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ADOPTION OF A WILDLIFE CONSERVATION PLAN BY CROP AND LIVESTOCK FARMS IN CANADA: WHAT FARMER AND FARM CHARACTERISTICS MAKE A DIFFERENCE?

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ABSTRACT

This paper examines the impact of various farmer and farm characteristics on the adoption of a Wildlife Conservation Plan (WCP) – "a formal written document prepared by an expert that describes the measures to be taken by an agricultural operation to conserve natural land and wildlife habitants adjacent to it" - by crop and livestock farms in Canada. Those characteristics considered in the analysis include: human capital (age, sex), financial (profits, non-farm income, farm assets), farm structure (size, ownership), and social (degree of urbanization, population density).

It uses data collected in the Farm Environmental Management Survey (2001) conducted by Statistics Canada and Agriculture and Agri-Food Canada. The target population consists of 21,000 active farms in Canada with sales greater than $10,000. The farms responded to the survey (N_r = 16,053 with 76.4% response rate) were classified into three major categories: (1) "crop farms" (N_c = 5,425), (2) "livestock farms" (N_l = 2,250) and (3) "mixed farms" (N_m = 8,378) with both crops and livestock. The results indicate that rate of adoption of WCP is comparatively less (13.9%) as compared to others, including manure, fertilizer, pesticide, water, and grazing management plans. The results from a Logit Regression analyses suggest that age, profitability, farm size, and degree of urbanization affect significantly on this behaviour in all farm types, however with varied size and signs. It highlights the importance of taking into account of voluntarily private-action of the farming community to formulate public-regulation aiming an environmentally friendly and conservative agriculture farm setting.

KEY WORDS: Crop and livestock farms, Environmental management systems (EMS), Wildlifeconservationplan(WC)

INTRODUCTION

Other than short and long-term financial performance of the firm, the management of which may be provoked by moral concerns for quality of the environment where the firm is located. Consequently, the management might decide to adopt various *Environmental Management Systems* (EMS) – an environmental-friendly production practice that documents a firm's activities that affect environmental performance – as a guide to reducing its ecological impact. There is no exception to this with respect to the firms operate in agriculture sector in Canada. The Farm Environmental Management Survey (FEMS) conducted by the Statistics Canada in 2001 in collaboration with the Agriculture and Agri-Food Canada identified a number of such EMS adopted by farms operate in this sector, including nutrient management plans (NMP), fertilizer management plans (FMP), pesticide management plans (PMP), water management plans (WMP), wildlife

conservation plans (WCP), grazing management plans (GMP), and nutrient management plans (NMP) etc. The basic activities carried out by the management of farms that implemented these EMS are summarized in Table 1.

A firm's decision to invest its scarce resources (that possess higher opportunity costs) on the adoption of a particular EMS may be a result of, from one hand, the direct and/or indirect private or social benefits that it can "obtain by adoption" and/or will be "forgone by non-adoption". The direct and/or indirect private or social costs that are "incurred by adoption" and/or can be "skipped by not-adoption" may also have a significant impact on this behaviour, on the other.

Table 1. *Definitions for various environmental management systems (EMS)*

Type	Definition
MMP	Explains the types of liquid, solid/semi-solid manure storage systems use (e.g. unlined lagoon, open tank, sealed, covered tank etc.), frequency of storage and use of manure; specific treatments use (e.g. aeration, additives, separation, drying etc.), and odor control systems etc.
FMP	Explains the measures use to apply fertilizer (e.g. broadcasting, banded, post-plant top/side dressing etc.); mix of legume and chemical fertilizer to be used in each season, and their frequencies etc.
PMP	Explains certain information with respect to different application strategies of herbicides, insecticides, and fungicides; sprayer calibration techniques, and alternative methods other than chemical pesticides to control weeds, insects ad diseases etc.
WMP	Explains the sources and total volume of water to be used on a per acre basis; methods use to irrigate the land (e.g. sprinkler, drip, surface flooding etc), and ways and means of domestic water testing etc.
WCP	Explains any measures taken to conserve natural land and wildlife habitants that are adjacent to the agricultural operation (e.g. livestock fencing, cultivation of perennial forage, trees, bushes etc).
GMP	Explains any measures taken to conserve natural wetlands including rotational grazing for livestock and practices such as "carry-over" and "re-seeding".
NMP	Explains the methods of testing nutrient content of the farm's liquid or solid/semi-solid manure before applying it to the land; consideration of nutrient carry-overs; distance to water ways, and timing of applications etc.

Source: Agriculture and Agri-Food Canada

One of the direct and private benefits to the firm by adopting an EMS may be, for example, higher revenue earned through increased market share or price premiums. Another private benefit may be, although rather indirect, that an EMS provides a credible signal to its existing and potential customers that it is an "environmentally-friendly" firm.

As reported by Henriques and Sadorsky (1996), many Canadian firms adopt environmentally friendly quality management systems to improve its public image and reputation with the community. In terms of costs, a firm may concern about conserving the factors of production used in its day-to-day operations (i.e. reduction of direct costs) and/or reducing the waste generated in such activities by adoption of a particular EMS. Costs could be further reduced as an EMS by

means of lower interest rates charged by financial institutions; lower premiums charged by insurance companies, and lower liability risks (e.g. compensation, legal fees) by minimizing the risk of involvement with the judiciary to solve the cases related to the environmental quantity (Khanna and Anton, 2002). According to Wall and Weersink (2001), an EMS is used in many developed countries as evidence of *due diligence* which is often the only acceptable defense in a legal challenge stemming from an environmental accident. Eventually, a firm's motivation for adopting EMSs, individually or collectively, without investing such resources on other competitive ends will be determined by the size of the margin between these benefits and costs to the adopter (Jayasinghe-Mudalige and Weersink, 2004), which may be highly subjective to the characteristics of the firm and the entrepreneur (Buchanan, 1969).

There are a number of studies that examined empirically the motives for adoption of certain agri-environmental practices by various types of agricultural operations in developed countries. Many of these studies have been focused on the factors affecting the adoption of such practices that generate direct and or indirect "private" benefits to the farmer (see, for example use of specific vaccines by cattle producers by Bhattacharyya *et al.*, 1997; various types of fertilizers and pesticides by Smith and Smithers, 1992).

In consequently, there exists a gap in the environmental economics literature, with respect to the studies that examined the impact of various human and socio-economic characteristics associated with farmers and of farms on the adoption of individual Best Management Practices (BMP) and/or certain EMS that possess "public goods characteristics", for example a well-formulated and comprehensive plan that explains the actions the farm can undertake to protect the wildlife in and around the farmland (exceptions, include adoption of modern soil conservation techniques by Rahm and Huffman, 1984, and integrated pest management techniques by D'Souza *et al.*, 1993). To the best knowledge of authors, this phenomenon was not examined empirically to date with respect to the farms operate in the agriculture sector in Canada.

The purpose of this study is to examine the impact of various farmer and farm characteristics on the adoption of a wildlife conservation plan (WCP) by crop and livestock farms in Canada. Further, it contrasts and compares whether that behaviour of farmers is associated with their desire to adopt any other plans, including those primarily generate "private benefits" (e.g. fertilizer and pesticide management plans) and "social benefits" (e.g. manure and water management plans).

METHODS

Theoretical framework

A rational farmer will invest on adoption of an EMS if it helps her, directly or indirectly, to maximize the profits of the farm. Alongside, the farmer may also decide to adopt certain other EMS (e.g. WCP) in her farm and/or area adjacent to the farmland that generates greater social benefits than the private benefits. In light of this, for the farms that involved with production of crop and

livestock in Canada we can hypothesize that "the motivation for the management of the farm to invest its scare resources on a WCP that generates greater social benefit (in compared to the private benefits) will depend on the human-capital (e.g. age, sex), financial (e.g. profits, non-farm income), operational and structural (e.g. size, ownership), and social (e.g. distance, population pressure) characteristics of the farmer and the farm". The following theoretical model was specified to test this hypothesis:

$$WCP_i = \alpha_0 + \Sigma\beta_{ij} X_{ij} + \varepsilon_i$$

Where, WCP_i describes whether the farm in question has adopted a WCP or not *(i* = 1, 2, ...*n*). X_{ij} is a vector of *j* explanatory variables included in the model. The terms β_{ij} denote regression coefficients corresponding to the explanatory variables (j = 1, 2, ...*l*). Further, α_0 and ε_i denote the intercept and random error terms, respectively.

Data collection and analysis

The secondary data included in the FEMS, which was a voluntary national survey focusing on the level of adoption of environmental management systems (EMS) and best management practices (BMP) by livestock and crop operations in all Provinces across Canada and on numerous other issues were used to estimate the coefficients of variables included in the model (Table 2).

Table 2 . Variables used in the model

Variable	Description (expected sign)
Human capital characteristics	
AGE	Age of the farm household head in years (+)
SEX	Gender of the farm household head (Male = 1; Female = 0)
TMA	Time allocation of the farm household head for farming (Full-time = 1; Part-time with off-farm work = 0)
Financial characteristics	
PFT	Overall profitability of the farm - calculated by taking the ratio of: total gross farm receipts of the operation in 2000 / total farm business operating expenses of the farm in 2000 (+)
INC	Income earned by the head of the farm household through non-farming operations, such as retail business and factory work (Non-farm income = 1; No non-farm income = 0)
AST	Total fixed assets of the farm – calculated by taking the total present market value of land, buildings, and farm machinery in thousands of Canadian dollars (+)
Operational and structural characteristics	
Organizational arrangement	
OSP	Sole proprietorship = 1; Other arrangements (i.e. for partnerships / corporation) = 0
OFC	Family corporation = 1; otherwise = 0
ONF	Non-family cooperation = 1; otherwise = 0
Land ownership pattern	
OWN	Ratio of own land to the total land area of the farm (+)
LLG	Ratio of land leased from the government to the total land area of the farm
FSZ	Area of the farm in hectares (+)
Social and regional characteristics	
DIS	The distance in kilometers "as a crow flies" from the farm operation to the nearest Census Metropolitan Area (CMA) (+)
PPD	The population density of the Census Sub-Division where the farming operation is located measured as the number of people per square km (-)##

Notes:
A farm without any formal agreement with any partner was assumed to be the base scenario.
The tendency to have a WCP decreases with increasing population density since there is low chance to have wildlife habitats in urbanized areas.

All active farms with sales greater than C$10,000 as included in the "Agriculture Division's Farm Register in Canada" (n = 21,000) were considered to be the target population for this particular survey. The response to survey was significantly high with 16,053 questionnaire were returned with 76.4 percent response rate[1]. The data from the 2001 Census of Agriculture in Canada were also tied to the FEMS database to obtain more accurate, up to date and comprehensive data.

For the purpose this analysis, farms that responded to the questionnaire were categorized into three major categories: (1) "crop farms" (N_C=5,425), (2) "livestock farms" (N_L=2,250), and (3) "mixed farms" (N_M=8,378), which possesses both crop and livestock in the farm in various proportions. Considering the dichotomous nature of the dependent variable, a *Logit Regression analysis* was used to estimate the coefficients of variables explained in Table 2, for example: adoption of a WCP = 1; non-adoption of a WCP = 0.

RESULTS

Descriptive statistics

There were 8764 farms out of 16053 that responded to the survey (i.e. 55 percent) did not adopt any EMS. Another 11.7 and 8.6 percent of individual farms adopt a single and two EMSs, respectively. As shown in Figure 1, only 13.9 percent of farms possess a WCP, and which is only second to the percentage of farms that adopt a NMP.

[1] The responses rate was high because two prominent government institutions in Canada, which have close connections with the country's farming sector – the *Statistics Canada*, and the *Agriculture and Agri-Food Canada*, backed it.

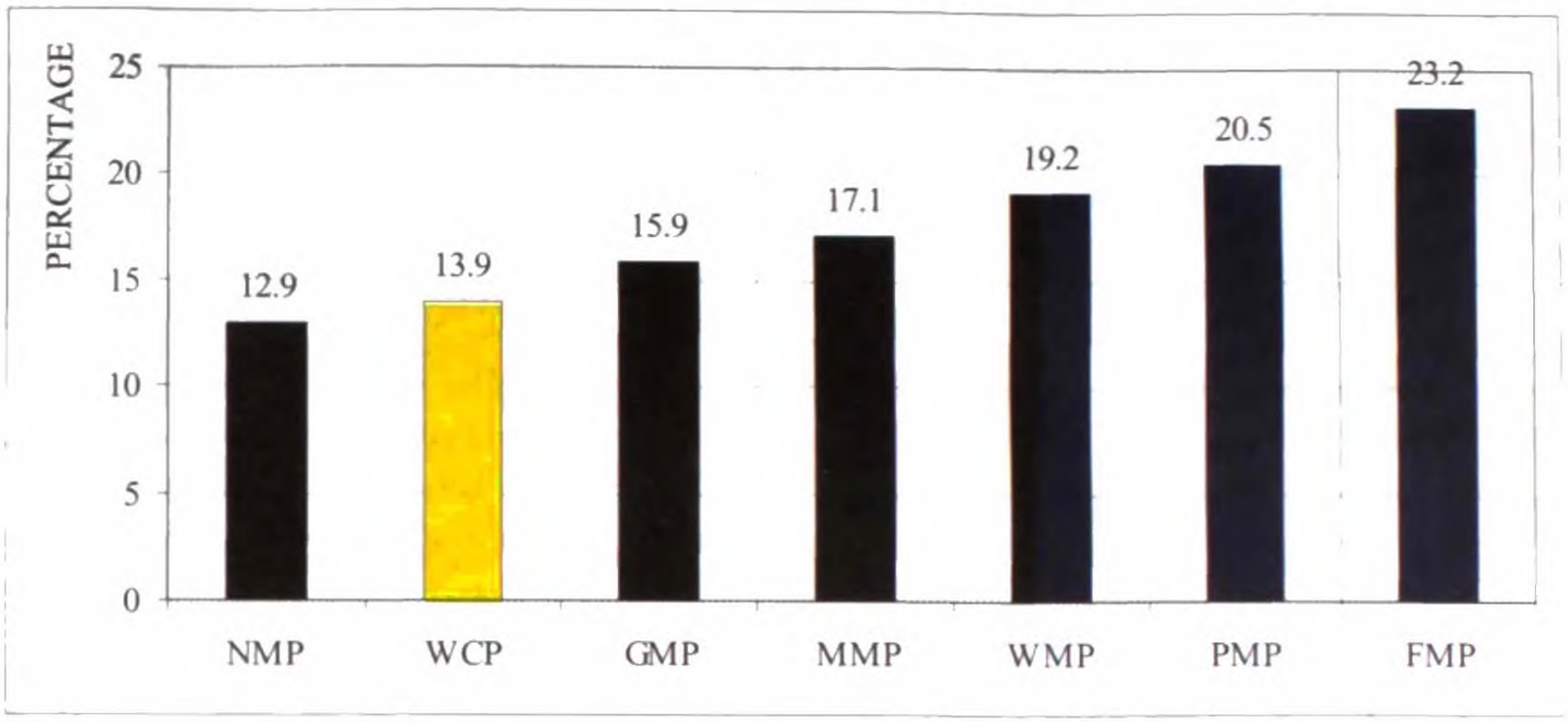

Figure 1. Percentage of farms that possesses a WCP in the total sample

The number and percentage of crop, livestock and mixed farms that adopt the seven types of EMSs are reported in Table 3.

Table 3 . Adoption of various types of EMS by farms in Canada:

Type of Plan	Livestock N = 2,250			Crop N = 5,425			Mixed N = 8,378		
	No	%	Rank	No	%	Rank	No	%	Rank
WCP	215	9.6	*4*	653	12.0	*5*	1365	16.3	*6*
MMP	309	13.7	*2*	255	4.7	*6*	2187	26.1	*1*
NMP	7	0.3	*7*	804	14.8	*4*	1263	15.1	*7*
FMP	66	2.9	*5*	1493	27.5	*1*	2163	25.8	*2*
PMP	55	2.4	*6*	1478	27.2	*2*	1762	21.0	*5*
WMP	261	11.6	*3*	988	18.2	*3*	1838	21.9	*4*
GMP	320	14.2	*1*	155	2.9	*7*	2081	24.8	*3*

Source: FEMS database – Statistics Canada

It shows that there were only 9.6, 12.0, and 16.3 percent of these farms respectively adopt a WCP. As a whole, mixed farms have the highest adoption rates in general across the seven EMSs considered while livestock farms have the lowest. The percentages of livestock farms with a FMP, PMP and NMP are lower than the WCP (i.e. 2.9, 2.4 and 0.3). We may suggest that the activities included in these EMS (see, Table 1) are "not important" to maximize the profit of a livestock farm, and consequently, the cost of adoption of which in these farms cannot be not justified. Although such activities included in a GMP are considered to be "very important" for livestock farms, a large difference with respect to the adoption rates of GMP and the WCP (i.e. 14.2 - 9.6) cannot be observed. In the context of crop farms, the percentages of MMP (4.7%) and GMP (2.0%) were less than the WCP (12.0%). In fact, like in the previous case, the adoption of MMP and GMP, individually or collectively, may not play a significant role in crop farms.

To verify whether there is any overlap with respect to farmers' understanding and interpretation of the specified tasks in each EMS and in turn to

adopt it together with others, the correlations between each of the six different EMS considered in this analysis with the farms having a WCP across all farms responded to the survey were examined (Figure 2). The correlation coefficient exceeds 0.5 only in WMP indicating that farmers with "more or less same characteristics" are likely to adopt both wildlife conservation and water management plans. This indicates that a farmer who has desire to conserve wildlife in the area also takes action to preserve natural resources such as water.

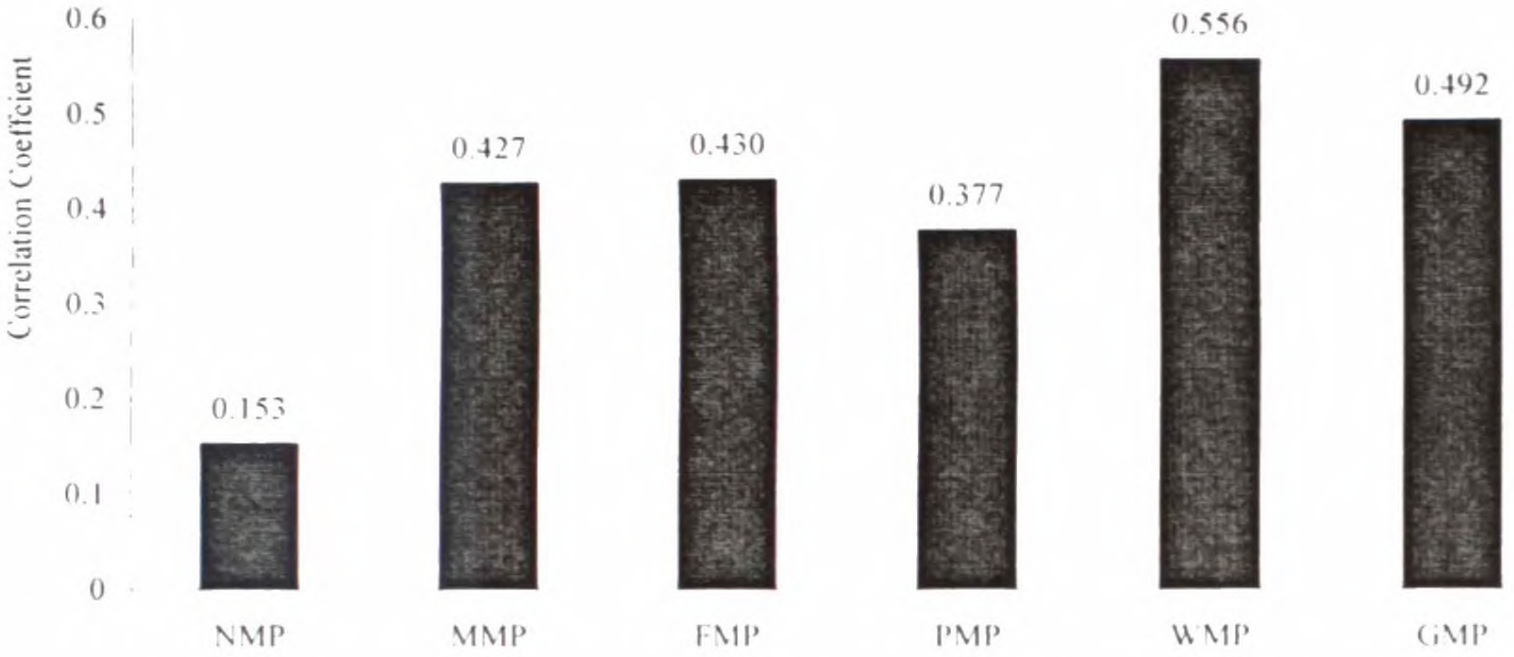

Figure 2. Correlation coefficient of WCP with other EMS:

Estimates of coefficients

The results from the Logit analysis that produce *logged odds* (logits) of parameters are reported in Table 4 for three models representing the farm types. All the models were significant at a level of 0.01. Further, the relatively higher *Pseudo R-square* values (0.7310, 0.7156 and 0.7240 for livestock, crop, and mixed farms, respectively) suggest that the models performed well.

There are three variables developed to explain the effect of age of the farmer (*AGE*), overall profitability of the farm (*PFT*), and size of the farm (FSZ) were significant at the 1 percent probability level in all three models, and possess the expected sign. This indicates that as the farmer gets matured (i.e. age increases by one-year) and earns higher profits (i.e. the ratio calculated in this respect increases by one unit), and the size of the farm gets larger (i.e. increases by a one-hectare) the logged odds (logits) of adoption of a WCP would be increased or decreased by the value of respective coefficients included Table 4, for example 0.892, 0.0675 and 0.0877 for crop, livestock and mixed farms, respectively for *AGE* (see, Borooach, 2002 and Pampel, 2000 for interpretation of results from Logit Regressions).

Table 4. Estimates of coefficients for livestock, crop, and mixed farms:

Variables	Estimates		
	LIVESTOCK (N = 2250)	CROP (N = 5425)	MIXED (N= 8378)
Human Capital Characteristics			
AGE	0.0892***	0.0675 ***	0.0877 ***
	(0.0083)	*(0.0042)*	*(0.0072)*
SEX	-0.0147	-0.0396	-0.0233
	(0.0292)	*(0.0211)*	*(0.0192)*
TMA	0.0974*	0.0635	0.0887
	(0.0422)	*(0.0475)*	*(0.0496)*
Financial Characteristics			
PFT	0.1264 ***	0.1206 ***	0.1254 ***
	(0.0399)	*(0.0469)*	*(0.0479)*
INC	-0.2180 *	-0.2221 *	-0.2197 *
	(0.0732)	*(0.0543)*	*(0.0524)*
AST	0.0497 **	0.0549 *	0.0459 *
	(0.0201)	*(0.0204)*	*(0.0209)*
Operational & Structural Characteristics			
OSP	0.0036 **	0.0027 *	0.0024 **
	(0.0011)	*(0.0013)*	*(0.0014)*
OFC	-0.0344	-0.0365	-0.0378
	(0.0191)	*(0.0182)*	*(0.0203)*
ONF	-0.0033	-0.0022	-0.0031
	(0.0723)	*(0.0741)*	*(0.0731)*
OWN	0.0489 ***	0.0588 **	0.0479 **
	(0.0155)	*(0.0281)*	*(0.0171)*
LLG	-0.1024	-0.0745	-0.0621
	(0.0970)	*(0.0998)*	*(0.0741)*
FSZ	0.0576 ***	0.0344 ***	0.0445***
	(0.0017)	*(0.0089)*	*(0.0058)*
Social & Regional Characteristics			
DIS	0.0129 **	0.0142 *	0.0139 **
	(0.0079)	*(0.0087)*	*(0.0078)*
PPD	-0.0076 ***	-0.0069 **	-0.00612 **
	(0.0024)	*(0.0032)*	*(0.0023)*
Constant	0.9960 ***	0.8475 ***	0.5673 ***
	(0.0372)	(0.0366)	(0.0374)
R–square	*0.7310*	*0.7156*	*0.7240*

Note: ***, **, and * denotes the 1, 5, and 10 percent significant levels, respectively.

The probability of adopting a WCP in all types of farms increases as the income of the farmer (*INC*) and the sustainability of the farm measured in terms of use of capital assets (*AST*) increases by a unit. Therefore, all the variables used to characterize the financial situation of farms characteristics, including the *PFT*, *INC* and *AST* had a significant impact on this behaviour. The results also suggest that farmers who "own" the most of their land were likely to adopt a WCP along with other EMS indicating their long-term commitment to their land as opposed to short-term interests.

Both *DIS* and *PPD* were significant at various levels in all three samples. Majority of these also possessed the expected sign. As expected, farmers who remote to a major urban center (*DIS*) were likely to adopt a WCP suggesting that wildlife is a factor that affect farming in these areas. Similarly, adoption decreases with the population density of the region in which the farm is located (*PPD*) increases.

CONCLUSIONS

The outcome of the analysis suggests that a number of factors show a significant impact on farm's decision to adopt a wildlife conservation plan to protect the flora and fauna in and around the farming environment. In abstract, the young and rich farmers with sufficiently large farms and assets tend to adopt a WCP. Although the percentage of adopting so is low in the farming population, those farms with a WCP is not significantly difference from the farms with other plans that generate higher private benefits, for example fertilizer and pesticide management plans.

The results provide some useful insights into the formulation of effective public policy aiming environmental protection, in general, and conservation of wildlife, in particular. The conversion of natural wildlife habitats into profitable agribusiness ventures through the development of crop and livestock farms creates much profit to the farming community. However, such an action has a number of consequences, for example ever-increasing human-wildlife conflicts for limited resources such as water and place to live (similar to human-elephant conflicts in Sri Lanka), loss of biodiversity, and air and water pollution etc. to both farming and non-farming communities.

In the wake of this understanding, a number of Municipalities in certain Provinces in Canada, for example in Alberta and Quebec, have made it mandatory to adopt some of these plans, for example NMP and MMP, in the farm. However, adoption of a WCP is not compulsory in any of the 10 Provinces in Canada. This highlights the fact that those farmers with a WCP in place possess positive incentives to behave environmentally friendly "voluntarily". The respective governments should take into account of this factor to avoid, or at least to minimize, such bad effects arising from commercial farming systems to the environment. For example, depend on its needs, a particular Municipality can make it a policy to have a WCP in place and can promote farmers to adopt other plans such as FMP and PMP together with a WCP and/or a WMP. These way, whilst deriving "private benefits" through the implementation of former, farmers can be motivated to "pay some sort of compensation" to the society for utilization of the public goods such as wildlife habitats by implementing the later. At the same time, these institutions can have an appropriate program to capture those farmers who do not possess a any of these plans into the system in order to prevent that "voluntary" action of a farmer not become a barrier to be competitive in the marketplace.

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