

QUALITY OF LIFE: THE IMPORTANCE OF MAN-ENVIRONMENT RELATIONS AND A TENTATIVE CONCEPTUAL MODEL

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ABSTRACT

In holistic planning for a group of hydrographic basins administrators must simultaneously envision the diverse socio-economic and environmental problems that accompany development projects. Today, solutions to these complex problems are increasingly sought through a new kind of consciousness-raising which emphasizes the importance of the concept of the quality of life. This notion, however, is extremely difficult to define. The primary goal of this study is to develop a descriptive and conceptual model of the quality of life concept. This dynamic and evolving model is based on pecuniary advantages and embodies six constituent parts: survival of the species, well-being, activities, production, overproduction, and life constraints. The model is applied to socio-economic and environmental repercussions resulting from the establishment of an integrated forestry complex (a Kraft bleached pulp and paper factory and sawmills) in the watershed of the Chamouchouane River, central Quebec, Canada.

INTRODUCTION

The pollution of freshwaters has become a problem of increasingly alarming proportions in virtually every country of the world. In reality, water is at the very base of all economy: agriculture, fisheries, heavy industries such as pulp and paper, mining, food processing, secondary manufacturing, transportation, electrical generation, thermal unit cooling, recreation, etc. On the other hand, administrators have usually envisaged the unilateral use of water resources for single-use projects [1] such as transport, irrigation, energy production, waste

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disposal, etc. The growth of industrial activity and the perfection of new processes induced by population increase and growing common needs, has accelerated the depletion of resources [2] in both a quantitative and qualitative sense while posing important dangers to the quality of the environment [3].

At the same time, ever higher levels of education coupled with expressions of conscience and aspirations on the part of the public have obliged the planner to correctly evaluate public preferences [4]. A case in point is the elimination of conflicts between the use of water for recreation and the disposal of wastes. This attitude on the part of the planner results in society acquiring more varied and important advantages from the exploitation of its resources. It is a large challenge to confront and the planner must assure that his activities of resource exploitation are not limited to the production of material goods and services. Rather, they should take into account uses for recreation or aesthetic ends as well as those which embody the complete range of reasonable options. To attain these objectives, the planner must concretely introduce the concept of the quality of life [5], in its largest sense, to his evaluation process. As a result, he will no longer limit himself to examining the effects of economic growth but will take into account the wide range of economic, ecological and social aspects which can endanger the quality of life [6].

Nevertheless, the notion of the quality of life is difficult to approach because it depends on numerous factors that are apparently unlike in nature. Despite these problems, the quality of life concept merits sufficient time devoted to attempts at its definition.

Definition of the Quality of Life Concept

The concept of the quality of life is greatly idealized at present and many people identify with it during evaluations of environmental impact. Already widespread at the societal level, especially in spheres connected with the study of the environment, this concept differs not only with individual interpretation but, as well, with the spectrum of elements which may be included in its definition [7-9].

Rather than attempt to list all elements describing the quality of life, thereby taking into account each individual and the influence of his living space, it is preferable to define the concept in a dynamic and evolving fashion based on actual aspirations. With some exceptions, the majority of people associate the quality of life with standard of living [8]. That is to say that people, for different reasons, evaluate anything that can increase their well-being in terms of income.

Description of the Quality of Life Model

In western civilizations as it exists today, a model of the quality of life must come to be associated with the standard of living concept, rather than one of spiritual or psychic elevation. This dynamic, evolving model will thus rely on the former concept, pecuniary advantages. The six components of this model are:

- | | |
|----------------------------|---------------------|
| 1. survival of the species | 4. production |
| 2. well-being | 5. overproduction |
| 3. activities | 6. life constraints |

The quality of life model and its six integrated components are presented in Figure 1. The five components linked horizontally represent the evolving progression of the model whereby each component influences those which follow (uni-directional line from left to right). The dynamic aspect of the model may be perceived in two ways. The first, figuring within the evolving chain of components, retransmits the pulse of consumer society to the well-being component by the intermediary of the two final components. The second way is much more complex as it encompasses life constraints. This final component provides the self-regulation of the model. It can influence each of the components in the evolving chain with variable intensity, and each component may influence the nature of life constraints. This is the reason why no direction is assigned to lines connecting "life constraints" with the five other components of the model.

Represented beneath the quality of life model (Figure 1) is the influence of life constraints, each characterized by variable intensities. The predominance of each identified constraint is associated with its respective component, although its influence on other components is not negligible.

Survival of the species—The very first notion to confront a human being is his survival. The survival of the species represents the beginning stage of the quality of life model. This notion is fundamental to the point that certain activities related to the survival of an individual are independent of his will. First, the human being faces a need to find nourishment, shelter and a fixed point of reference in order to satisfy his goal of security. Second, man must reproduce to assure the continuance of the species. Certain fundamental needs may often be fulfilled by society. In North America, many of these needs, such as housing, nutrition and health care, are available with the help of a minimum income, even if this minimum income derives from income redistribution.

Well-being—Subsequently, the moment arrives when the individual acquires additional values to the basic ones cited above. Not only does he think of basic nourishment, but he develops a certain pleasure relative to the quantity and quality of his food. He competes to obtain the most comfortable habitation possible [8]. The pecuniary advantages, marginal benefits and new physical and psychological needs contribute to the passage from a subsistence state to one of well-being. The boundary between these two states is difficult to determine in space and time. The concept of well-being, while it remains very broad and very personal, varies in intensity and the elements comprising this concept differ from one individual to another.

Activity—From this state of well-being a function of each individual, springs a wide range of activity dependent in nature upon the social status of each person.

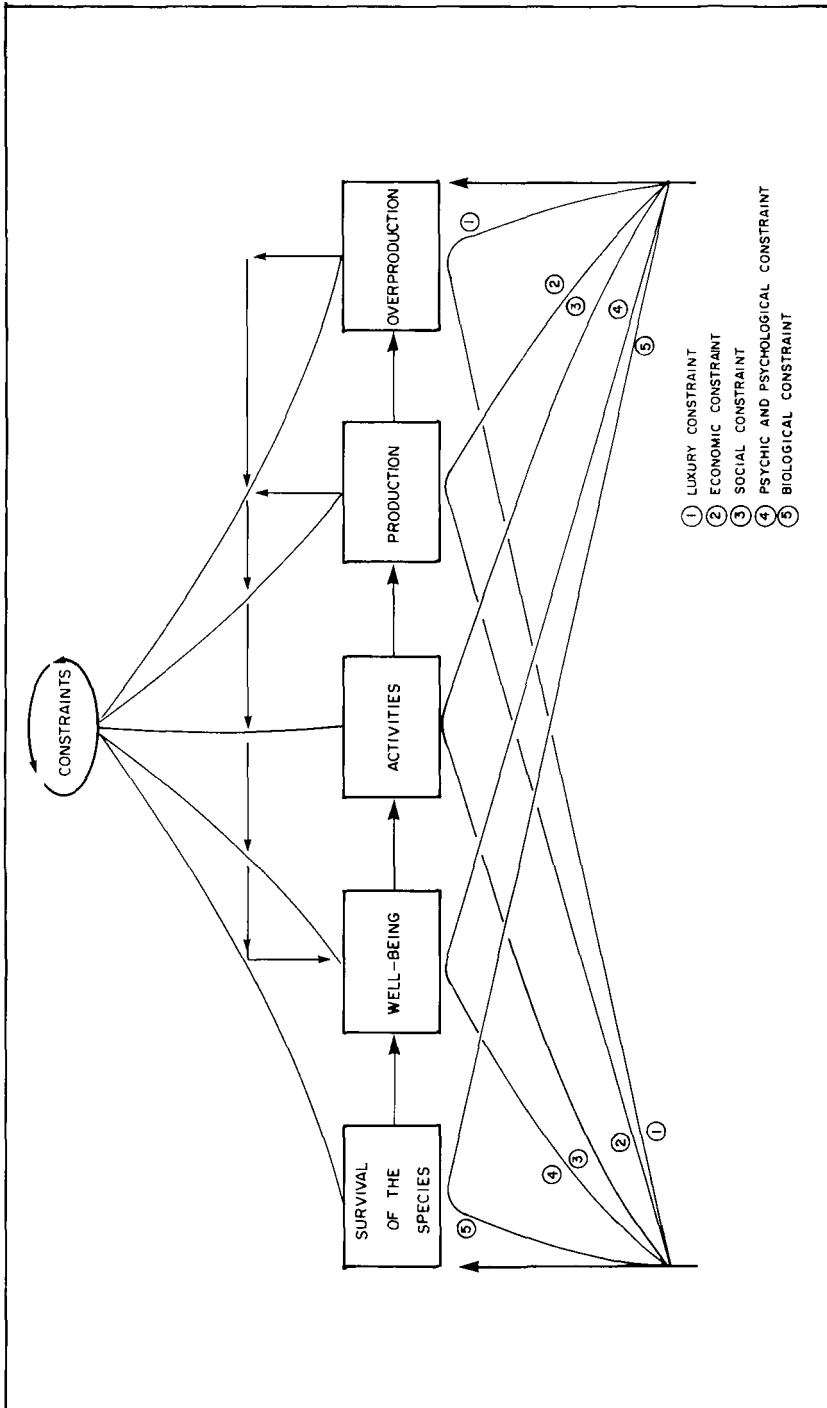


Figure 1. Illustration of the influence of constraints on the quality of life model.

In conserving his well-being, man carries on other activities related to elements contained in this concept. The phenomenon to supplementary activities deriving from a certain acquired state of well-being constitutes the third element of the evolving quality of life model. These activities can be of any order: physical, mental, social, etc. [10, 11].

Production—Like human activity, the production which results from these activities is of all types. With its concept of production, the model integrates the fact that Western man tends to associate monetary value with all production. The consumption of various good through human activity stimulates the production of goods and services, favoring by this very fact the internal workings of the economy. This type of production is associated in particular with recreational activities.

Overproduction—This element is the fifth stage of the model. It appears because man does not stop at the simpler aspects of production. By continuously producing more, certain types of goods and services become common values. These values can contribute to an increase of well-being by a retroactive phenomenon, by augmenting the inventory of goods and services available and by reducing their price. These goods and services thus become accessible to the majority of people.

The production of these goods and services expands collective horizons in the sense that each individual is offered an ever greater range of choice. However, at a given time, individuals are always subject to income constraints that limit the quantity, quality and types of goods and services which they can buy.

Constraint—Several different types of constraints can exist (biological, social, economic, psychological, luxury, etc.). Each of these constraints is tied to the five components of the quality of life model, subsequently influencing the components which follow. Equally, the constraints can provide feedback to all levels of the components by modifying their structure. Behind each of the five components, however, it appears possible to assign a dominant constraint:

Survival	Biological constraint
Well-being	Psychic and psychological constraint
Activity	Social constraint
Production	Economic constraint
Overproduction	Luxury constraint

Despite the marked dominance of one constraint over one component, it would not be illusory to envision interactions among the constraints which, as a consequence, can affect the diverse components with different intensities.

CASE STUDY: THE ESTABLISHMENT OF AN INTEGRATED FORESTRY COMPLEX

In order to make evident the potential impacts of an industrial development, the quality of life model is applied to repercussions on the economy and the aquatic environment that may be occasioned by the establishment and exploitation of an integrated forestry complex on the Chamouchouane River, Lake St. John, Québec, Canada.

Project Description

The establishment of this integrated forestry complex (Figure 2) includes the construction of a factory producing Kraft bleached pulp at an annual capacity of 262,000 tons (or 237,686 metric tons). It also involves major expansions of three sawmills recently acquired in the county by the Donohue Company, Ltd. The three sawmills will produce 135 million board-feet and will generate 548,000 tons (or 497,146 metric tons) of shavings that will represent 80 per cent of the provisions required by the pulp factory. The other 20 per cent will be provided by nearby sawmills [12]. The three sawmills acquired by Donohue Company, Ltd. are: Produits Forestiers M.P., at St-Thomas-de-Didyme; Scierie Normandin Limitée, with a cutting unit situated 19 kilometers from Girardville and a drying and planning operation situated outside Normandin; and the Scierie Chibougameau Lumber Ltd., located approximately 80 kilometers from St-Felicien, Lake St. John.

The factory will be supplied principally with black spruce (*Picea mariana*), gray pine (*Pinus banksiano*) and balsam fir (*Abies balsamea*) [13]. Cutting processes are of the clear-cut type. Except for watercourses less than ten feet wide, wooded streamside fringes will be preserved, their size varying according to the tributary.

Description of the Influenced Natural Habitat

The Chamouchouane River offers 52 miles (83.2 kilometers) of sites suitable for spawning by the endemic *Salmo salar ouananiche*. The River aux Saumons, a tributary of the Chamouchouane, offers 12 miles (18.2 kilometers), yet constitutes the principal site for reproduction [14]. The pulp factory is situated on the east bank of the Chamouchouane River approximately 15 miles (24 kilometers) from the mouth and 4 miles (6.4 kilometers) upstream from the town of St-Felicien. Forest interests of the Donohue Company, Ltd. are situated in large part within the watershed drained by the Chamouchouane River. Predictions of zones to be cut in the next twenty years have been made and are depicted in Figure 3.

From an environmental viewpoint, the presence of the integrated forestry complex on the banks of the Chamouchouane River will entail several consequences for the aquatic habitat, and will have repercussions on the survival

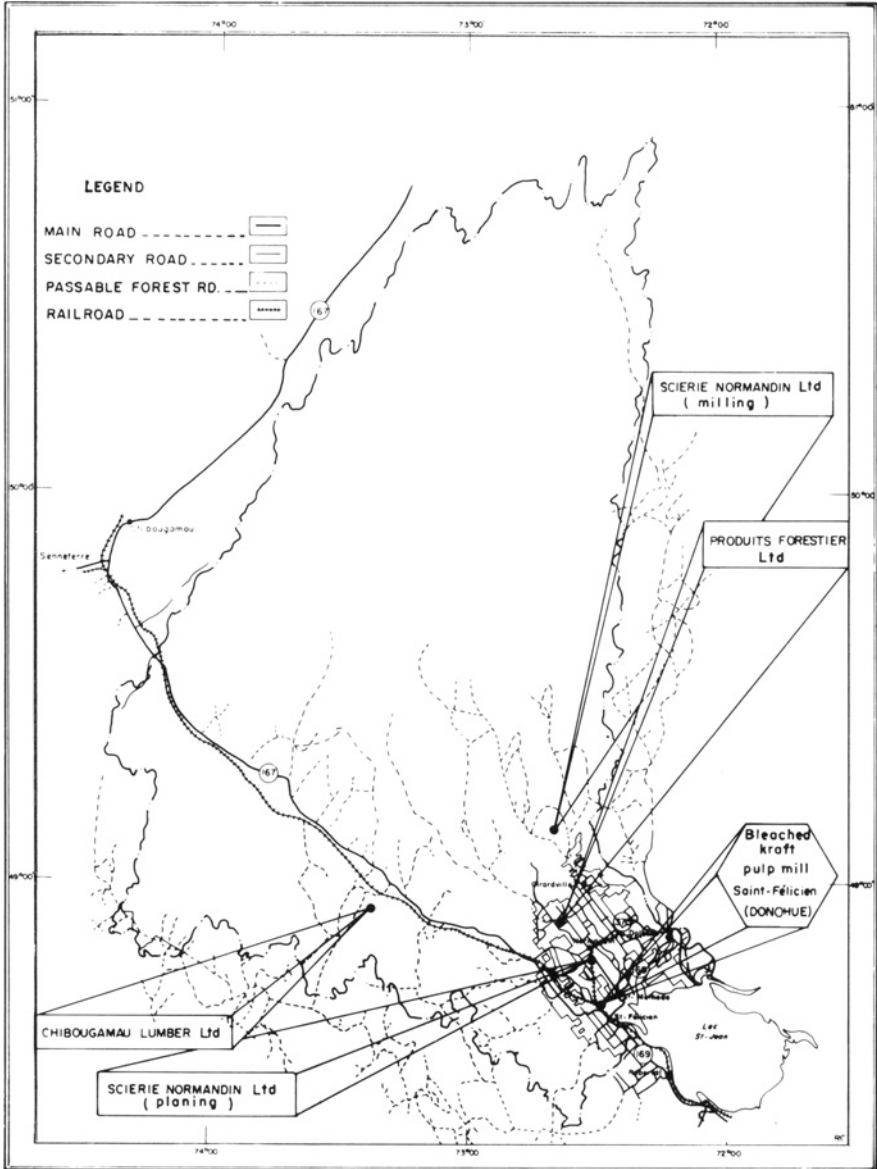


Figure 2. Location of the integrated forestry complex.

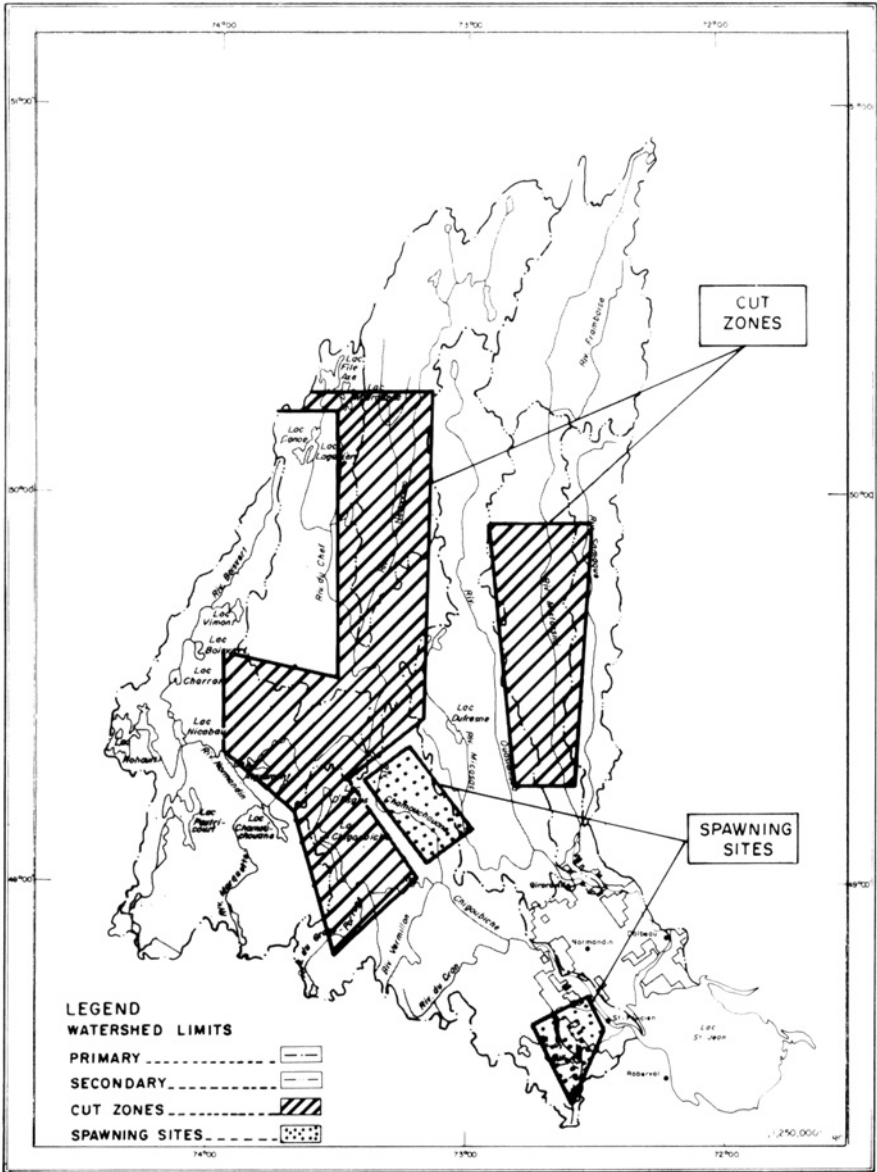


Figure 3. Location of cut zones and the spawning sites of *Salmo salar ouananiche*.

of an important resource, *Salmo salar ouananiche* [15, 16]. The *Salmo salar ouananiche* of the Lake St. John region, a freshwater salmon, is actively sought by numerous sport fisherman from Quebec and elsewhere. Moreover, it can reasonably be considered to constitute a resource unique to this region. There is little actual doubt that the ouananiche population of Lake St. John is in fact the sole future reserve for this species. There are approximately twenty lakes in Quebec with ouananiche present, however, Lake St. John remains the most suitable and the most prolific of lakes supporting ouananiche [17, 18].

Due to industrialization and general non-point degradation of surface waters, the ouananiche of Lake St. John no longer has access to lake tributaries of importance for reproduction. Studies performed by Lesage in this region have revealed certain biological cycles in this fish and the abundance of its population [19]. Evidence has been presented that the ouananiche follows an abundance cycle of seven years. In actual fact, even if access to tributaries should be very limited, the ouananiche population of Lake St. John maintains itself at an acceptable level.

The Chamouchouane River receives 80 per cent of all spawners [14]. According to Paulhus [20] and Lesage [19], ouananiche migrations from the lake to spawning sites, via the Chamouchouane River, occur from the beginning of July through the end of September. The majority of spawners are from the six-year-old age class.

The principal spawning areas of the ouananiche on the River aux Saumons will not be directly influenced by deforestation or Kraft wastes from the pulp mill. However, the ouananiche also ascends further upstream on the Chamouchouane River to reproduce. Indeed, several miles upstream from St-Felicien, important spawning sites are situated near areas of eventual timber removal (Figure 3).

Description of the Influenced Socio-Economic Environment

The population of Lake St. John West county totaled 57,074 in 1971 (year of more recent complete and available statistics). This group represented a little less than 1 per cent of the Quebec population. The demographic evolution of the county is represented in Figure 4, as well as its relative importance in time compared to that of the entire Quebec province. The urban population is located in a few small centers of approximately 10,000 inhabitants: Dolbeau, Mistassini, Roberval, St-Felicien.

Data from a study on unemployment undertaken by the Ministry of Labor and Manpower indicate that the unemployment rate grew to over 20 per cent of the active population of the county in 1976 [21]. From the standpoint of employment, this region is particularly disfavored; the average unemployment rate in Quebec, the same year, was 8 per cent.

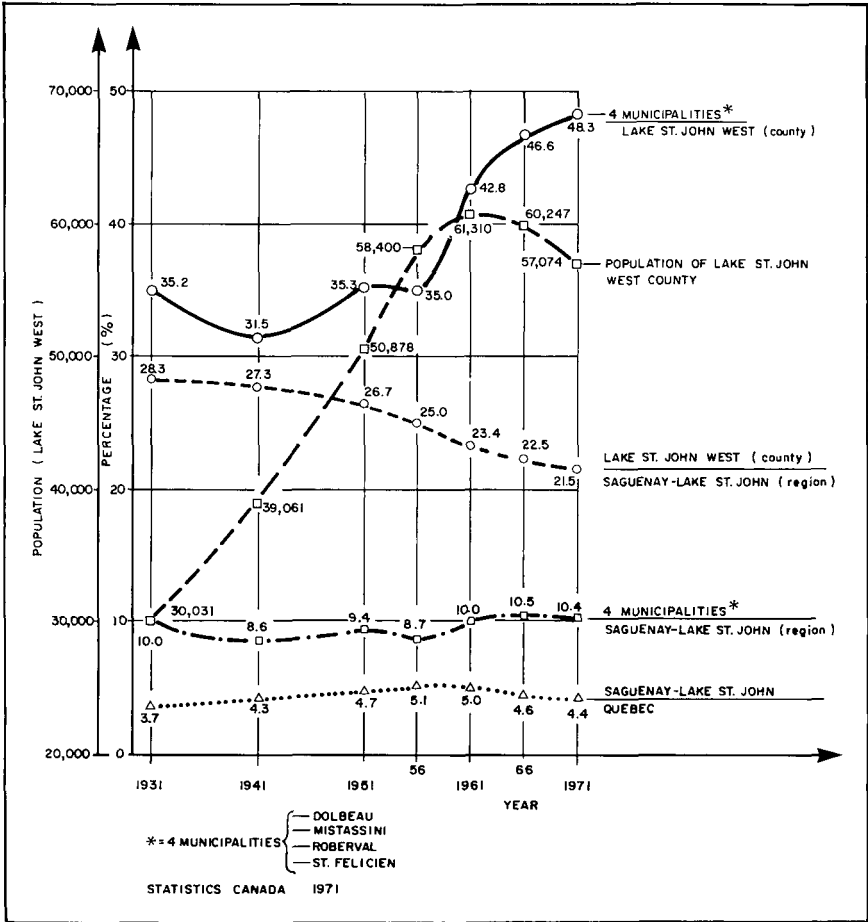


Figure 4. The evolution of population in Lake St. John West county and the importance of certain groups within the county, 1931-1971.

In this study region, 55.4 per cent of the population is employed in the tertiary sector, 22.8 per cent in the secondary sector, and 24.0 per cent in the primary sector. Primary activities involve agriculture and the extraction of raw materials, secondary activities include industrial manufacturing and construction, while tertiary activities comprise the service sector. Table 1 depicts the relative importance of each of these sectors within the study region.

From an educational standpoint, in 1971 approximately 33 per cent of the active regional population had not studied beyond grade 9, 44 per cent were high school graduates and 23 per cent had attended a college or university [22].

Table 1. Summary Table. Percentage Distribution of Sectors, Sub-Sectors and Major Groups as a Function of Principal Characteristics in the County and Region, 1961, 1971.

Characteristics Activity Sector	Lake St. John West county						Saguenay - Lake St. John region					
	Employment		Total Remuneration		Value of Production		Employment		Total Remuneration		Value of Production	
	61	71	61	71	61	71	61	71	61	71	61	71
Primary Sector	38.7	24.0	(63.3)	(29.7)	-	-	19.7	10.0	(20.7)	(9.9)	-	-
agriculture	14.9	10.7	(16.9)	(8.9)	4.4 ^a	4.1 ^a	8.0	5.0	6.0	3.6	1.8 ^a	1.6 ^a
forest	21.4	12.2	(46.4)	(20.8)	-	-	10.1	4.5	(14.7)	(6.3)	-	-
Secondary Sector	15.9	22.8	32.4	35.4	-	-	31.8	30.0	53.8	49.2	-	-
industrial	10.6	16.3	24.1	29.3	36.3	32.3	22.0	25.1	44.8	42.6	51.9	47.4
foods and beverages	-	-	-	-	-	-	-	2.0	-	2.4	-	6.2
wood	3.1	9.2	5.4	14.4	6.5	15.2	-	2.8	-	3.5	-	3.7
pulp and paper	-	-	-	-	-	-	-	6.0	-	11.7	-	10.8
primary metal	-	-	-	-	-	-	-	-	-	-	-	-
processing	-	-	-	-	-	-	-	12.3	-	22.5	-	24.6
construction	5.8	5.4	8.3	6.1	-	-	8.0	6.2	9.0	6.6	-	-
Tertiary Sector	47.3	55.4	50.7	55.7	-	-	52.0	59.2	40.3	47.1	-	-
private sector	15.7	(20.4)	18.8	(17.1)	59.5 ^a	(63.6) ^a	19.0	(20.7)	15.4	(16.3)	46.3 ^a	(51.0) ^a
detail sales	9.7	(12.3)	11.6	(10.3)	35.5 ^a	(38.2) ^a	12.0	(12.4)	9.6	(9.8)	28.7 ^a	(30.6) ^a
public sector	18.6	27.0	31.8	38.6	-	-	20.1	26.0	24.9	30.8	-	-
TOTAL			(\$'000)	(\$'000)	(\$'000)	(\$'000)			(\$'000)	(\$'000)	(\$'000)	(\$'000)
1961	14,618		21,516	109,181	22,436		61,327		154,546		690,492	196,169
1971	12,091		47,329	198,040	32,378		62,252		259,856		1,260,038	275,885

^a The value of product sold is indicated for this sub-sector of activity.

Source: Statistics Canada 1961 and 1971 [22]. Note: () = Estimated

APPLICATION OF THE MODEL

Following a detailed study of the ecological and socio-economic impacts of the establishment of the integrated forestry complex [23], nine principal indicators have been selected (Figure 5). Development of each of the indicators permits one to simultaneously perceive and catalogue the different effects of the project on the quality of life of individuals.

EXPLANATION OF RELATIONSHIPS BETWEEN INDICATORS AND THE QUALITY OF LIFE MODEL

Total Employment

Obtaining employment within the region increases an individual's state of well-being, permitting him to acquire new items and to reinforce his well-being. Establishment of the integrated forestry complex in the county will permit a greater use of local manpower. The vast experience of this manpower in forestry presents a supplementary advantage to bringing about the complex, especially since 16 per cent of unemployed workers registered at Canada Manpower Centers in the county in 1976 belonged to this occupational group [21].

The relative importance of this activity, even in a period of decline (a drop of slightly more than half of total employment has been documented between 1961 and 1971), is its effect as a show of force capable of maintaining a 12.2 per cent employment rate comparative to several other regions (Table 1). An explanation of this state of affairs is relatively simple. Lake St. John West county is known for its role as a large supplier of timber [24]. Several pulp and paper companies, and several sawmills, presently operate within the county without in fact transforming the resource in place [25]. A net flux in raw materials is thus found to exist between Lake St. John West county and other counties in the region.

The integrated forestry complex has been conceded a guaranteed annual cut, by the provincial government, of 610,000 cunits (each equal to 100 square feet) over a twenty-year period in Crown forest of the Roberval area [26]. Given that the three sawmills acquired by Donohue, Ltd., already cut 300,000 cunits annually, a calculated addition of 310,000 cunits must be considered. This level of productivity will be achieved by increasing the capacities of two of the sawmills. For this, activities related to the exploitation of forest resources will have to intensify. They will result in the direct creation of at least 590 new employment positions. The wooded area to be cut in the next twenty years are depicted in Figure 3. Moreover, 460 new direct employment opportunities are projected to result from the bleached Kraft pulpmill [27].

The integrated forestry complex will also generate significant indirect employment in residential and commercial construction. Equally, increased demand for public services (schools, health, municipal services, etc.) will produce

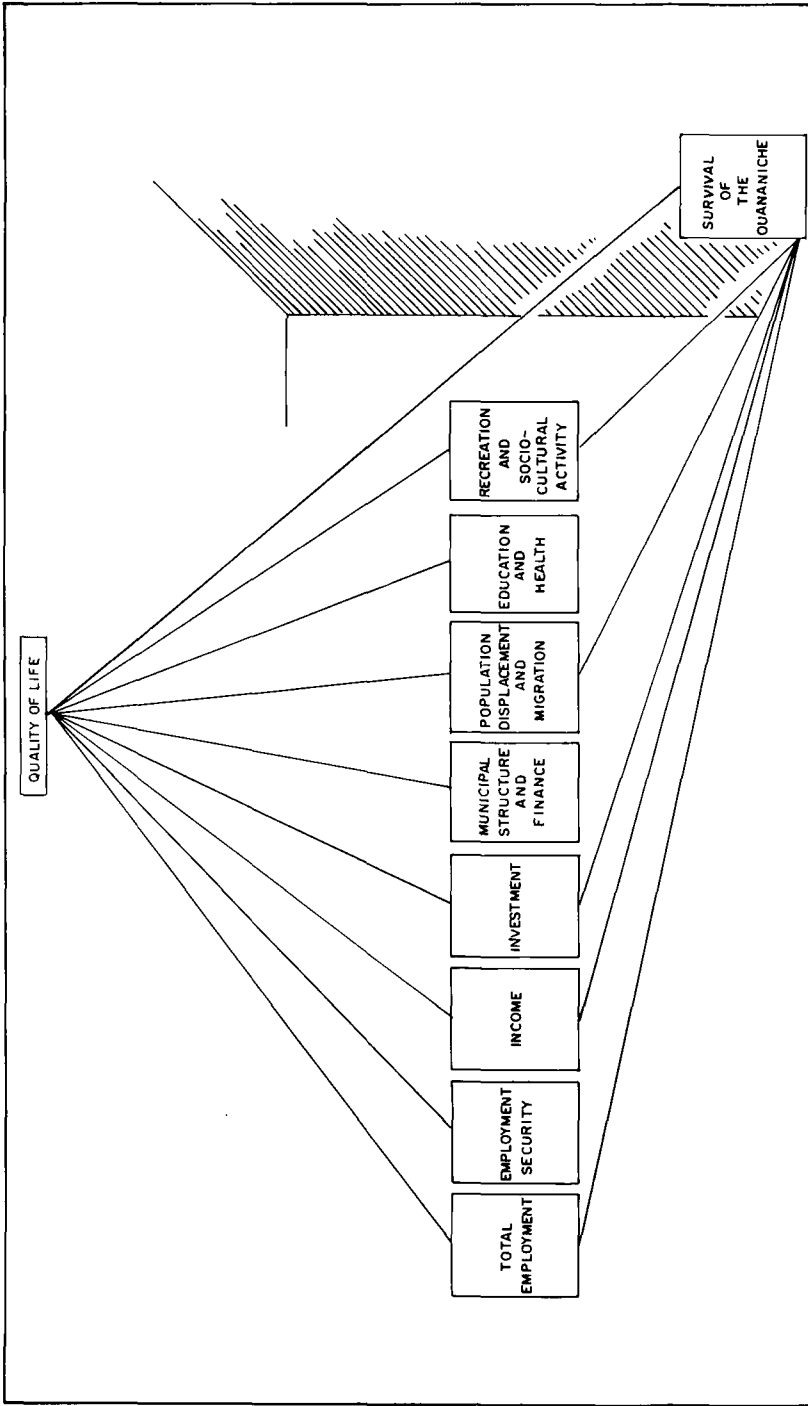


Figure 5. Relations between the superior levels of two sectorial graphs and the quality of life model.

new employment possibilities. Nevertheless, the number of new indirect positions will be relatively small. The study region already possesses an important service structure readily capable of responding to the majority of increased demand [28].

Employment Security

Employment security helps to diminish psychological stress in the individual. It is this aspect which lessens the dominating constraint associated with well-being. It helps to explain why today the obtention of work is no longer an end in itself. In addition, workers require a certain level of job security, the goal of which is to assure the future (guaranteed income), thereby permitting present consumption and investment. Employment security is a function of the type of work, the union (if any), the work force, actual unemployment, etc.

The integrated forestry complex will create a total of 1050 new direct positions in the manufacturing industry [27]. In comparison with the total amount of employment in the manufacturing industry in 1971, this represents 53.2 per cent. That is to say, positions created directly by the complex will increase by a little more than half total employment in manufacturing if all factors remain constant in the meantime.

Also, employment generated directly by the complex is in a very productive field of activity. The trades applied are generally specialized, favoring the appearance of a union which will defend favorable work conditions and good employment security. Finally, the project will not solely create employment by reinforcing the industrial structure; several existing employment positions will be consolidated. For example, the purchase of the three sawmills will consolidate the activities of 980 workers. Intraregional exchange with other industries will also effectively close certain positions.

Income

Like total employment, an augmentation of income betters the quality of life of an individual by developing his state of well-being. Total annual salary disbursed for new direct positions in the development project approaches \$10,815,000, representing 78 per cent of salaries paid in the manufacturing industry of the county in 1971 [27].

Investment

The investment aspect is related to the production in the quality of life model. The primary goal of investment is to augment production. Nevertheless, a negative feedback mechanism incorporated in the model demonstrates that adequate investments can improve the well-being of people. The action of investing may thus be taken, in its largest sense, to include sales. Purchasing a house figures as a sale, much like the purchase of corporate shares. On the other

hand, investment is associated with the creation of economic goods. The construction of residential housing is an investment in the same sense as the purchase of equipment used to transform raw materials.

The total gross investment made by Donohue Company, Ltd. and British Columbia Forest Product on this project (including subsidies from both federal and provincial government) should amount to \$300,000,000 [12]. To this investment must be added all other investments made possible in other industries (provoked by reinforcement of the industrial structure) as well as residential and commercial development.

Municipal Structure and Finance

The notion of structure represents the spatial and temporal organization of a community while finance refers to total revenues and expenses of the municipality.

The towns of Roberval and St-Felicien, considered as major service centers, impose upon each individual inhabitant a range of rules which must be respected. Regulations aimed at limiting the short-term production of goods and services are in reality a form of discrimination favoring the adoption of new orientations and new ways to increase production.

Population growth in the Roberval-St-Felicien region will require, at the municipal level, the development of an infrastructure contingent upon residential development (water and sewer works, road networks police and fire services, etc.). Development of this infrastructure would be very costly for the municipality however, required municipal finances will in part accrue from the establishment of the bleached Kraft pulp mill.

Populations Displacement and Migration

This indicator refers to two different aspects of population dynamics. The first, population displacement, essentially represents tourist movements while the second, migration, refers more specifically to the transfer of population to, from or within the county.

Whatever the reasons for population movements (tourist appeal, new employment), the goal, an improvement of well-being remains consistently the same. In most population movements there are cases where some individuals displace themselves temporarily in order to significantly increase their income. For certain others, such an income supplement would be considered over-production, the last component of the quality of life model. Even if these be isolated cases, such individuals can have considerable impact on the improvement of the quality of life in the county by acting directly on this last component of the model.

The locality of St-Felicien is projected to corner the majority of new arrivals, approximately 1000 persons, resulting from the establishment of the integrated forestry complex [23].

Education and Health

In the North American context, where the survival component can in large part be taken for granted, education and health exert more direct influences on human well-being. In this way they bring about a large variety of activities. It is for this reason that minimal conditions of schooling and health must be dispensed to the population with the goal of facilitating individual lives.

The reorientation of the population in response to the integrated forestry complex will occasion some modifications at the level of health and education. With respect to education, even if there should be no investment for the construction of new physical structures, increased demand for these services will result at first and must be filled in some way. From the point of view of health, the incorporation of heavy metals in aquatic food chains could affect the health of people in the region. It is known that the mill will release heavy metals, such as mercury, in small amounts. The possible accumulation of heavy metals in biota remains a danger to which the St-Felicien region is no less vulnerable. Moreover, given the diverse modifications possibly taking place in the aquatic habitat, water quality may be significantly affected [29, 30]. Problems of local eutrophication [31] and drinking water quality can compromise the health of regional inhabitants either temporarily or over the long-term. If long-term, problems of drinking water degradation may require water treatment or supplementary supplies from different municipalities of the region, and, particularly, St-Felicien.

Recreation and Socio-Cultural Life

In the measure that incomes grow and working conditions improve, people tend to transform their lifestyles by increasing the time devoted to leisure, thereby favoring recreational and socio-cultural activities [32]. Socio-cultural activities relate primarily to activities of a daily nature while recreational activities take place during weekends and vacations. For this reason, recreation and socio-cultural life are related to the "activity" component of the quality of life model.

Population increases in St-Felicien brought about by the integrated forestry complex will have socio-economic and environmental repercussions for leisure activities. In fact, socio-cultural and recreational activities will be the most affected. The redistribution of population provoked by the complex will significantly increase demand pressures. Depending on whether or not the capacity of these services is saturated, price, investment, the quality and quantity of service, etc., may be subject to modification. In a more localized fashion, the counteraction of erosion and other effects of the wood cut may require supplementary payments by residents of the banks of the Chamouchouane River. Moreover, changes in the physiography of the river may compromise future recreational developments (beaches, parks, campgrounds, etc.). In effect, the

supplementary costs entailed by serious modifications to the river may compromise the feasibility or profitability of future recreational areas.

Construction of the Kraft pulp mill approximately 16 kilometers from the mouth of the Chamouchouane River will modify water quality to the point of limiting the development of several future recreational sites. On the other hand, the attraction of the ouananiche in the Saguenay-Lake St. John region remains popularly embedded in the memory of man. Given the case that this species' survival were endangered, considerable deprivation would be experienced by people of the region and outside that could no longer practice their sport (fishing and naturalist activities). In the event this should occur, a detectable modification in the utility of certain recreational facilities would take place.

Survival of *Salmo salar ouananiche*

In a given region, the survival of a fish species such as *Salmo salar ouananiche* is one element behind the concept of the quality of environment. In recognition of the importance of the disappearance of a species and the importance of the quality of habitat in the quality of life concept, the survival of the ouananiche is linked to the improvement of well-being. Nevertheless, this element surpasses a purely regional context and can be related to a much wider geographical area.

The integrated forestry complex of St-Felicien will produce two major effects on habitat. On one hand, the pulp mill will operate with the Kraft process, which is recognized to be one of the more polluting of the available technologies [29]. More specifically, the wastes are accompanied by a strong BOD (organic wastes), considerable dissolved and suspended matter, and diverse toxic substances [33, 34].

On the other hand, through a complex process, the wood cuts will have consequences that impact on fish life. In fact, several researchers have already demonstrated the importance of this activity on habitat. Effects on fish are caused on one hand by forestry activities, such as the construction of access roads and the machinery used, and on the other by climatic changes. Problems of erosion related to excessive surface runoff will result [35, 36].

Numerous toxic substances are discharged by the Kraft process into the ambient habitat. The most important are the resinous acids, fatty acids and sulfur compounds, particularly the mercaptans. According to B.C. Research [37], 30 per cent of the total toxicity of Kraft pulp and paper effluents will be due to resinous acids and various products of their saponification. Seppovaara and Hynninen attribute the toxicity of these discharges to diverse sulfur constituents (mercaptans and methylmercaptans) [38].

Numerous studies have documented the sub-lethal effects of Kraft effluents on the salmonids (Table 2). Respiratory, reproductive, circulatory and endocrine systems are all affected. Also noted are modifications in metabolism, growth, behavior, and, finally, the odor and taste of the fish flesh.

Table 2. Sub-Lethal Effects of Kraft Components on Salmonids

<i>Biological Systems</i>	<i>Specific Effects</i>	<i>References</i>
Respiration	elevated coughing frequency	39, 40
	increased respiratory volume	40
	increased oxygen demand	40
Reproduction	reduced fertility and egg production	41
Circulatory System	lowered arterial pressure	40
	quantitative change in blood cells	42, 43
Metabolism	varied glucose, glycogen and lactate levels	42, 43
	reduced swimming ability	
Growth	reduced growth rate	44, 45
	reduced efficiency of nutritional conversion	46, 44
	augmented growth rate	47, 48, 49
Behavior	altered feeding behavior	47
	sluggishness	47
	depressed response to danger	45
	altered orientation	45
	avoidance reaction	50
Taste and Odor	altered taste and odor of flesh	51
Endocrinology	increased mucous secretion	39
	augmented cortisol level	52

Following an evaluation of potential sub-lethal effects, evidence has been presented that the avoidance of effluents (a behavioral effect) will be the most likely response of the ouananiche of Lake St. John. Extremely minimal dilutions of 1:115 will occasionally occur during the summer dry season when the ouananiche migration is just beginning [23]. On the other hand, according to the data collected, avoidance problems may take place at dilutions less than 1:165.

It must be noted that this effect may be one of the most important in the actual context. It can only be affirmed that other sub-lethal effects of a physiological nature will also occur. Nevertheless, there is a risk that the ouananiche will refuse to migrate in the Chamouchouane River. Consequently, even if the species should remain in "good health" within the lake, it may be unable to reproduce and may thus be threatened with extinction.

CONCLUSIONS

1. A review of the literature has demonstrated the notion of the quality of life is difficult to define because it depends on numerous factors apparently unlike in nature. Consequently, several definitions of the quality of life are to be found in the available literature. This study proposes a definition of the concept that is dynamic and evolving in time, and is based on actual aspirations.
2. The model proposed is both conceptual and descriptive. It is formed of six components: survival of the species, well-being, activities, production, overproduction, and life constraints.
3. The model has been shown to be useful for the identification of indicators and fields of activity for which the indicators are necessary, as a function of the principal objective: an improvement of the quality of life.
4. The descriptive model is applied to the socio-economic and environmental repercussions caused by the establishment of an integrated forestry complex in the watershed of the Chamouchouane River. The nine indicators chosen are: total employment, employment security, income, investment, municipal structure and finance, population displacement and migration, education and health, recreation and socio-cultural activity, and survival of the *Salmo salar ouananiche*.
5. Application of the quality of life model demonstrates the intimate relationship between water quality in the Chamouchouane River and the health, recreation and socio-cultural activities of the population of the watershed.

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