



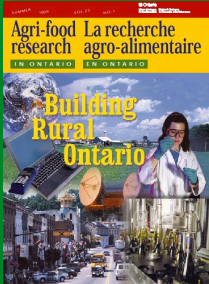
HOME

WHAT'S NEW

CALENDAR

PRODUCTS

NEWS RELEASES



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SUMMER 1999 VOL.23 NO.1

Agri-food research La recherche agro-alimentaire

IN ONTARIO EN ONTARIO

[Cover & Credits](#) || [Forefront](#) || [Human Resources](#) || [Natural Resources](#) || [Les Recherches En Bref](#) |

COVER AND CREDITS

- [Front Cover](#)
- [Back Cover](#)
- [Table of Contents and Credits](#)

| [Top of Page](#) |

FOREFRONT

- [Research: Building Rural Ontario](#)

| [Top of Page](#) |

HUMAN RESOURCES

- [Labour Markets in the New Rural Economy](#)
- [Health Care Restructuring and Rural Community Health: A Case Study of Meaford, Ontario](#)
- ['Pacts' for Rural Ontario: Partnerships, Accessibility and Connectivity - Transformation Strategies for Rural Ontario](#)
- [Understanding the Socio-Economic Diversity of Rural Southern Ontario](#)

| [Top of Page](#) |

NATURAL RESOURCES

- [Rural - Urban Conflicts Over Groundwater](#)
- [Constructed Wetlands Treat Rural Waste Water Naturally](#)
- [Farming Systems Research: Success is More Than Just the Sum of the Parts](#)

[Ontario Rural Wastewater Centre: Helping You Make the Right Choices in Wastewater Treatment](#)

[Cryptosporidium: Is Manure a Contributor to Contamination?](#)

[A Decision Support System for Manure Management](#)

| [Top of Page](#) |

LES RECHERCHES EN BRIEF

[Les Recherches En Bref](#)

| [Top of Page](#) |

| [Research, Education, Laboratories & Risk Management Home Page](#) |

| [Central Site](#) | [Feedback](#) | [Search](#) | [Site Map](#) | [Français](#) |
| [Home](#) | [What's New](#) | [Calendar](#) | [Products](#) | [News Releases](#) |



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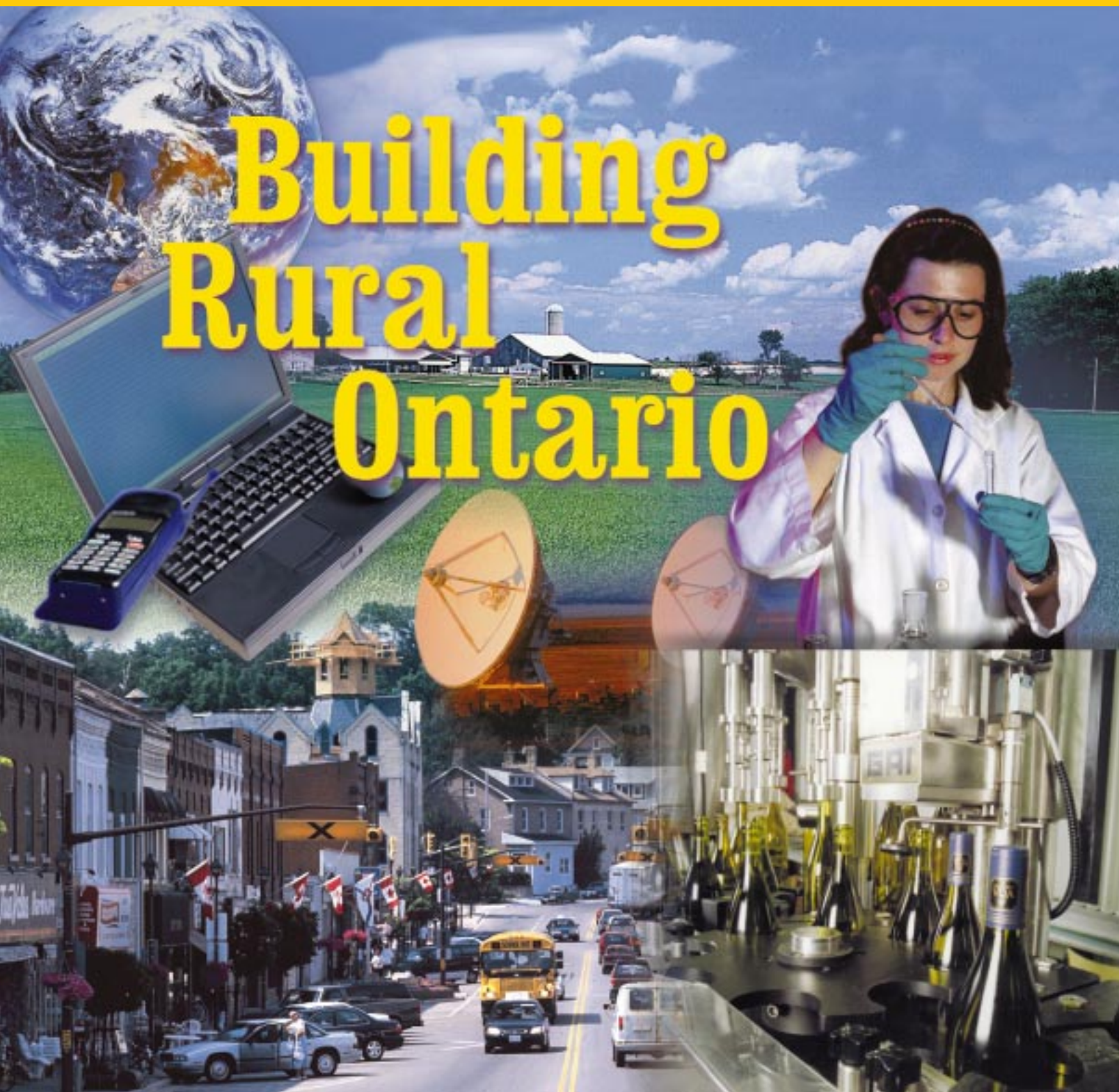
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IN ONTARIO

EN ONTARIO



HERE'S WHAT'S NEW INSIDE:

- **Life in the New Rural Economy: new demographics and new markets mean opportunities for the growing service and manufacturing sectors.**
- **ISO 14000 and agriculture: what does it mean to Ontario producers, processors and retailers. Would the costs outweigh the benefits?**



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HUMAN RESOURCES

LABOUR MARKETS IN THE NEW RURAL ECONOMY	2
HEALTH CARE RESTRUCTURING AND RURAL COMMUNITY HEALTH: A CASE STUDY OF MEAFORD, ONTARIO	4
'PACTS' FOR RURAL ONTARIO: PARTNERSHIPS, ACCESSIBILITY AND CONNECTIVITY – TRANSFORMATION STRATEGIES FOR RURAL ONTARIO	6
UNDERSTANDING THE SOCIO-ECONOMIC DIVERSITY OF RURAL SOUTHERN ONTARIO	8



NATURAL RESOURCES

RURAL – URBAN CONFLICTS OVER GROUNDWATER	11
CONSTRUCTED WETLANDS TREAT RURAL WASTE WATER NATURALLY	14
FARMING SYSTEMS RESEARCH: SUCCESS IS MORE THAN JUST THE SUM OF THE PARTS	17
ONTARIO RURAL WASTEWATER CENTRE: HELPING YOU MAKE THE RIGHT CHOICES IN WASTEWATER TREATMENT	20
CRYPTOSPORIDIUM: IS MANURE A CONTRIBUTOR TO CONTAMINATION?	22
A DECISION SUPPORT SYSTEM FOR MANURE MANAGEMENT	24
LES RECHERCHES EN BREF	26



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Research: Building Rural Ontario

What makes some rural communities thriving centres where jobs and amenities offer quality living, while others struggle with less success? What can be learned from those that do well, and how do we balance the range of economic, social and environmental interests for all rural residents? The benefit of answering the questions is obvious – and research is essential to make it possible.



But the challenge is enormous and complex. So much has changed on a landscape historically characterized by its status quo. New demographics, economies, the role of local governments, and the changing prominence of agriculture have all transformed rural and small town Ontario. While

farming is still a dominant force, it's been surpassed by the service sector, which contributes more to the diversified incomes of both farm and non-farm residents.

Rural non-farm populations have burgeoned, often in conflict with traditional farming lands and practices. Soil, water and air quality are of interest to all, whether one's livelihood depends upon it or not. And farming itself has a new face, increasingly technologically driven, vertically integrated, with larger, more intensive operations. Raw product has become value-added, and world markets have moved closer to home.

But new issues and economies bring new opportunities – when the facts are gathered and the success strategies mapped out. Enter the job of the social and scientific researchers. Careful and considered recommendations are needed in rural labour markets, water quality, health care infrastructure, telecommunications, nutrient management, and many more areas which are key to rural sustainability.

The Ontario Ministry of Agriculture, Food and Rural Affairs funds research designed to do just that, through the 'Sustainable Rural Communities' and 'Agri-Food System Resources & Environment' programs at the University of Guelph. Together with other provincial and national rural research groups, the programs help local governments and citizens' groups identify what's needed to help make their communities work better and how to make it happen.



With globalisation of markets, restructuring of rural economies, and evolution of local governments, what are the impacts on rural life and livelihoods? Part of the answer to this question is revealed in changes in labour market supply. What people do, and where they work are two of the main features of employment in the New Rural Economy.

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A labour survey of rural and small town households was undertaken in Huron County, an agricultural area of southwestern Ontario in 1997-98. It produced 265 returns involving 612 individuals of working age (over 16 years). Sixty percent of respondents lived in town (Exeter), 22% in a village (Blyth), 10% on farms, and the remainder were considered to be rural non-farm residents. The most common household composition was two members, and there were slightly more females represented in the survey. The extent and consequences of change in labour activity since 1991 were also measured for all respondents and through personal interviews of 12 households.

The survey may have underestimated the extent of unemployment (only 2%). People with part-time, casual or self employment tended to declare themselves employed, although their employment may have been seasonal or sporadic. A finding of particular note was that households without automobile access were likely to be disadvantaged, in accessing social services or jobs.

Survey Highlights

- Of the 612 people in the survey, **68%** were in the workforce, **30%** were not, and **2%** identified themselves as unemployed.
- The range of jobs held was very **diverse**, reflecting a mixed economy.
- **36%** of the employed held **more than one job**.
- **26%** declared themselves to be **self-employed**.
- Only 42 of the 69 farm households surveyed identified themselves as **self-employed**.
- Over **55%** of the households had at least two **incomes**.
- The majority of respondents (78%) left their place of residence to go to work.
- Men travelled farther to work than women.

A Decade of Change, 1991-97

- In 1997, people had more jobs than they did in 1991.
- Households, overall, had less income (after inflation) than in 1991.
- 12% said they experienced major change in their activity profiles since 1991; 19% had some adjustments, but the majority (69%) considered themselves stable, having no reported change in their activity.

What's New about the New Rural Economy?

As society and economies evolve, and the pace of change accelerates, life in rural areas also undergoes transformation. There is a reshaping of old structures (downsizing of agriculture, rationalization of services, and the restructuring of local government) and the introduction of new structures (networks, including vertical integrations, just-in-time production, and land trusts, etc.).

The New Rural Economy suggests a shift from primary and old manufacturing activities to a greater role for the services sector, more links to the global economy, increased communication, and dependence on information for business development, production, and marketing. The prominent scale of new business is medium and small-scale firms, while old firms are downsizing or rationalizing. Clearly, labour is the expendable component of contemporary economies, while access to information is of increasing importance.

The New Rural Economy is not all new, but the mix of old and new is certainly different from the past. The particular mix will vary geographically, as each municipality responds differently according to local problems and opportunities. As well, the nature of the existing infrastructure will influence what changes are possible, as will new networks and institutions formed. The New Rural Economy is not, therefore, a uniform reaction to global change, but a diversifying element in the reshaping of rural society.

- The majority of changes reflected life events (i.e. birth, death, marriage, etc.) as well as employment restructuring.
- Where obstacles to betterment were identified, the main grouping of concerns was around training and personal development.
- There was no apparent difference between respondents in villages or towns, or between town and farm dwellers.

It was evident from the survey that work has become fragmented for many households in Huron County, and that commuting and self-employment (especially at home) have become common in the county's mixed economy. The characteristics of high mobility and fragmented job holding are typical of the new rural economy in Ontario, and reflect the many ways by which families piece together their livelihoods in agricultural areas.

Collectively, the survey results contain common themes of increased employment insecurity, changes in workplace culture, the shift to self-employment, an increase in non-traditional employment arrangements, and the importance of personal adaptability in the rural labour market. ■

Acknowledgements

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ARTWORK: DOUGLAS J. DONALD

Health Care **RESTRUCTURING** AND Rural Community Health:

A Case Study of Meaford, Ontario

Health care in rural Ontario has been a topical issue for several years. Faced with the challenge of rising costs and the need for delivery of quality services, the Ontario government has undertaken changes aimed at better cost efficiencies across the province. Our research focused on the unique challenges of health care restructuring in rural Ontario, specifically in the town of Meaford, where the restructuring plan called for downgrading of the town hospital to a Primary Health Care Centre.

Health care in Grey and Bruce counties, where Meaford is situated, costs about \$200 million annually. In fiscal year 1995/1996, the Grey-Bruce District Health Council was advised that provincial health funding would be reduced by 18% over the next three years. The Council, in partnership with residents of Grey and Bruce Counties, the local hospitals, and the health care agencies formed the Health and Hospital System Restructuring Project, “to ensure that Grey-Bruce residents have access to appropriate high-quality, cost-effective health services”.

We began our research by constructing a demographic profile of Meaford, using data from the Statistics Canada database, reviewing local media coverage of health care restructuring, and conducting in-depth interviews with 22 Meaford residents.

In constructing our profile, we found that the hospital was a major employer in the community and that downgrading its status would have far-reaching implications. We identified short-term effects such as lost jobs and wages (and out-migration of health care professionals), and long-term effects leading

to the contraction of the local economy in general. To counter an already declining economy, Meaford had been attempting to market itself as a retirement community. The absence of a hospital would undermine this economic strategy and likely result in some out-migration by seniors as well.

Changes in the population demographics suggested the greying of Meaford’s population at a faster rate than the county, province or country. Employment opportunities in Meaford were already limited, as evidenced by high unemployment rates, particularly for youth. Further decline of the economy would likely lead to out-migration of youth as well.

Our literature search indicated that in general, the health care sector contributes not only to economic capital, but to human capital in rural communities as well. Human capital is directly related to a community’s capacity to generate social capital, as evidenced in Meaford, where the hospital was a community linchpin. Human capital and its volunteer sector are an intrinsic part of a community’s social safety net.

We noted that the proposed restructuring

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would impact most greatly on seniors, the poor, and women. Historically, women have been discriminated against in rural labor markets across all employment sectors. In Meaford, the health care sector employed over 11% of the working women in Meaford, and only 2% of the men. Any contraction in the health care sector would have more severe repercussions for women's employment. It would also likely lead to an increase in the amount of unpaid, informal health care within the community, a burden that women too, would largely carry.

In analyzing the interview transcripts, we found that the residents generally accepted the restructuring as inevitable, while at the same time fearing the problems it would create for Meaford. The interviewees noted that many residents were under increasing stress due to community unemployment, and that the

economic consequences of the health care restructuring would worsen the situation.

Our research led us to several conclusions regarding rural community health restructuring. First, the implications are not limited to health care itself. The rural health care sector is intimately related to all aspects of community life; it cannot be altered without affecting the very fabric of the community. Second, health care restructuring has different impacts on different sub-populations within the community, with the greatest negative impact being felt by the elderly, the poor, and women. And finally, the unique characteristics and demographics of rural communities make health restructuring a different challenge in each. The Ontario Minister of Health aptly observed that "there can be no cookie-cutter solutions to the challenges posed by rural health care". ■



Fig. 1. Meaford General Hospital, Meaford Ontario



'PACTS' for Rural Ontario: Partnerships, Accessibility and Connectivity

Transformation Strategies for Rural Ontario

The term 'connected' rural communities conjures up images of technologically advanced landscapes with countryside residents no longer separated by distance. When communities do become well 'plugged-in', what makes it happen successfully?

In rural Ontario, as elsewhere in Canada, communication infrastructure has generally lagged behind that available in urban areas. With the advent of digital telecommunication services, electronic commerce, and requirements for high speed internet access, disparities in Canada's rural telecommunication infrastructure are of concern to rural stakeholders. These include rural residents and organizations, private sector business with rural clients such as banks and agri-business and government operating in rural areas. As a result, there are now efforts being made to upgrade rural telecommunication infrastructure and related applications (e.g. internet tools, voice telephony, wide area networks, and electronic commerce) with an intent to enhance rural development.

Telecommunication is promoted by many as an engine for economic development, and there are a growing number of studies that demonstrate the positive correlation between the two. For example, telephone networks allow rural users to access other services layers and technology ranging from fax, electronic mail, internet access and distributed databases.

Governments are making major commitments to increasing telecommunication access. For example, Industry Canada's 'Smart Communities' program is part of a strategy designed to make Canada the "most connected nation in the world". Despite this, we believe that rural areas will continue to be under-served until a clear rural telecommu-

nications policy emerges for catalyzing improvements. Without that, market forces and the deregulation of the telecommunications industry may lead to further strengthening of the urban core, to the detriment of rural areas.

PACTS is a research project that will document and compare existing experiences by rural Ontario communities that are using information communication technologies (ICTs) to further their goals. Most attention will be paid to how different groups formed partnerships to agree on community goals or visions, and how they harnessed ICTs to further their goals. By early 2000 we will make available three case studies about different experiences across Ontario. The case studies will be prepared using a common research framework to identify how they are similar, and where they differ. This research is expected to distinguish lessons in existing examples that may be applicable elsewhere, from ones that are specific to the examples and cannot be replicated.

Our research framework has three pillars: *Partnerships, Accessibility and Connectivity*. **Partnerships** is about different organizations and sectors within a rural community that *come together*. They agree on a desirable future and define a vision to work towards. **Accessibility** is about having access to information, communication *infrastructure* and services that are affordable such as having digital phones and access to the internet. **Connectivity** is about the *services* such as electronic banking and the *applications*,

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such as distance education that put the infrastructure to work *towards the communities' goals*. We are assuming that these three pillars are needed to fulfill a community's vision in terms of improved health, education, business development, and access to government services.

Where to begin? While it took 30 years for radio to reach 60 million North American homes, television reached them in 15, and cable TV in 10; the internet has done it in only a few years. Telecommunication technology is moving at an impressive speed, and so are the community efforts to harness it. In Ontario there are a growing number of telecommunication initiatives that deserve evaluation. The growth in rural networks, internet websites, and distributed databases is significant. Do we have a grasp of how these systems respond to rural community needs? How can we ensure investments in rural connectivity and information and communication technology (ICT) applications, many of which may involve government funding or incentives yield the desired results? PACTS began by consulting with rural Ontario stakeholders to determine their research priorities. Learning about partnerships emerged as the Number One research priority.

Together with our rural partners, we will continue working toward the following objectives:

- To develop case studies of successful rural networks in Ontario using the 'three-pillars' approach.
- To describe the lessons they have learned, the key principles that made them work, and the external factors that enabled and influenced their evolution. We expect these lessons will help other rural communities in

defining how to harness ICTs to achieve their own goals, and in making it happen through private and public sector partnerships.

- To quantify the economic and social impact of investments in ICTs, in the context of the objectives determined by partnership among different sectors in rural communities in Ontario. We will seek to capture the outputs (example: access to the internet by rural doctors), and the outcomes (example: electronic patient exchange among health units) with a view to one day tracking the results (example: a healthier rural community).
- To document successful leadership and training in rural communities that demonstrate the positive impact of ICTs on rural information technology employment.

We will continue to work at the invitation of rural communities and stakeholders. We will seek to partner with other groups interested in learning about how to make ICTs a part of transforming rural communities.

We expect the case studies will help other rural communities in defining how to harness ICTs to achieve their own goals, and in making it happen through private and public sector partnerships. Research and outreach activities such as these will prove their value when communities are able to move from discussion to action, implementing their own local versions of 'PACTS'. ■



'PACTS' began by consulting rural stakeholders across Ontario about their research priorities in rural telecommunications.



Understanding the socio-economic DIVERSITY of rural Southern Ontario

The process of decentralization and municipal restructuring has increased the demand for data and information on the socio-economic conditions of localities. In the emerging economy, local agencies will have more decisions to face and a greater role in guiding economic and social development.

Although micro-level data are increasingly available to the public, it appears difficult for the variety of rural stakeholders to capture the overall picture and the comparative conditions across the province. Too often, the analysis of rural areas is based on aggregated data, such as 'urban' and 'rural', which tend to mask substantial differences across 'rural' space and municipal types.

The purpose of our research was to establish the degree of spatial diversity exhibited across Southern Ontario, by using a set of 34 indicators computed from Census of Canada 1991 and 1996 data at the Census Subdivision (CSD) level. This research adopted a regional approach in that, although rural areas are the main interest, we included in the analysis all the CSDs of Southern Ontario without defining *a priori* what 'rural' CSDs were on the bases of one or a number of criteria, such as population thresholds and population density. Rural areas are increasingly integrated into regional socio-economic systems, which implies that we can gain a better understanding of rural conditions by considering the system as a whole, and not only a part of it.

The 34 indicators considered are commonly used and understood demographic, social and economic variables, such as share of population by age cohorts, share of employment by sectors, unemployment rates, and average income. Each indicator was mapped individually and then a factor analysis was applied to both the 1991 and 1996 data. Factor analysis is a statistical technique that makes possible the identification of summary variables (factors) that account for the variability in groupings of the observed indicators. Each factor provides a summary measure on a grouping of indicators that tend to be associated.

Socio-economic differences across rural Ontario

The factor analysis resulted in eight factors, whose basic structure did not change between 1991 and 1996. On the basis of the indicators associated with each, the eight factors were named as follows: 1) labour force participation and age; 2) income, educational and occupational status; 3) socio-economic disadvantage; 4) unemployment and under employment; 5) agri-rural attributes;

Income, Educational and Occupational Status, 1996

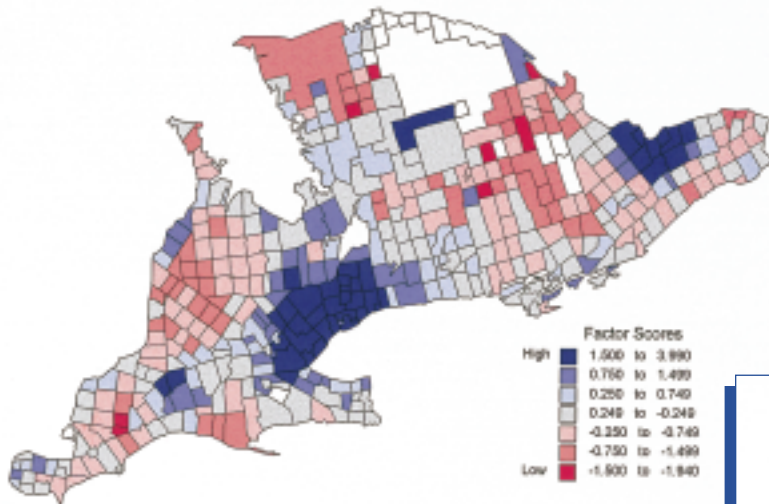


Fig. 1a

Fig. 1a shows the Census Subdivisions (CSDs) (mainly townships and cities) whose area is large enough to be seen on this map. Fig. 1b shows the location of CSDs (mainly towns and villages) whose area is too small to be seen on Fig. 1a.

Income, Educational and Occupational Status, 1996

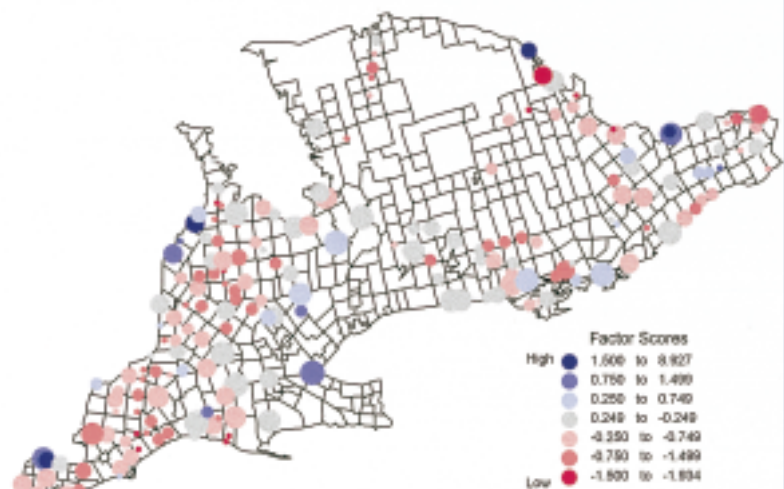


Fig. 1b

6) in-migration and population growth; 7) non-market service employment vs. manufacturing employment; and 8) 'traditional' employment structure. The factor scores, i.e. the value of each factor for each CSD, were mapped. The results show that major socio-economic differences exist across what is conventionally considered rural and small town Ontario.

As an illustrative example, one set of maps from the 1996 factor analysis is reported here. Figures 1a and 1b show the spatial distribution of the factor scores for the income, educational and occupational status factor, across the 610 CSDs of Southern Ontario. Table 1 reports the average value of the indicators associated with this factor by the same categories of factor scores used on the figures. Each column of Table 1 provides

a profile of the CSDs of Southern Ontario with respect to the set of indicators listed.

High factor scores are indicative of high income, educational, and occupational status. On average, CSDs with the highest factor score values (the dark blue on the maps) report an average household income of \$71,964, a share of population with some post-secondary education of 64.4%, and 39.6% of the labour force employed in professional, managerial and intellectual occupations. At the opposite end of the range, the average value of these indicators for CSDs with the lowest factor scores (the dark red on the maps) is \$37,391, 39.4%, and 18.2% respectively. Five other indicators listed on this table are also associated with this factor.

The main area of high income, educational and occupational status extends in

Table 1. Income, educational, and occupational status factor – Average values of the indicators associated with the factor by factor score categories, 1996

Indicator	FACTOR SCORES						
	≤-1.50	-1.49 to -0.75	-0.74 to -0.25	0.24 to - 0.24	0.25 to 0.74	0.75 to 1.49	≥ 1.50
Average household income (\$)	37,391	40,230	44,528	46,932	51,718	58,781	71,964
Average female income (\$)	14,677	15,526	17,329	18,151	19,306	20,881	24,510
Average value of dwellings (\$)	96,441	111,486	121,304	138,172	152,797	173,007	227,448
Average gross rent (\$)	440	490	538	591	619	674	783
Percentage of population 20 years of age and over with some post secondary education	39.4	40.1	45.3	48.3	53.1	56.5	64.4
Percentage employment in professional, managerial, and intellectual occupations *	18.2	20.6	23.7	26.1	29.2	31.1	39.6
Percentage dynamic services employment **	13.1	14.3	16.6	18.5	20.7	25.2	29.7
Government transfer payments as percentage of total income	24.2	21.5	18.4	17.1	14.8	11.5	8.5

* Professional, managerial, and intellectual occupations include: management occupations; business, finance and administrative occupations; natural sciences and related occupations; occupations in social science, education, government service and religion; professional occupations in art and culture.

**Dynamic services employment includes: transportation and storage industries; communication and other utility industries; wholesale trade industries; financial and insurance industries; real estate operator and insurance agent industries; business service industries.

an arc of variable width around the western end of Lake Ontario, radiating outward from Toronto and extending beyond the Toronto Census Metropolitan Area (CMA). Secondary areas of high positive scores are associated with the Ottawa and London CMAs. Not only do these areas include major urban centres but also encompass smaller population concentrations and the intervening countryside that is home to a large exurban rural non-farm population that for the most part out-commutes to the region's employment centres. It is well to bear in mind that CSDs that are part of the study area's CMAs and Census Agglomerations contain about 43% of the study area's rural population (according to the definition of Statistics Canada). Indeed, many 'rural' townships are included among the CSDs that have the highest scores on this factor.

Guiding rural decision-making

In conclusion, the analysis, only briefly reported on here, provides a detailed picture that can help local decision-makers to better understand the comparative conditions of the

area in which they operate. At a broader level, the eight factors identified show that no clear segregation appears between what is conventionally viewed as 'rural' and 'urban'. Substantial sub-regional diversity as well as differences between areas categorized by municipal status are recorded. This should have a major bearing in the future analysis and design of rural programs and policies.

On the research side, each of the maps produced could be considered as a starting point for further analysis. Research is needed, in particular, to explain the processes underlying the composite patterns identified, as well as those underlying some of the individual variables used in the study. The next step of the research should focus on long-term trends and the determinants of socio-economic changes that are occurring across Southern Ontario. ■

Acknowledgements

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Rural–Urban Conflicts OVER Groundwater

MAKING WISE QUALITY AND QUANTITY DECISIONS

Abundant supplies of clean ground water are essential to rural inhabitants who rely on aquifers – for drinking, watering livestock, irrigation or industrial uses. Conflict is common in communities where the quantity or quality of water is compromised by over-extraction or contamination. Agricultural uses have often been blamed for ground water contamination, particularly by nitrates leached from the fertilized soil. Depletion of water quantity is usually associated with municipal and industrial works, impacting on farmers and rural residents who may require deeper wells, or expensive import of transported water.

Government policy makers have at times proposed restrictions to limit groundwater contamination to a certain threshold, and/or to curtail rates of ground-water extraction. Our research examined the economic validity of these policies in a real-life case study of groundwater use in Wilmot Township, Regional Municipality of Waterloo.

From an economic viewpoint, restrictions to protect groundwater quality could impose costs on farmers who fertilize fields to obtain higher yields. New regulations requiring costly specialized technologies to manage nitrate leaching could result in reduced agricultural profits. At the same time, not controlling nitrate leaching may result in contamination of a municipal water supply, thus increasing treatment costs for municipal water users.

Similarly, activities intended to conserve the quantity of groundwater impose costs on large volume extractors (e.g. industrial establishments and municipal suppliers). However, failure to act could result in early watertable depletion, thus increasing economic costs for future water users who may have to deepen their wells, spend money to pump water from deeper wells, or find an alternative source of water.

Quantifying the cost of potable water

The aquifer beneath Wilmot Township is an important source of potable water for the 13,000 residents of the area and 250,000 urban residents in nearby Kitchener-Waterloo (K-W). Wilmot Township is a prime agricultural region.

In 1996, a groundwater quality survey showed that nitrate levels in the area ranged from as low as 1 part per million (ppm) to 19 ppm. The Ontario drinking water objective

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Table 1: Net Present Value of Economic Losses Associated with Four Groundwater Management Approaches

Management Approach	Size of economic loss compared with the optimum	Percentage
Integrated Approach	\$0	0%
Status Quo	\$561,000	0.89%
Extraction Controls	\$776,000	1.23%
Nitrate Controls	\$2,553,000	4.06%

for nitrate in water is 10 ppm. To protect future drinking water supplies, the Region had contemplated wellhead protection policies. Some policies included restriction of agricultural activities in high risk areas. To reduce the problem of water table depletion due to high withdrawal rates, extraction controls by Ministry of the Environment had been proposed.

We constructed four scenarios representing four groundwater management choices for Wilmot Township area. The options included the status quo, a policy to reduce nitrate leaching, a policy to reduce extraction volumes, and an integrated quality and quantity policy approach.¹

To simplify the research, nitrate leached from fertilized fields was

the only contaminant considered. Thus, the level of agricultural fertilizer application would determine the cost of water contamination as well as the benefit of increased crop yield. Contamination cost was quantified as the marginal expense of treating nitrate-contaminated groundwater. But the benefit of fertilizer application was the marginal increase in market revenue obtained by farmers. The benefits of potable water were estimated using results of other studies for water demand in Ontario, and the cost of water table depletion was estimated based on the cost of deepening and operating wells, and the scarcity value of water as a resource.

Dynamic programming and the economic principle of optimization were then combined in a mathematical model to show the economic result of each of the four management scenarios. For every policy scenario considered, the model predicts levels of groundwater extraction, levels of agricultural production (for a given nitrate management plan), and total economic benefits derived from water use and

agricultural fertilization in the township.

According to the model, the scenarios ranked by benefits from highest to lowest were: integrated approach, status quo, extraction control policy, and nitrate reduction policy. In the ideal state, groundwater extraction rates would be set at exactly the amount that would maximize benefits to the area, and nitrogen use would be restricted to the level where its marginal environmental cost was equal to its marginal environmental benefit. If these were actually done, the benefits obtained under this scenario would be maximized. Thus, the integrated approach would yield optimal results.

By comparing each alternative management approach with the optimal approach, the model identifies the economic loss (foregone loss of benefits) that would result from pursuing a non-integrated alternative. These results are summarized in Table 1.

Economic justification for policy decisions

Consider the policy recommendation that stronger restrictions be placed on the farming community to keep nitrate levels below a given threshold. This appears quite reasonable except that, depending on the extent of restriction, policy makers may be creating greater costs than benefits. By forcing the farming community to cut back its use of fertilizers, policy makers may help make groundwater cheaper but make farming less profitable. Since agricultural activities account for a major portion of the economic activities in Wilmot Township, the marginal cost of this policy would be larger than the marginal benefit.

To the municipal water user, a water quality program is beneficial. Compared to the optimal outcome, this policy would cause economic benefits of urban water users to increase by 17% while benefits of the farming community would fall by approximately 10%. However, as Table 1 shows, the overall economic well-being of Wilmot Township region would decrease by 4%.

Water quantity conservation does not necessarily increase economic benefits either. It would be beneficial if reductions in water



extracted caused substantial changes in the cost of operating wells, but that cost in Ontario is minimal relative to other economic factors. Also, because of high rates of aquifer recharge, water conservation does not contribute significantly to future costs of accessing groundwater. Table 1 shows that an extraction control policy would reduce total benefits by more than 1%. The full cost of this would be borne by municipal water users whose welfare would fall by 9% (Fig. 1). Under extraction controls, farmers would be better off than even under the optimal management approach since policy makers would focus attention on extraction controls while not addressing quality issues.

Finally, the economic losses from groundwater use under current policy (status quo) are less than 1%. The municipal water users are clearly much worse off than they would be under a nitrate management policy. However, the status quo is the policy scenario that is closest to the optimal outcome predicted by the model.

Only an integrated approach, accounting for the negative effects of each policy on the total welfare of users (farming community and water users) would result in the optimal outcome. To integrate groundwater extraction and contamination into one problem, the model used three types of relationships: economic, biophysical and hydro-geologic and considered such factors as: benefits of water use, the cost of stock depletion, the effect on future supplies, the effect on agricultural profits, the quality of water and the cost of providing clean water.

Apart from implementing the ideal integrated approach to address the rural-urban groundwater conflict in Wilmot Township, it becomes clear that the best action for the perceived groundwater management problem is almost no action. This is explained by the interrelationship between water quality and quantity decisions. Higher nitrate concentrations provide an incentive to reduce extraction while high extraction rates result in higher nitrate loading per unit volume of water. Under current, minimal policy activities, the total economic benefit to society is closer to

the optimum than proposed alternative policies. While improvements on the status quo are possible, setting arbitrary controls on farming activities with the hope that some regulation is better than none would be flawed. The policy implication is that all such regulations should be economically justified.

Our research led us to a few general conclusions. As was demonstrated in this case study, reduction in profits for the farming community can be greater than savings made because of improved groundwater quality. If the farming community contributes to water quality improvement by foregoing some profits, they may have a strong argument for requesting some form of cost sharing.

However, despite the cost of water quality programs to farmers, they may become necessary if the value of drinking water grows substantially. Such would be the case with a large and rapidly growing urban population in Wilmot Township, or high value industries that depended on large amounts of clean groundwater. Also, increased treatment costs for contaminated groundwater could justify the introduction of water quality programs. ■

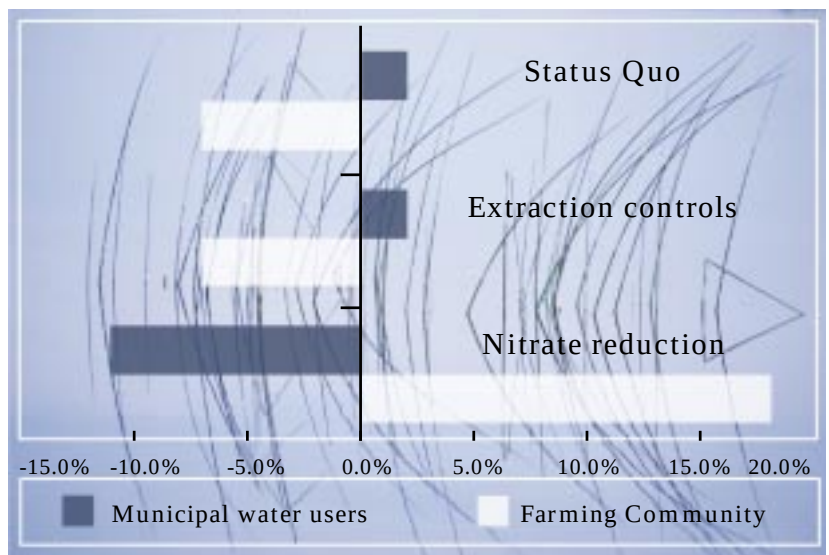


Fig. 1. Changes in economic welfare of water users and farming community (each scenario compared to integrated approach)

For details of the assumptions in each scenario, see Zachariah (1999) "Optimal Economic Management of An Aquifer: In Integrated Quality-Quantity Approach", PhD Dissertation, University of Guelph.

Constructed Wetlands

The village of Alfred is a rural community in Eastern Ontario that shares a problem common to other rural centres throughout the province; current municipal wastewater treatment lagoons are at maximum capacity, limiting population growth and expansion of local agri-food industries.

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For minimal environmental impact, wastewater treatment lagoons should discharge into receiving streams only when the flow rates are high, so that the assimilative capacity of the stream is great enough to withstand the nutrient loading. But typically, wastewater volumes are too great and discharge during low stream flow is required. At Alfred College, we are researching the use of constructed wetlands to treat lagoon effluent, prior to being discharged to a receiving stream. The system would allow for continuous discharge, even to streams with low flow rates.

In spring 1999, an artificial wetland built adjacent to the village of Alfred municipal treatment lagoons, will begin treating 5% to 15% of the wastewater flow entering the lagoons (approximately 21,000m³ per year). The wetland is comprised of two free-surface wetland cells, an aerobic pond, an overland flow and phosphorus adsorption filters (Fig. 1). It will operate from May to October, using the lagoons for storage in the winter. During the three year testing period, the effluent from the wetland will discharge back into the existing municipal lagoons.

To establish vegetation in the constructed wetland, aquatic plants, cattails and bulrushes were planted in fall 1998. Two techniques were used (Fig. 2); 1200 cattail plugs and 800 bulrush plugs were planted by hand with the

assistance of students from Alfred College and volunteers from the South Nation Conservation. Dried cattail heads were also used to seed the cells. Once the plants are established in spring 1999, the emergent plants will be counted to compare the success of the two methods. Three wastewater treatment options will be tested in the demonstration site:

- 1) lagoon → wetland → overland flow → phosphorus adsorption filters
- 2) lagoon → wetland → phosphorus adsorption filters
- 3) lagoon → phosphorus adsorption filters

The results will determine the components required in design of a full-scale wetland, that is capable of direct discharge.

Phosphorus Adsorption – Keeping the Wetland Working

To address the challenge of continued phosphorus removal in natural systems, (see sidebar), several adsorption media are also being evaluated. Blast furnace slag and steel furnace slag have been shown by other researchers to be capable of removing high levels of phosphorus. The concentration of aluminum, iron and calcium oxides of slag governs phosphorus adsorption.

Three slag samples are being tested in the laboratory. The samples were characterized according to particle size and chemical composition, run through batch adsorption tests (final orthophosphate concentrations for all three slag types tested

Treat Rural WasteWater Naturally

were below 0.03mg/L for the testing range of 0.1 mg/L to 100 mg/L of orthophosphate). Column tests will be used to determine the required detention time of the wastewater in the adsorption filter. Four columns, nine cm in diameter will run for various lengths of time. The results will be used to design the full-scale filters for the Alfred demonstration site.

In its first year of operation, the wetland will also be monitored to determine the removal efficiencies for BOD₅, nitrogen, ammonia, suspended solids, and pathogens. Nine sampling locations throughout the system will be monitored six times during the operating season. By comparing the pollutant concentration at each site, removal efficiencies can be calculated. Additional funding is being sought to monitor the long-term performance of the wetland.

The site should provide significant insight into constructed wetland performance. Sustained phosphorus removal technologies developed in this project have the potential to be used in other applications. For example, subsurface tile drain outlets could benefit from phosphorus adsorption filters. Food processing plants also produce phosphorus rich wastewater requiring high levels of treatment at a reasonable cost. Efficient phosphorus treatment would help to alleviate nutrient loading and resulting eutrophication in Ontario lakes and streams, and ultimately, allow for continued rural economic growth. ■



Fig. 1. The experimental constructed wetland at Alfred consists of two free-surface wetland cells, an aerobic pond, an overland flow and phosphorus adsorption filters. It will begin treating 5% to 15% of the wastewater flow entering the Alfred municipal lagoons in summer 1999.



Fig. 2. Aquatic vegetation is critical to the success of a wetland in treating wastewater. At the Alfred site, cattails and bulrushes were planted by hand and by seeding. The success of the two methods will be compared once the plants are established.

TREATMENT IN A CONSTRUCTED WETLAND

Constructed wetlands use aquatic plants, such as cattails and bulrushes in combination with physical, chemical and biological processes to treat wastewater. The plants serve several purposes:

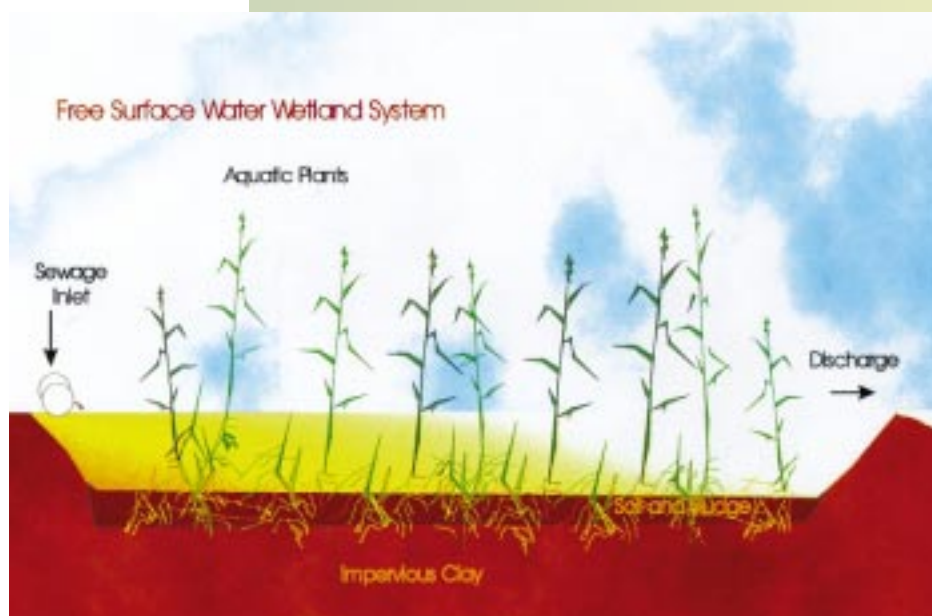
- reduce flow velocities and increase sedimentation,
- provide an environment for microorganism growth,
- transfer oxygen to the bottom of the water column through their roots, and
- create and maintain a litter-humus layer that is highly reactive.

Most of the solids are removed through sedimentation and filtration, since vegetation obstructs the flow and reduces velocities. These processes remove a significant portion of the Biochemical Oxygen Demand (BOD), nutrients (mostly nitrogen and phosphorus) and pathogens. The remaining soluble organic material, left over after sedimentation, is aerobically degraded by bacterial biofilm that is

attached to the plants. In the wetland cells, the aquatic plants supply oxygen to the wetland floor through their roots, thereby promoting the aerobic digestion of organic material.

The wetland promotes nitrification / denitrification, a process that removes nitrogen from the water as bacteria converts ammonium to nitrate under aerobic conditions. Denitrification occurs under anaerobic conditions when the nitrates are converted to harmless nitrogen gas and released to the atmosphere. Pathogenic removal in constructed wetlands is achieved through a combination of natural die-off, temperature, sunlight (ultraviolet light), water chemistry, predation and sedimentation.

Phosphorus removal by natural systems can fluctuate substantially over both the short-term (i.e. release of adsorbed phosphorus) and the long-term (i.e. when all adsorption sites are full). For this reason, it has been considered that the constructed wetland might have little or no capacity for phosphorus removal after a few years. According to some researchers, the start-up period for a wetland can extend over varying periods of time, ranging from one to five years for phosphorus removal. During this period, performance for phosphorus removal decreases until it reaches steady state. Adsorption contributes to high phosphorus removal during the first few years of wetland operation, but once the finite adsorption capacity of the soil has been used up, the phosphorus effluent concentrations start to rise. The Alfred demonstration site is studying the use of slag filters for additional phosphorus adsorption.





Success is more than just the sum of the parts.

FARMING SYSTEMS RESEARCH:

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The Farming Systems Research Team at the University of Guelph is a multi-disciplinary group that examines sustainability issues in the Ontario agricultural sector. Using a holistic approach and modelling tools, they work to determine the impact of adoption of a new production technology, for example, on all aspects of the farming system. In other work described in this article, the team examined the effects of environmental management practices on farming systems.

ISO 14000 and Ontario Agriculture

In 1997, the Ontario Farm Environmental Committee identified a need for research into international standards for environmental management (ISO 14000) and their significance for Ontario agriculture. They recognized that altering a farming system to accommodate a new set environmental standards could have substantial financial and production impacts. The Farming Systems Research team was asked to provide answers to the following questions: Could the existing Ontario Environmental Farm Plan (EFP) be incorporated in ISO 14000 certification? If not, how could it be changed or what other environmental management system would be appropriate? What would be the costs and benefits to Ontario producers who decide to comply with ISO 14000 criteria – and to Ontario agriculture as a whole?

The group found that the Ontario

Environmental Farm Plan and ISO 14000 could be compatible with three basic changes to the Plan: the addition of an environmental policy, provisions for third party on-site auditing, and a commitment to continuous improvement.

Costs and benefits from compliance with ISO 14000 could not be determined generically due to the variability in farm conditions, but significant costs could be expected by producers if alterations to farm practices and auditing procedures were necessary. However, benefits could result from: competitive advantage, reduced liability risks, meeting market demands, and anticipating and reducing government regulation.

ISO 14000 was not felt to be an initiative that would benefit all producers. Only those involved with negotiated contracts (rather than spot markets) and exporters would likely find it worth pursuing. And it was noted that involvement of some producers with ISO 14000 initiatives might result in further

fragmentation of Ontario's farming sector. Marketing based on ISO 14000 would likely be more successful if processors and retailers were included. Registration could be part of a broader Quality Assurance plan, pursued by a group or association of like-minded producers.

The non-farm industry in North America has been cautious in adopting ISO 14000. The food industry is also waiting to see if ISO 14000 is going to be warranted economically before taking it on. None of the representatives interviewed in the study suggested they would be looking for ISO 14000 registration from agricultural producers in the near future.

International programs for food safety (HACCP) and quality (ISO 9000) are similar to ISO 14000 and have been implemented in the food industry because of consumer demands and government regulation. It is possible that ISO 14000 will follow the same path and become a significant element for the agri-food industry. Given the similarities among international programs for standardised systems, several firms considered their experience with HACCP and/or ISO 9000 certification as valuable for helping them complete ISO 14000. But as an international initiative, ISO was perceived as problematic because of: a lack of performance standards related to production, relatively high costs, the potential variability in approved Environmental Management Systems throughout the globe, and the possibility of it becoming a non-technical barrier to trade.

Interest in and response to this study was strong both domestically and internationally, given that little is known about ISO 14000 and its potential impact on the agricultural sector. In Ontario, research continues with pilot studies of selected farms undergoing ISO certification, and in the U.S., the issue is also being pursued. The Institute for Agriculture and Trade Policy in Minnesota is sponsoring a Fall '99 conference as a follow-up to a Ontario Farm Environment Committee / Farming Systems Research Team workshop held in March, 1998 entitled "ISO 14000 and Ontario Agriculture: Is the Time Right?"

Encouraging Producers to Adopt Environmental Management Systems

The team has also examined factors influencing producers' adoption of best management practices (BMPs) for improving environmental conditions. They focused on adoption of conservation tillage systems on clay soil-based farming systems in Southwestern Ontario.

Economic considerations of time and fuel cost were found to be the primary considerations. While environmental benefits were acknowledged, few adopters in the study region identified it as being the deciding factor. Barriers to adoption were: aversion to change in practices, and scepticism regarding yield performance – even when presented with favourable local data on yield achievement under conservation tillage systems. Other barriers were perceived capital costs of equipment and belief that such techniques were uneconomical on smaller holdings.

Related work on a profitability analysis of alternative tillage systems for corn and soybean production on clay soils revealed that average yields were similar under conventional tillage and conservation tillage systems, although actual corn and soybean yield response to tillage treatment was affected by drought (year), and soil type. No-till systems generated the lowest net returns among the alternative tillage systems, due to higher machinery-related costs and lower yields.



Across soil types, risk averse individuals would least prefer no-till treatments compared to the remaining conservation tillage systems, because net income from the no-till systems were the lowest, and with considerable income variability.

Environmental Farm Plan Participation



A third element of research was identification of the barriers to farmer participation in the Ontario Environmental Farm Plan. Perspectives were considered from two groups: non-participating farmers and Environmental Farm Plan field staff.

Several impediments were noted, centering on issues of trust and confidentiality, and stated as: perceived invasion of privacy, aversion to peer scrutiny, mistrust of government and bureaucracy. Concern was

also voiced over the perceived purpose and structure of the Farm Plan itself: complexity and associated level of effort, perceived time commitments, perceived financial obligations, absence of motivation and/or impetus for participation.

It was apparent that there is an important role for farmer-to-farmer communication in promoting the Farm Plan and for mitigating concerns related to environmental management.

The Farming Systems Research team at the University of Guelph continues to seek out partnerships with the agricultural community to complete research on sustainability issues. For the latest information on our research, including news of the team's biennial meeting to be held in October (see below), check our web site at www.oac.uoguelph.ca/FSR/ ■

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 John Smithers (Geography),
 Alfons Weersink (Agricultural Economics),
 Ellen Wall (Plant Agriculture).

FARMING SYSTEMS RESEARCH/EXTENSION

Sustaining Agriculture In The 21ST Century: Thinking Outside The Box.

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Oct. 20-23, 1999



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ONTARIO RURAL WASTEWATER CENTRE:

Helping You Make the Right Choices in Wastewater Treatment

Rural wastewater differs from its municipal counterpart and offers extra challenges in treatment. It often has a low flow volume and high numerical values for biochemical oxygen demand, nutrients and pathogens. Rural wastewater is typically treated on-site, at the home, farm or small industry. Examples include: abattoir wastewater, household septage (from one quarter of all Ontario households), runoff from feedlots, and municipal lagoon influent. By contrast, most cities collect wastewater in sewers, mixed with stormwater runoff and groundwater infiltration, bringing huge flow volumes to centralized treatment facilities.

A new *Ontario Rural Wastewater Centre* is being established to address the training, information and R+D needs of the vast number of people depending on rural wastewater treatment: farmers, rural industries, rural municipal wastewater systems designers and workers, and the designers, installers, inspectors, and homeowners of the 1.2 million septic systems in use in Ontario. To-date, training programs in Ontario and throughout Canada have focused almost exclusively on traditional sewered systems.

Centre a First in Canada

The project is a partnership of the University of Guelph (Alfred College and the School of Engineering) and the Rideau Valley Conservation Authority. The Centre has a dual research and education mandate and will provide hands-on training, including components of Ontario college and university programs dealing with wastewater treatment. Courses will be offered in both english and french to serve all of Ontario, with future expansion anticipated for other regions in Canada, and for international clients. The Centre is a first for Canada. In the United States, 23 such centres have been

established. Claude Weil of Alfred College and Doug Joy of the School of Engineering, both University of Guelph faculty with decades of rural wastewater management experience, will manage the Centre.

The philosophy of the Centre will be eco-system management and environmental stewardship, through multi-stakeholder participation. This means working together with organizations such as the South Nation and Rideau Valley Conservation Authority and many rural groups, from farmers to cottagers and rural industries.

Courses will be developed in the areas of septic systems, agri-food systems and rural municipal systems, with input from these groups. Industry will donate most of the equipment to be used, which will be displayed as working models. The students will be able to disassemble systems, and troubleshoot problems.

There will be demonstration sites in central Ontario at the University of Guelph and in eastern Ontario at Alfred College and the Baxter Conservation Area of the Rideau Valley Conservation Authority. An internet outreach will help serve isolated communities

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with distance education courses in both english and french, and provide a forum for exchange of information.

Better Treatment Technologies ...Faster

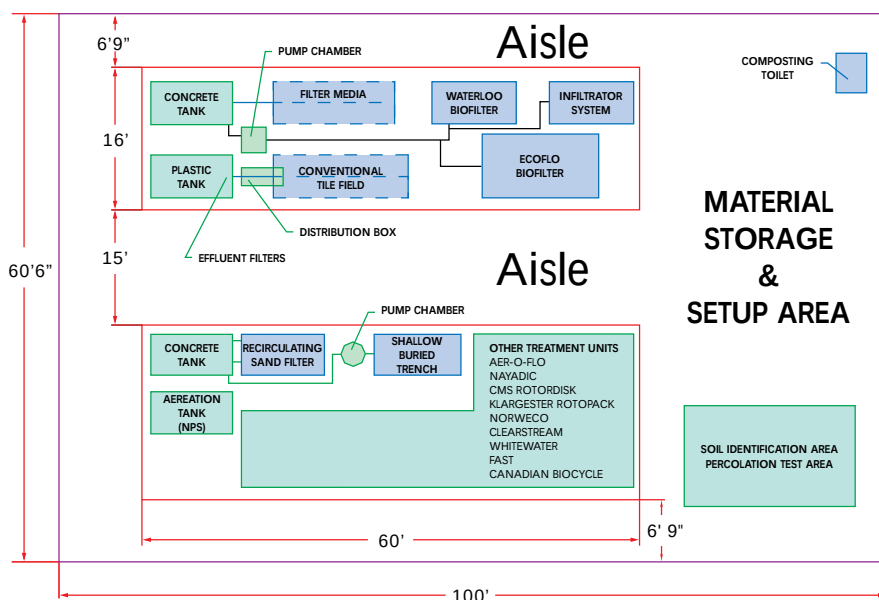
Research will be incorporated into the education programming. The Research and Technology Transfer Group at Alfred College (R&TT) is constructing an experimental wetland to treat a portion of the wastewater from the Village of Alfred (see article pg. 14 by Sarah Hurd), which will be used as a demonstration for a course on wetland design. Together with a commercial partner, they have also developed a flocculator for the treatment of dairy milkhouse washwater, which will be one of several alternatives presented in a training course for the dairy industry.

Other research underway includes: membrane filtration of slaughterhouse wastewater, removal of phosphorous from rural wastewaters through adsorption and coagulation, effect on water quality of late-fall manure application and the development of a brownwater treatment reactor for manure pile runoff.

By combining research with education and demonstration opportunities, *The Ontario Rural Wastewater Centre* will speed the development and adoption of improved wastewater technologies. With facilities and curriculum set to be in place for fall 1999, the Centre will move quickly to address that most critical of all rural resources – clean water. ■



Researchers Claude Weil and Larry Hepner at the controls for recirculating sand filters at the Delaware Valley College on-site centre. The demonstration centres planned for Ontario will provide similar first-hand practical experience in rural wastewater treatment.



Initial design for the Eastern Ontario demonstration site at the Baxter Conservation Area of the Rideau Valley Conservation Authority.

Acknowledgments:

Initial funding for the Ontario Rural Wastewater Centre is being provided by the National Soil and Water Conservation Program and by a major grant from the Strategic Skills Development Fund of the government of Ontario with matching contributions from industry, the University of Guelph (through OMAFRA) and the Rideau Valley Conservation Authority.

Cryptosporidium:

Is Manure a Contributor

Cryptosporidium parvum is a surface-water protozoa that can cause cryptosporidiosis, a severe diarrheal condition in humans and animals. It's not normally found in groundwater since it's big enough to be filtered out as water moves through the soil. However, chlorine is ineffective in killing it, so rural and urban municipalities that rely on surface water supplies have to employ alternative treatment methods.

Agricultural sources, such as runoff from fields receiving livestock manure, have been blamed for contributing to *Cryptosporidium* outbreaks in recent years. In perhaps the most dramatic of these, 400,000 people were infected in Milwaukee in 1993.

There have been other outbreaks in the U.S. and Canada over the past several years, including one in Collingwood, Ontario in 1997. Due to advances in diagnostics since 1993, it has been determined that the massive

Milwaukee outbreak was attributed to human, and not livestock sources of the pathogen.

At Ridgetown College, University of Guelph, the impacts of Ontario livestock practices on levels of *Cryptosporidium* in surface water are being investigated. A previous study in 1996 measured levels of the protozoa in manure storages, to develop recommendations for farmers. Other studies had looked at the prevalence of the protozoa in fresh animal feces but not at levels in manure storages or in the runoff from solid manure storages. This is a

significant factor in Ontario, where most manure is stored before it is spread onto the land.

Sixty farms in southwestern Ontario were chosen for the study, and a total of 552 fecal samples were collected during three farm visits. There were 20 each of: swine farrowing operations with liquid manure; dairy with solid manure and runoff storages, and dairy with liquid manure. Numbers of *Cryptosporidium* oocysts from fresh manure from calves or young pigs were compared to levels in manure from the storages.

For the 60 farms in the study, 90% of the swine farms, 65% of the dairy farms with solid manure systems, and 50% of dairy farms with liquid manure tested positive for the protozoa at least once during the study. In total, 26% of all swine manure samples tested positive, compared to 8.1% for dairy with solid manure, and 7.3% for dairy with liquid manure.

For each of the three farm types, 50 to 55% of the farms tested positive for *Cryptosporidium* at least once for the fresh manure samples (i.e. from young pigs or calves). In contrast, 75% of the swine farms tested positive at least once for a storage sample; 20% for dairy farms with solid manure storages (plus runoff tanks); 0% for liquid dairy manure storages.

In 1998, the second study of *Cryptosporidium* and manure was begun with funding from OMAFRA and Agriculture and Agri-Food Canada, through the National Soil and Water Conservation Program.

Currently underway, it considers the viability of the organisms in the samples, which had not been done previously. We felt it was important to see if the organisms in the manure

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to CONTAMINATION ?



CRYPTOSPORIDIUM

takes on many different forms during its life cycle. The most easily observed is the oocyst. Oocysts appear as refractile spherical bodies, ranging from 4 to 5 μm in size. Dark granules are often seen embedded within the oocyst. Infection begins with the ingestion of the sporulated oocyst, a stage that may remain viable for prolonged periods of time in the environment.

Once in the body, the parasite attacks the epithelial cells, where they begin two asexual generations. The resulting sporulated oocysts contain four sporocysts each, which are released with the feces.

Source: Internet Resources, UCLA

storages were mostly viable, or if over time, they tended to die off. We are collecting manure samples from 10 swine farms over a one-year period to establish this and to look for seasonal variations in levels.

A second part of the study is to establish differences in drainage tile water quality from watersheds where manure is spread on the land, compared to areas where no livestock are present (a total of 20 tile drain outlets). A final goal is to quantify contributions from various sources in different watersheds – looking at potential contributions of sewage treatment plant outflows, storm sewer discharges, wildlife, and cattle watering in streams. Eight sites are included.

Preliminary data suggest that oocysts are

present in approximately 50% of manure samples, and of those testing positive, at least some viable organisms are present 60% of the time. The tile drain study has found *Cryptosporidium* in about 33% of the samples so far, with viable organisms present in nearly all of these. This includes water draining from livestock watersheds and from non-livestock watersheds. About 40% of the surface water samples have also tested positive, but it is too early to tell which source of water has the greatest contribution.

The study is scheduled to be completed by the end of 1999. By that time, we should have a clearer picture of steps that farmers should take, or continue to take, to avoid contamination of surface water. ■

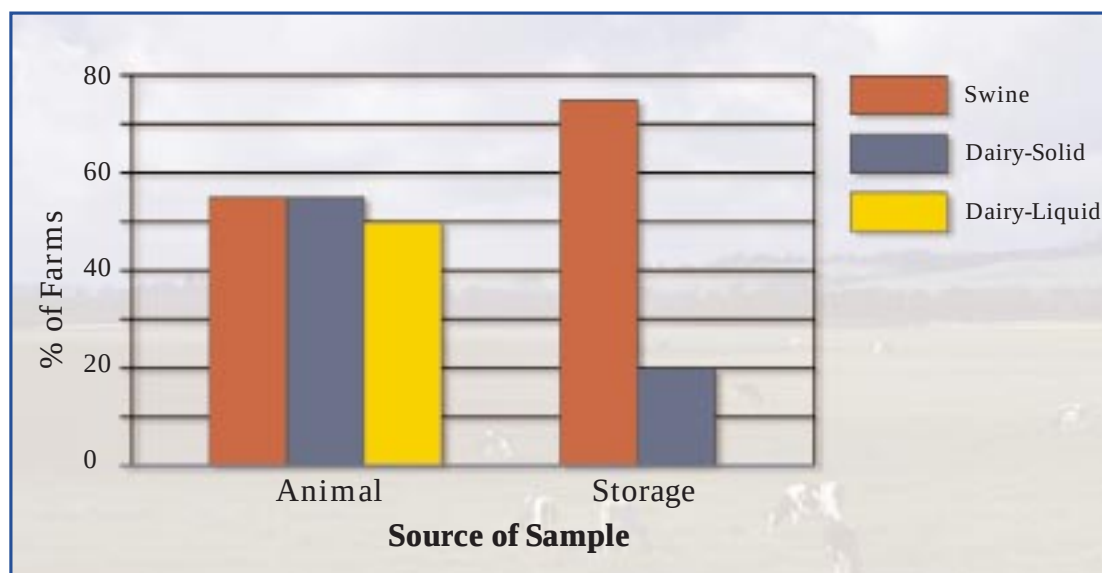


Fig. 1. Percentage of farms testing positive for *Cryptosporidium* at least once during the study. Figure 1 shows the marked difference between levels of the protozoa in swine versus dairy farm manure storages.

A Decision Support System for Manure Management



CREDIT: LARRY LEFEVER/GRANT HEILMAN PHOTOGRAPHY

Dairy and swine producers need up-to-date solutions for safe and efficient manure handling. At the University of Guelph, a decision support system (DSS) has been developed to provide the best available knowledge of cost/benefit options. The need for the DDS is likely to intensify because of the move toward nutrient management planning throughout the province.

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This 'expert system' incorporates the necessary technical, economic and environmental risk assessment for a range of commonly-used livestock manure systems in Ontario. It integrates information on: animal nutrition; engineering aspects of manure handling in the barn, in storage, and during land application; agronomy associated with growing crops using the nutrients from manure; soil, water and atmospheric sciences aspects of environmental impacts of manure; and the economics of manure handling and environmental risk.

The system is available as a computer program, MCLONE4, written in Visual C++. Visual C++ uses a 32-bit operating system platform, and can be executed in Windows95™, Windows98™ and NT™ but not in

Windows 3.1™ or earlier versions of the Windows™ operating system.

To develop the DSS, two surveys were carried out in cooperation with the Dairy Farmers of Ontario and with Ontario Pork. The details of the components of different manure handling systems employed by producers were used in the selection of cooperators, to help identify the capital and operating costs of the components.

Questionnaires were completed by 353 dairy producers and 656 swine producers. Between 30 and 50% of dairy and swine producers stated that they would be prepared to use a decision support software to improve manure management in their operation. Both groups in the survey highlighted their concerns over environmental and economic aspects of manure management.

Manure Management and Municipal Measures

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Issues associated with large, intensive livestock operations usually focus on their environmental impacts on water, soil and air quality. Manure – odour and potential for contamination is usually the source of the controversy.

Across North America a variety of municipal approaches have been used to mitigate the issue. The differences usually reflect agriculture's importance in the local economy, the political weight of non-farm development, the community's experiences with farm issues, the health of the local environment, and the size and nature of the livestock industry.

Every province (except Newfoundland) has adopted 'Right to Farm' legislation. In Ontario, the Planning Act, Municipal Act, Building Code, and Minimum Distance Separation Formula are key tools municipalities use, as well as official plans and bylaws, to try to balance the needs of the various rural sectors. Provincial policy also assists by helping to establish the right balance between farm and non-farm uses.

Most recently, municipalities have been moving to require a 'Nutrient Management Plan' prior to issuing a building permit for an intensive livestock operation. Though it may appear to be a regulatory move, the farm operators as well as the community benefits, as they become more knowledgeable about the best nutrient management options for the operation. Voluntary approaches such as the Ontario Environmental Farm Plan may also yield better solutions than sole reliance on regulatory requirements, given that many of the troublesome activities go beyond jurisdictional and practical abilities of a municipality to regulate.

“This expert system incorporates the necessary technical, economic and environmental risk assessment for a range of commonly used livestock manure systems in Ontario.”

Evaluating and Fine Tuning Predictive Capability

Field and laboratory investigations provided basic information necessary to evaluate components of the DSS. A feeding trial was established at the Ponsonby Research Station in which two groups of dairy cows received either of two diets differing in the proportions of rumen-degradable protein and soluble protein. At the Arkell Research Station, emissions of N₂O, NO and NH₃ before and after liquid swine manure application were measured. Leaching of nitrate and the movement of bacteria after the application of liquid swine and solid beef manure were compared in detailed studies at Arkell and on a cooperators farm in the Regional Municipality of Waterloo. Experimental variables included the soil water content at application, and the time of application.

Further development of the DDS has fine tuned its predictive capability. The economic data in the program have been enhanced with the addition of a default data bank of information on system costs gathered from operating swine and dairy farms. A wider range of handling systems equipment for dairy and swine manure have now been included. The value of the applied nutrients are now calculated to offset, in whole or in part, annual operating and capital costs. The evidence from the economic analysis in MCLONE4 indicates that farmers face a net cost of managing manure, even after the nutrient content has been factored into the equation.

A new approach has been taken in the environmental risk area. Based on the range of losses of nitrogen and phosphorus nutrients, indices were developed and ranked. A new odour module was added based on known

dispersion characteristics around buildings and over typical terrain. Losses of nitrogen from leaching are now determined. The potential movement of bacteria into groundwater is also predicted. Combined, these indices give the owner a rating of environmental risk that will be incurred by the proposed or existing system.

The nutrient application portion of the program is based on the recommendations and current information found in the Guide to Field Crops in Ontario (OMAFRA 1998) publication.

Following the incorporation of beef and poultry manure evaluation capabilities and the equipment associated with them, the program will be the most comprehensive decision support system available for manure management.

The benefit to Ontario agriculture of the DSS lies primarily in helping farmers to minimize the impact of manure handling on the environment, by establishing the handling system that will best help them achieve that objective. ■

Les recherches en bref

Ressources humaines

Le marché du travail au sein des nouvelles économies rurales

Tony Fuller

Quels sont les effets de la mondialisation des échanges, de la restructuration de l'économie et du nouveau rôle des administrations locales sur le milieu rural et le gagne-pain des personnes qui habitent dans ces régions? Pour trouver réponse à cette question, il faut notamment examiner les changements subis par le marché du travail au chapitre de l'approvisionnement. En 1997-1998, on a mené une enquête auprès de ménages habitant en milieu rural et dans de petites villes du comté de Huron, une région agricole située dans le sud-ouest de l'Ontario. Soixante pour cent des répondants habitaient dans la ville de Exeter, 22 pour 100 dans le village de Blyth, 10 pour 100 exploitaient une entreprise agricole et les autres répondants ont été considérés comme des personnes habitant en milieu rural et n'exploitant pas une entreprise agricole.

Points saillants de l'enquête: Des 612 personnes interrogées, 68 % faisaient partie de la population active, 30 % n'en faisaient pas partie et 2 % se considéraient comme étant au chômage. L'économie de la région étant mixte, les emplois occupés étaient très variés. Trente-six pour cent des répondants qui avaient un travail occupaient plus d'un emploi et 26 % se sont identifiés comme des travailleurs autonomes. Seulement 42 des 69 ménages agricoles ayant participé à l'enquête se considéraient comme des travailleurs autonomes. Plus de 55 % des ménages avaient au moins deux revenus. La majeure partie des répondants (78 %) travaillaient à l'extérieur de leur lieu de résidence. Les hommes parcouraient de plus grandes distances que les femmes pour se rendre au travail. Il y avait plus d'emplois en 1997 qu'en 1991. Dans l'ensemble, le revenu des ménages, après inflation, était inférieur à ce qu'il était en 1991. On n'a relevé aucune différence apparente entre les répondants habitant dans les villages et ceux habitant dans les villes, ni entre les résidents des villes et les personnes ayant une exploitation agricole.

L'enquête a permis de constater que, pour un grand nombre de ménages du comté de

Huron, le travail est fragmenté et que, en raison de l'économie mixte de cette région, un grand nombre de personnes travaillent à l'extérieur de la région ou travaillent à leur compte (souvent à la maison). La grande mobilité de la main-d'œuvre et la fragmentation de l'emploi sont courantes dans les nouvelles économies rurales de l'Ontario et sont attribuables aux moyens que prennent les familles pour gagner leur vie dans les régions agricoles de la province.

Incidence de la restructuration des services de santé sur les localités rurales

Allan C. Lauzon, Leanne O. Hagglund

Nos travaux de recherche ont porté sur les défis que pose la restructuration des services de santé dans les localités rurales de l'Ontario, plus particulièrement dans la localité de Meaford, où on prévoit abaisser le statut de l'hôpital pour en faire un centre de soins primaires.

Nous avons constaté que l'hôpital fournissait un grand nombre d'emplois dans la localité et que le changement de statut aurait des effets à court terme, tels que la perte d'emplois et de revenus et le départ de professionnels de la santé, ainsi que des effets à long terme, qui ralentiront l'activité économique locale. Afin de redonner de la vigueur à une économie en perte de vitesse, les dirigeants municipaux tentent de faire connaître la ville de Meaford comme un endroit attrayant pour les personnes à la retraite. L'absence d'un hôpital nuirait à cette stratégie économique et entraînerait sans doute le départ de personnes âgées.

L'incidence de l'initiative de restructuration dans les localités rurales ne se limite pas aux services de santé. Le secteur des services de santé en milieu rural est étroitement lié à tous les aspects de la vie de la collectivité, de sorte que toute modification apportée à ces services se répercute sur le tissu social de la localité. La restructuration des services de santé a des effets distincts sur plusieurs sous-populations et touche le plus les personnes âgées, les pauvres et les femmes. En raison des caractéristiques démographiques propres à chaque localité rurale, la restructuration des services de santé pose un défi différent dans chaque collectivité.

Stratégies visant les partenariats, l'accès et la connectivité pour les régions rurales

Don Richardson, Ricardo Ramirez

Dans les régions rurales de l'Ontario et du reste du pays, l'infrastructure des communications n'est généralement pas aussi avancée que celle des centres urbains. Notre recherche repose sur l'hypothèse suivante: la connectivité des télécommunications facilite le développement de l'économie et des communautés rurales lorsqu'elle s'accompagne de partenariats visant des objectifs communs et l'amélioration de l'accès aux services (santé, éducation, emploi, affaires, etc.) pour les habitants des régions rurales. Ces éléments sont les trois piliers nécessaires à la mise sur pied d'initiatives durables et bénéfiques au chapitre des télécommunications.

Nous croyons que les services offerts dans les régions rurales seront insuffisants tant que l'on n'aura pas créé un contexte favorable à l'élaboration d'une politique d'amélioration de ces services. Les communautés et les organismes indépendants qui souhaitent tirer parti des technologies de l'information et des communications risquent de faire de mauvais investissements dans l'infrastructure nécessaire à la connectivité s'ils n'accordent pas suffisamment d'attention aux deux autres piliers que sont l'accès aux services et les partenariats.

En collaboration avec nos partenaires en milieu rural, nous continuerons de travailler à la réalisation des objectifs suivants: 1) continuer d'élaborer des documents d'information sur les politiques applicables à la planification du développement des communautés rurales et quantifier l'incidence économique des investissements dans les technologies de l'information et des communications; 2) réaliser des études sur des initiatives de développement économique en milieu rural faisant appel aux technologies de l'information et des communications et dont la réussite repose en partie sur l'utilisation de la méthode des *trois piliers+; 3) déterminer les besoins en formation professionnelle des hommes et des femmes sur le plan des partenariats, de l'accès aux services et de la connectivité des télécommunications; 4) documenter les initiatives réussies de formation en milieu rural qui démontrent l'incidence

positive des technologies de l'information et des communications sur l'emploi dans le secteur des technologies de l'information dans ce milieu; 5) concevoir un système prototype de cartographie et d'information géographique accessible par le Web pour les régions rurales de l'Ontario et dresser un inventaire des initiatives et de l'infrastructure des télécommunications en milieu rural, ainsi que des intervenants de ce secteur.

Diversité socio-économique des régions rurales du sud de l'Ontario

Philip Keddie, Alessandro Alasia

Les régions rurales sont de plus en plus intégrées à des systèmes socio-économiques régionaux. On peut donc mieux comprendre les conditions qui prévalent en milieu rural en examinant ces systèmes dans leur ensemble plutôt qu'en se limitant à certaines de leurs composantes. L'étude avait pour but de déterminer le niveau de diversité spatiale dans le sud de l'Ontario en se fondant sur une série de 34 indicateurs établis à partir de données de subdivision des recensements nationaux de 1991 et de 1996.

Les 34 indicateurs retenus sont utilisés couramment. Ils reposent sur des variables démographiques, sociales et économiques telles que le pourcentage de la population par cohorte d'âge, le pourcentage d'emploi par secteur, les taux de chômage et le revenu moyen. On a constaté qu'il y avait d'importantes différences socio-économiques dans ce que l'on appelle généralement les régions rurales et les petites villes de l'Ontario. Les figures 1a et 1b de l'article illustrent la répartition spatiale des scores factoriels du revenu, de la scolarité et de la situation professionnelle dans les 610 subdivisions de recensement du sud de l'Ontario. En moyenne, dans les subdivisions où les scores factoriels étaient les plus élevés (indiquées en bleu foncé sur les cartes), le revenu d'un ménage moyen était de 71 964 \$, 64,4 pour 100 de la population avait fait des études postsecondaires et 39,6 pour 100 de la population active exerçait une profession libérale, occupait un poste de gestion ou remplissait des fonctions nécessitant des aptitudes intellectuelles.

Le principal secteur où le revenu, la scolarité et la situation professionnelle sont les plus élevés est délimité par un arc de largeur variable commençant à l'extrémité ouest du lac Ontario, traversant

Toronto et se terminant au-delà de la région métropolitaine de recensement de Toronto. Ce secteur comprend non seulement de grands centres urbains, mais également de petites localités et des régions rurales où habite une vaste population exurbaine non agricole dont la plupart des membres font la navette pour aller travailler dans les centres d'emploi de la région. En fait, un grand nombre de cantons *ruraux+ font partie des subdivisions de recensement affichant les scores les plus élevés. Lors de la prochaine étape de l'étude, on devrait se pencher sur les tendances à long terme et les déterminants des changements socio-économiques en cours dans le sud de l'Ontario.

Richesses naturelles

Conflits entre des localités urbaines et rurales au sujet de l'eau souterraine

Oswald Zachariah, Kim Rollins

Les personnes habitant en milieu rural qui puisent dans les aquifères l'eau dont elles ont besoin pour leur consommation personnelle, leur bétail, leurs cultures et diverses fins industrielles doivent pouvoir compter sur un approvisionnement abondant en eau souterraine potable. Il n'est pas rare que des conflits surviennent dans les localités où l'extraction excessive ou la contamination compromettent l'approvisionnement en eau ou la qualité de cette eau. Dans le passé, les décideurs ont proposé de limiter la contamination et l'extraction de l'eau souterraine. Nos travaux de recherche ont porté sur la validité économique de certaines politiques adoptées à cet égard, plus particulièrement dans le canton de Wilmot, une région agricole à fort rendement située dans la municipalité régionale de Waterloo.

L'aquifère du canton de Wilmot est une source importante d'eau potable pour les 13 000 résidents de la région et les 250 000 résidents de la localité urbaine de Kitchener-Waterloo. Nous avons élaboré quatre scénarios portant sur la gestion de l'eau souterraine dans le canton de Wilmot: 1) le statu quo; 2) une politique visant à réduire le lessivage des nitrates; 3) une politique visant à réduire l'extraction d'eau; et 4) une politique intégrée axée sur la qualité et l'approvisionnement. Allant du plus au moins avantageux, ces scénarios se classent ainsi: politique intégrée, statu quo, politique de réduction de l'extraction

et politique de réduction du lessivage des nitrates.

En comparant chaque scénario à la solution optimale, on a pu déterminer les pertes économiques (tableau 1) et autres qui résulteraient de l'adoption d'une démarche non intégrée. En obligeant les agriculteurs à utiliser moins d'engrais, les décideurs réduiraient peut-être les coûts de l'eau souterraine, mais rendraient les exploitations agricoles moins profitables. Comme l'agriculture est un important secteur d'activité économique dans le canton de Wilmot, le coût marginal d'une telle politique l'emporterait sur les avantages qu'on en retirerait. Des mesures de conservation de l'eau seraient bénéfiques si elles réduisaient sensiblement les coûts de fonctionnement des puits. Or, ces coûts sont minimes en Ontario par rapport aux autres facteurs économiques. Enfin, les pertes économiques découlant de l'utilisation de l'eau souterraine aux termes de la politique actuelle (statu quo) correspondent à moins de 1 pour 100.

Malgré les coûts qu'ils représentent pour les agriculteurs, les programmes de gestion de la qualité de l'eau pourraient devenir nécessaires si la valeur de l'eau potable augmente considérablement, par exemple en raison de l'accroissement de la population urbaine ou du nombre d'industries de grande valeur ayant besoin de grandes quantités d'eau souterraine propre. De plus, l'augmentation des coûts d'épuration de l'eau souterraine pourrait justifier la mise en oeuvre de programmes de gestion de la qualité de l'eau.

Aménagement d'une terre humide pour l'épuration naturelle des eaux usées

Sarah Hurd

Au printemps 1999, une terre humide aménagée aux côtés des bassins d'épuration du village d'Alfred épurera de 5 à 15 pour 100 des eaux usées qui se jettent dans ces bassins (environ 21 000 m³ par année). Cette terre humide comprend deux cellules à surface libre, un bassin aérobie, un canal d'écoulement des eaux de ruissellement et des filtres d'adsorption du phosphore (figure 1 dans l'article). Elle sera en service de mai à octobre; les bassins serviront d'aire de stockage pendant l'hiver. Au cours de la période de mise à l'essai, qui durera trois ans, les effluents de la terre humide seront rejetés dans les bassins municipaux. On comparera trois options pour l'épuration des eaux usées afin de déterminer si toutes les composantes sont

nécessaires pour l'aménagement d'une terre humide de dimensions suffisantes pour permettre une décharge directe.

On évalue plusieurs méthodes d'adsorption pour assurer l'élimination permanente du phosphore du milieu naturel. On se servira des résultats d'analyse de trois échantillons de laitier pour concevoir les filtres grandeur nature dont on aura besoin pour le projet pilote d'Alfred. Au cours de la première année de fonctionnement, on surveillera le rendement de la terre humide pour en déterminer l'efficacité au chapitre de l'élimination de la DBO₅, de l'azote, de l'ammoniacale, des solides en suspension et des pathogènes.

Les technologies d'élimination permanente du phosphore mises au point dans le cadre de ce projet pourraient être utilisées à d'autres fins, par exemple en tant que filtres placés à la sortie des drains souterrains ou utilisés dans les usines de transformation des produits alimentaires qui génèrent des eaux usées riches en phosphore. L'épuration efficace des eaux usées permettrait d'atténuer les charges en polluants phosphorés et l'eutrophisation des cours d'eau ontariens qui en résulte, ainsi que de soutenir la croissance économique des régions rurales.

Recherche sur les systèmes agricoles

Ellen Wall

L'équipe de recherche sur les systèmes agricoles est un groupe multidisciplinaire de l'Université de Guelph qui étudie les questions entourant la durabilité du secteur agricole de l'Ontario. Dans le cadre des travaux décrits dans l'article, cette équipe a étudié les effets de pratiques de gestion de l'environnement sur les systèmes agricoles.

En 1997, le comité écologique agricole de l'Ontario a demandé à l'équipe d'étudier les normes internationales de gestion de l'environnement (ISO 14000) et leur importance pour le secteur agricole de l'Ontario. L'équipe a constaté que le Plan agro-environnemental de l'Ontario et les normes ISO 14000 seraient compatibles si on apportait trois modifications au plan: l'ajout d'une politique environnementale, des dispositions concernant la vérification sur place par une tierce partie et un engagement envers des améliorations permanentes.

On a jugé que les normes ISO 14000 ne bénéficieraient sans doute pas à tous les producteurs en raison des coûts importants

qu'entraînerait toute modification aux pratiques agricoles et aux procédures de vérification. Seuls les producteurs qui passent des marchés négociés plutôt que des marchés libres bénéficieraient de ces normes. Les activités de marketing reposant sur les normes ISO 14000 donneraient sans doute de meilleurs résultats si les entreprises de transformation et les détaillants respectaient ces normes. Des exigences d'inscription pourraient être intégrées à un plan d'assurance de la qualité auquel souscrirait un groupe ou une association de producteurs oeuvrant dans un même secteur.

L'équipe s'est aussi penchée sur les facteurs qui incitent les producteurs à adopter les meilleures pratiques de gestion pour l'assainissement du milieu. Elle s'est concentrée sur l'utilisation de systèmes de conservation du sol dans des systèmes agricoles à sol argileux dans le sud-ouest de l'Ontario. L'équipe a constaté que les principaux facteurs sont d'ordre économique (temps gagné et économies sur les coûts de carburant) plutôt que d'ordre environnemental. Les obstacles à l'adoption des meilleures pratiques de gestion sont les suivants: crainte du changement, perception des coûts d'achat de matériel et scepticisme concernant le rendement, même après avoir pris connaissance de données locales favorables sur le rendement associé aux systèmes de conservation du sol.

Enfin, l'équipe a déterminé les obstacles à la participation des agriculteurs au Plan agro-environnemental de l'Ontario: perception d'une atteinte à la vie privée, aversion à l'examen par d'autres agriculteurs, méfiance à l'endroit du gouvernement et des bureaucrates. Des agriculteurs se sont interrogés sur l'objectif et la structure du plan et ont soulevé les points suivants: complexité et efforts nécessaires, temps devant y être consacré, obligations financières perçues, manque de motivation ou d'intérêt. Il ressort de cet examen qu'il faut mettre l'accent sur la communication entre les agriculteurs pour promouvoir le plan et donner suite aux préoccupations soulevées au sujet de la gestion de l'environnement.

Centre ontarien d'information sur les eaux usées en milieu rural

Chris Kinsley, Terry Davidson

À bien des égards, les eaux usées en milieu rural sont différentes de celles en milieu urbain et présentent donc un défi

supplémentaire en ce qui concerne leur épuration. Dans bien des cas, ces eaux ont un faible débit, leur demande biochimique d'oxygène est élevée et elles sont riches en nutriments et en pathogènes.

En Ontario et ailleurs au Canada, les programmes de formation mettent l'accent presque exclusivement sur les systèmes traditionnels d'épuration. Pour remédier à cette situation, on met sur pied un centre ontarien d'information sur les eaux usées en milieu rural afin de répondre aux besoins en formation et en information du grand nombre de personnes qui dépendent des installations d'épuration des eaux usées en milieu rural, à savoir les agriculteurs, les industries rurales, les concepteurs de systèmes d'épuration des municipalités rurales, les personnes qui s'occupent de ces systèmes, qui les installent et qui les inspectent, ainsi que les propriétaires des quelque 1,2 million de fosses septiques utilisées en Ontario.

Ce projet est le fruit d'un partenariat regroupant l'Université de Guelph (le Collège d'Alfred et la faculté d'ingénierie) et l'Office de protection de la nature de la vallée Rideau. Le centre, à qui on a donné un mandat de recherche et d'éducation, fournira une formation pratique (en anglais et en français) comprenant des éléments des programmes de niveau collégial et universitaire ayant trait à l'épuration des eaux usées.

Des entreprises feront don de la plupart des systèmes nécessaires, à partir desquels on concevra des modèles fonctionnels qui seront mis en montre. On mettra sur pied des projets pilotes à l'Université de Guelph, à l'Office de protection de la nature de Baxter, dans l'est de l'Ontario, et au Collège d'Alfred. En regroupant les activités de recherche sur les eaux usées, de formation et de mise à l'essai, le centre ontarien d'information sur les eaux usées en milieu rural accélérera la mise au point et l'adoption de meilleures technologies d'épuration des eaux usées.

Cryptosporidium: le fumier contribue-t-il à la contamination?

Ron Fleming

Certaines personnes ont déclaré que le milieu agricole avait joué un rôle dans les poussées de *Cryptosporidium* survenues au cours des dernières années, en soutenant que ce parasite s'était propagé dans les eaux de ruissellement des champs où se trouvait du fumier de bétail. Au Collège Ridgetown de l'Université de Guelph, on étudie l'incidence des pratiques de gestion du

bétail sur les concentrations de *Cryptosporidium* dans les eaux de surface.

En 1998, on a commencé à étudier la viabilité de micro-organismes dans les fosses à fumier. Pour ce faire, on prélève des échantillons auprès de 10 fermes porcines afin de déterminer si les concentrations de micro-organismes varient d'une saison à l'autre. On compare la qualité des eaux de drainage dans les bassins hydrographiques où on a épandu du fumier à celle des bassins où il n'y a pas de bétail. Enfin, on quantifiera l'apport de diverses sources (usines d'épuration des eaux usées, points de décharge des eaux pluviales, points d'abreuvement des animaux sauvages et du bétail dans les cours d'eau) à huit endroits différents.

Les données préliminaires semblent indiquer qu'environ 50 pour 100 des échantillons de fumier renferment des oocystes et que, parmi les échantillons où l'on a détecté ce micro-organisme, on a également relevé la présence de micro-organismes viables dans 60 pour 100 des cas. Dans le cadre de l'analyse des eaux de drainage, on a relevé la présence de *Cryptosporidium* dans environ le tiers des échantillons jusqu'à maintenant. Presque tous les échantillons où ce parasite était présent contenaient également des micro-organismes viables, et ce tant pour les échantillons prélevés dans les bassins hydrographiques où se trouvait du bétail que pour ceux prélevés dans les bassins où il n'y avait pas de bétail. Enfin, on a détecté la présence de micro-organismes viables et non viables dans environ 40 pour 100 des échantillons d'eau de surface, mais on ne peut dire pour l'instant quelle source d'eau a contribué le plus à la contamination.

Système de soutien de la prise de décision pour la manutention du fumier

Michael Goss

Les producteurs de porcs et les exploitants de fermes laitières ont besoin de moyens efficaces et sûrs pour la manutention du fumier. Des chercheurs de l'Université de Guelph ont mis au point un système de soutien de la prise de décision pour aider ces personnes à prendre les mesures nécessaires après avoir pris connaissance des tout derniers renseignements sur les coûts et les avantages de chaque option. Ce système s'avérera sans doute de plus en plus utile en raison de l'importance accrue de la planification de la gestion des nutriments dans la province.

Ce *système expert+ regroupe des données sur: la nutrition animale; les aspects techniques de la manutention du fumier dans les étables, de son entreposage et de son épandage; les caractéristiques agronomiques des récoltes pour lesquelles on utilise du fumier afin d'en faciliter la croissance; l'incidence du fumier sur le sol, l'eau et l'atmosphère; et les facteurs économiques et les risques environnementaux associés à la manutention du fumier. Le système est offert sous forme d'un programme informatique, MCLONE4, écrit en Visual C++, qui fait appel à un système d'exploitation 32 bits. Il peut être utilisé avec les systèmes Windows95MC, Windows98MC et NTMC.

Les données économiques du programme ont été complétées par une base de données sur les coûts, qui est activée par défaut. Ces données ont été recueillies auprès d'exploitations laitières et porcines. Le programme fournit des renseignements sur une plus vaste gamme de systèmes de manutention du fumier d'étable. La valeur de l'apport en nutriments a été calculée pour contrebalancer, en totalité ou en partie, les coûts annuels de fonctionnement et d'immobilisations. L'analyse économique réalisée à l'aide du programme MCLONE4 révèle que, même en tenant compte de l'apport en nutriments, la manutention du fumier représente des coûts nets pour les agriculteurs.

On a adopté une nouvelle démarche en ce qui concerne les risques environnementaux. Ainsi, on a élaboré et classé des indices à partir de la fourchette des pertes en azote et en nutriments phosphorés. On a ajouté un nouveau module sur les odeurs fondé sur les caractéristiques de dispersion autour des bâtiments et au-dessus des terres ordinaires. On a également déterminé les pertes en azote attribuables au lessivage et prévu le déplacement potentiel des bactéries dans les eaux souterraines. Tous ces indices permettront à l'utilisateur d'établir le niveau de risque environnemental associé à un système nouveau ou existant. Lorsqu'on y aura intégré les données sur le fumier de bovins et de volaille et le matériel qui y est associé, le programme sera le système de soutien de la prise de décision le plus complet pour la manutention du fumier.