eight EMSs were obtained from the Farm Environmental Management Survey (FEMS) conducted in 2001 by Statistics Canada and sponsored in part by Agriculture and Agri-Food Canada (AAFC). Over 21,000 farmers were surveyed and approximately 76 percent responded. Of the 16,053 farmers responding, 2,250 raised only livestock, 5,425 grew only crops, and 8,378 had both livestock and crops. The survey gathered information on the use of a variety of farm management practices including the adoption of eight environmental management systems.

The eight EMSs considered are: (1) whole farm environmental plan; (2) manure management plan; (3) fertilizer management plan; (4) pesticide management plan; (5) water management plan; (6) wildlife conservation plan; (7) grazing management plan, and (8) nutrient management plan. The definition of the eight EMSs and their adoption rate among different farm types are listed in Table 1. The most common EMSs used by all farmers are fertilizer and pesticide management plans. These have been enacted by 27 percent of all crop-only farmers. Approximately the same percentage of mixed farms have a fertilizer management system but there is a drop in the use of a pesticide management plan by those farmers with both crops and livestock compared to those specializing in crop production, which may be associated with potentially more crop rotations and thus lower pesticide use by mixed farms. The correlation coefficient between these two EMSs is 0.8 which indicates that the same farmers are likely to adopt both a fertilizer and pesticide management plan.

Mixed farms have the highest adoption rates in general across the eight EMSs considered while livestock-only farms have the lowest. For example, over one-quarter of livestock farms that also grow crops have a manure management plan in place compared to 15 percent of livestock-only operations. The same approximate adoption rates across the farm types are evident for a grazing management plan. A whole farm environmental plan is the most comprehensive of the possible EMSs options but it is the least likely to be adopted. For example, all eight EMSs are appropriate for mixed farms and only 15 percent have a whole farm environmental plan (WFEP) in place. The correlation between WFEP and other systems is low with the exception of nutrient management plans for which there are more likely to be over-laps in reporting requirements.

3.1 Defining Urbanization

The degree of urbanization is captured by two variables; 1) the distance of the farm operation to an urban centre, and 2) population density. Distance is measured "as the crow flies" from the geographical center of each dissemination area[i] (DA) to the geographical center of the nearest CMA[ii] or CA[iii]. Thus, a different distance value is assigned to each farm observation according to the DA in which the farm is located. Population density is measured as the number of people per square km of a DA in which the farming operation is located.

3.2 EMS Adoption Rates and the Effect of Urbanization

The mean values for the two urbanization variables were calculated for each of the eight EMSs stratified by adopters and non-adopters. The results are illustrated in Figure 1 with distance as the urbanization measure and Figure 2 with population density. The graphs are presented only for mixed farms but the results are similar for exclusively crop and livestock farms. As expected, the distance to an urban centre is smaller for adopters of an EMS than for non-adopters (Figure 1). The mean values of these entire EMS are statistically significant at p=0.01. Average distance for adopters is smallest for whole farm and nutrient management plans and greatest for wildlife conservation and grazing management plans. The two former plans represent the most comprehensive coverage of agri-environmental practices and thus are more likely to be used in the most intensive urban areas as measured by the relatively short distance to a CMD. In contrast, farms concerned with grazing and wildlife habitat are likely to be operating large areas and thus are likely to be further from a CMD.

The effect of population density on adoption rate of EMSs is similar to that found using the distance measure for urbanization (Figure 2). Adopters of EMSs are more likely to be located in regions with a higher population density than non-adopters. The mean values of all EMSs, except the wildlife conservation plan (WCP) and nutrient management plan (NMP), are significant at $p = 0.01$, where the WCP and NMP are significant at $p = 0.05$ and $p = 0.10$ respectively. For example, the average population density of the region for farms adopting a manure management system was approximately 22 people per km^2 as opposed to around 14 people per km^2 for farms not adopting. The result is consistent with the hypothesis that farmers operating in the urban milieu are more likely to use an EMS as a means to deal with direct social pressure or indirect regulatory pressures from non-farm neighbours.

3.3 Number of EMSs Adopted and Urbanization

A significant number of farmers may adopt more than one EMS. For example, 37.2 percent of mixed farms had more than one EMS in place. The mean values for urbanization were calculated for the all farms on the basis of the number of EMSs adopted. The results are plotted in Figure 3 for the distance measure and in Figure 4 for the population density measure. The number of EMSs adopted increases with the degree of urbanization. For example, the average distance to a CMA for non-adopters of an EMS by mixed farms is approximately 60 km but it drops to 40 km for those farms adopting seven plans (see Figure 3). Similarly, the average population density for mixed farms adopting only 1 EMS is approximately 15 persons per km^2 and increases to over 55 persons per km^2 on average for those adopting seven plans (see Figure 4). Note that mixed farms on average tend to operate in less urbanized environments than specialized crop or livestock farms.

4 Conclusions and Policy Implications

A portion of Canada's farmland is in close proximity to rapidly expanding urban areas. This presents a policy dilemma so far as farmers' preferences for land use are likely to conflict with the preferences and concerns of nearby urban residents. This conflict is likely to be intensified by increases in proximity between farmers and non-farm residents and, therefore, we hypothesized that the degree of urbanization was likely to affect farm management decisions. Our empirical observations support our hypothesis – adopters of environmental management systems were, on average, located closer to urban areas than non-adopters.

While the aforementioned results provide insight into what is going on, additional research is needed to refine our understanding of the urbanization effect. First, future studies need to examine the urbanization effect while simultaneously accounting for other variables (e.g., farm size) that may influence the decision of farmers to adopt environmental management systems. Such analysis will enable us to better isolate the influence of urbanization on farm management decisions. Second, future studies need to empirically assess *how* urbanization influences farm level decisions. For example, do urban concerns manifest themselves in stricter regulations at the municipal level? Does the presence of increasing numbers of residential neighbors increase the likelihood of legal conflict and thereby, heighten farmers' desire to pursue activities that enable them to appeal to due diligence? Are farmers voluntarily responding to concerns voiced by urban neighbours? The answer to these questions will illuminate important issues such as the appropriate role of governance in arbitrating conflicts that may emerge between municipalities and/or farmers and urban residents.

Expanding urban and ex-urban populations suggest that farm level practices will continue to be scrutinized by their urban counterparts. Policy makers will face the difficult challenge of advising government on how best to respond to the changing needs of farmers and urban residents. Recognizing, as this study does, that the degree of urbanization may already be precipitating changes in farm management practices provides an initial starting place for future inquiry.

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Table 1 –Definition and adoption rate of environmental management systems (EMSs) by farm type:

Environmental Management System (EMS)		Number (%) Adopting EMS by Farm Type		
Type (Notation)*	**Definition**	**Livestock n = 2001**	**Crop n = 5425**	**Mixed n = 8378**
Whole Farm Environmental Plan (WPEP)	An overall assessment of environmental issues or concerns related to the farm	150 (7.5)	564 (10.4)	1304 (15.6)

Manure Management Plan (MMP)	Manure storage systems used, specific treatments used (e.g. additives, separation, drying), and odour control systems	309 (15.4)	255 (4.7)	2187 (26.1)
Nutrient Management Plan (NMP)	Methods of testing nutrient content of manure; soil testing procedures, consideration of nutrient carry-overs, timing of applications etc.	7 (0.3)	804 (14.8)	1263 (15.1)
Fertilizer Management Plan (FMP)	Measures used to apply fertilizer; mix of legume and chemical fertilizer to be used in each season, and their frequencies etc.	66 (3.3)	1493 (27.5)	2163 (25.8)
Pesticide Management Plan (PMP)	Application strategies; sprayer calibration frequencies and techniques, and alternative methods other than chemical pesticides etc.	55 (2.7)	1478 (27.2)	1762 (21.0)
Water Management Plan (WMP)	Sources and volume of water to be used, irrigation methods, domestic water testing etc.	261 (13.0)	988 (18.2)	1838 (21.9)
Wildlife Conservation Plan (WCP)	Measures taken to conserve natural land and wildlife habitants adjacent to farm	215 (10.7)	653 (12.0)	1365 (16.3)
Grazing Management Plan (GMP)	Measures taken to conserve wetland areas, rotational grazing, and practices such as re-seeding	320 (16.0)	155 (2.9)	2081 (24.8)

*A formal, written plan prepared by a trained person or specialist to cover certain operational aspects of the farm

Figure 1 - Average distance to urban center for adopters and non-adopters of environmental management systems (EMSs) by mixed farms:

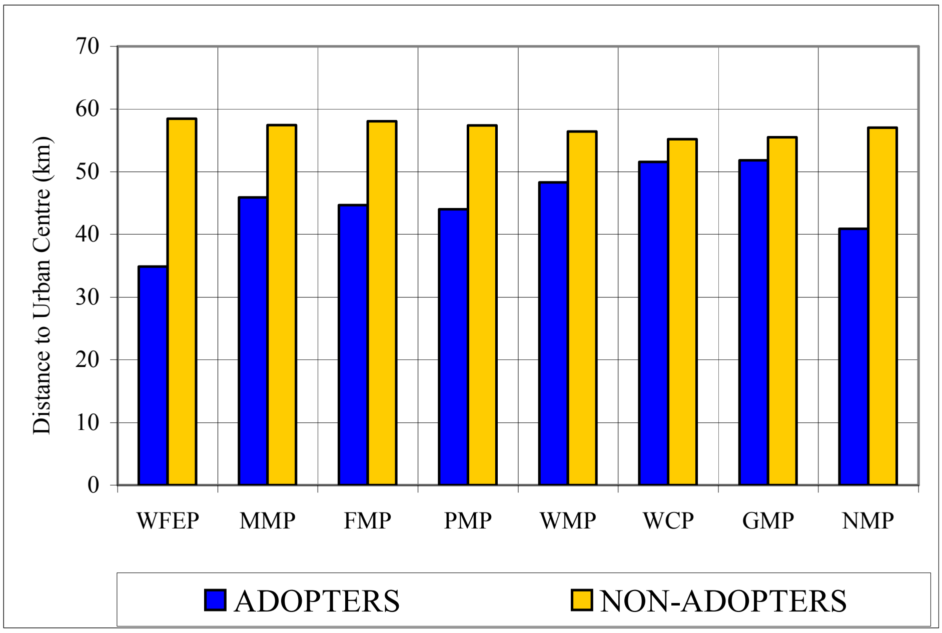


Figure 2 - Average population density of location for adopters and non-adopters of environmental management systems (EMSs) by mixed farms:

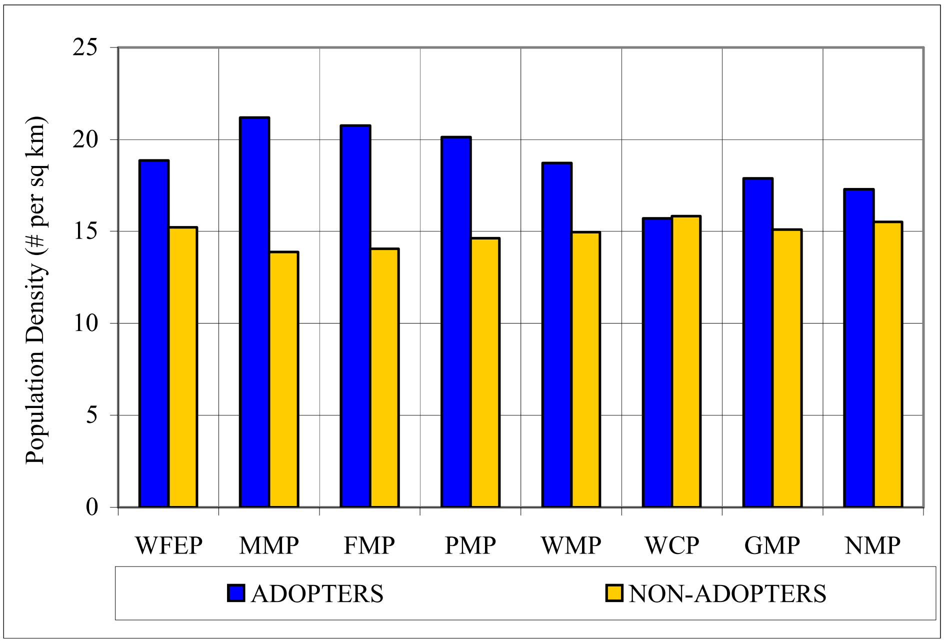


Figure 3 - Average distance to an urban center by the number of environmental management systems adopted for crop, livestock and mixed farms:

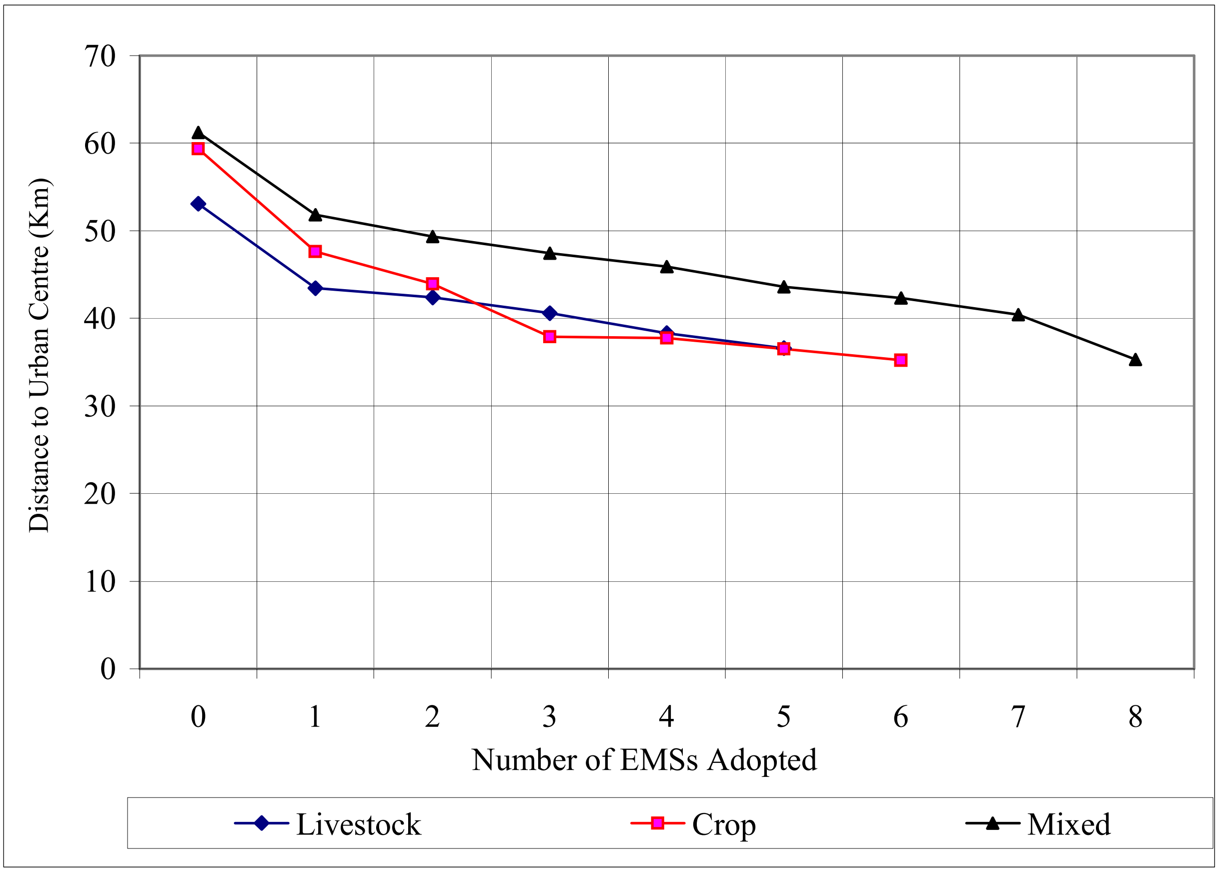
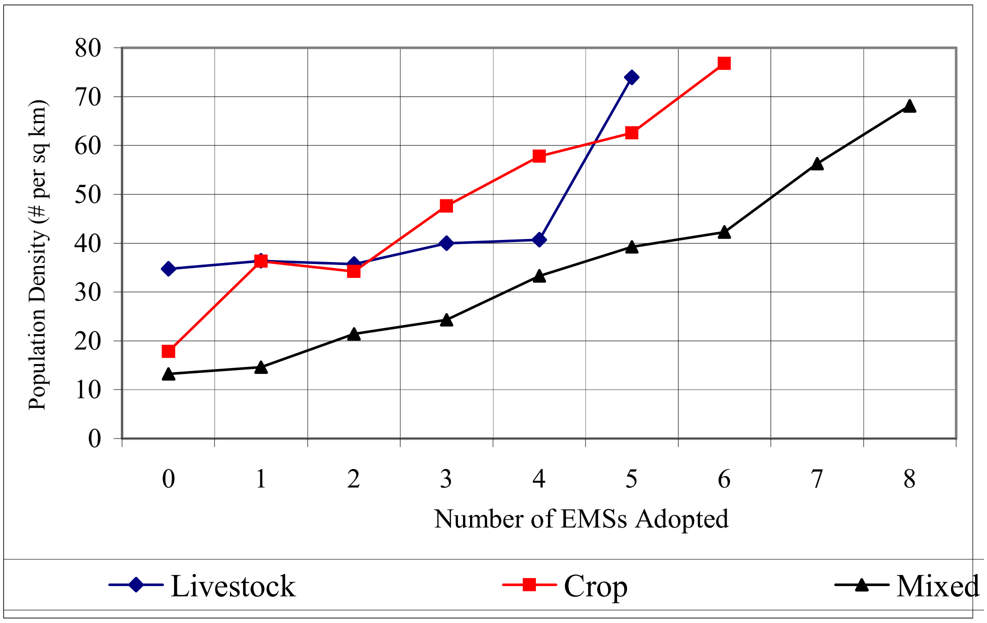


Figure 4 - Average population density by the number of environmental management systems adopted for crop, livestock and mixed farms:



Endnotes

[i] The DA is a small area with a population of 400 to 700 persons. It is the smallest standard geographic area for which census data are reported. All of Canada is divided into dissemination areas.

[ii] The CMA is a geographic area with an urban core population of 100,000 and over. It includes all neighbouring municipalities where 50 percent or more of the workforce commutes to the urban core.

[iii] The CA has an urban core population of 10,000 to 99,999. It includes all neighbouring municipalities where 50 percent or more of the workforce commutes to the urban core.