small political group, to make major development decisions in terms of iver.
of key Federal-Provincial agencies which would deal with conflicts and to (1).
government agencies and public interest groups which would provide tudy groups on the river estuary.

Ottawa River.—In late 1978 the Federal Environment Minister along with the Environment Ministers from the provinces of Quebec and Ontario agreed to establish a new technical committee on the Ottawa River. The committee was to study problems related to toxic substances and recommend solutions, identify quantities and spread of nutrients, evaluate the importance of agricultural sources of phosphorus, and advise the Ministers on other water quality matters. The report from the committee is expected by the end of 1979.

UNITED STATES OF AMERICA

From Mr. Joseph C. Lawler, BS, MS, DEng *(Fellow)*, Boston, Mass.

Disposal of hazardous wastes is now, belatedly, recognized as a major problem in the United States. The Environmental Protection Agency estimates that 35 million tons of such wastes are produced annually in the USA. The initial list identifies 158 wastes classified as hazardous because of toxicity, chemical reactivity, combustibility, or corrosiveness, and many more are expected to be added.

The seriousness of the problem was brought forcibly to public attention by the so-called Love Canal situation at Niagara Falls, New York. A 16 acre site adjacent to the canal, used as a burying ground for chemical wastes between 1947 and 1952, was given to the city by its chemical company owners in 1953, together with a warning of its previous history. The city built an elementary school and 225 low-cost dwellings on it. Upward migration of the soluble buried wastes contaminated surface areas and by 1976 they were seriously affecting the health of the residents, particularly the children. In 1978, Public Health authorities recommended that pregnant women and children under two years of age should move out of the area. Property values dropped sharply and the development is now partially abandoned. An Environmental Protection Agency investigation found 82 separate chemicals in various concentrations in the air and in the soil of the site.

The Agency has now proposed comprehensive rules to ensure safe disposal of this mass of material "from the cradle to the grave". The projected regulations stipulate safe transportation practices from the point of origin to EPA-approved disposal sites. The sites themselves would be required to be lined with clay, plastic sheeting, or other impervious materials, and once closed would be quarantined, monitored, and maintained for a minimum of 20 years thereafter. The cost of the proposed regulations to industry is estimated at $750 million annually, or about $21 a ton. The problem of locating suitable sites and overcoming local objections to their activation has been only partly addressed.

Contamination of groundwater supplies by sodium and calcium chlorides used for highway de-icing in the northern tier of states is also receiving more attention. Large quantities of these materials are used by highway departments during the winter at rates ranging from 15 to 50 tons per mile of paved highway during the season, the amount depending on local conditions. Analysis of water samples in some areas has shown more or less serious chloride contamination of wells and farm ponds adjacent to highways in country districts, and roadside soil samples have shown sodium concentrations deleterious to vegetation. Environmentally undesirable chloride concentrations have been found in small streams, but no significant amounts have been detected in the rivers. Highway maintenance organizations are being urged to minimize salt usage, and authorities suggest that any new wells should be constructed as far from roadsides as may be done conveniently. The situation is not presently considered serious enough to warrant stronger action.

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FACTORS INFLUENCING DOMESTIC WATER USE IN DEVELOPING COUNTRIES, WITH REFERENCE TO ELOBEID, SUDAN

By Sharaf Eldin Ibrahim Bannaga, BSc, MSc, PhD, MSES*

INTRODUCTION

An adequate, safe, water supply is a primary factor in the well-being and economic progress of a community. Water is essential to the functioning of a developed society and is a major factor in matters of personal convenience. The progress in every-day comfort brought about by a safe and accessible water supply is of a truly revolutionary nature in most developing countries.

The provision of adequate water supplies for the population of the Third World has been a recurring theme of recent United Nations gatherings. Conferences on the Environment at Stockholm in 1972, Habitat at Vancouver in 1976, and on Water at Mar del Plata in 1977, stressed that provision of safe water to the house should be the greatest public necessity throughout the world.

The World Bank, the International Development Bank (IDB), and the Agency for International Development (AID) have shown considerable interest in the quantitative relationship between economic development and the demand for a domestic water supply. Pineo and Subrahmanya[1] have shown how the water supply in developing countries is related to their economic level as measured by gross national products (GNP) per capita. Countries with less than about $110 GNP per capita generally leave a large proportion of their populations unserved. No country with a GNP per capita of over $500 has less than 50 per cent of its population served.

However, there is only a limited amount of literature on the studies and analyses of the provision of water in developing countries, in particular on the interelation between the effect of adequate water services on the health and well-being of the people, and the extent to which sufficient demand for the provision of these services is inhibited by social, economic, and environmental factors. There have been two studies of the subject, one carried out by Lee[2] in India and the other by White et al.[3] in East Africa. At present, in industrial countries, water and waste schemes are generally based either on the existing provision with an annual percentage growth factor, or on current design criteria. Neither of these bases is satisfactory.

THE ELOBEID WATER STUDY

With these ideas in mind the opportunity was taken during a water study at Elobeid in the Sudan, to try to find out just what connection there is between the amount of water used and the living conditions of the people using it. The study also considered a variety of other matters concerned with the present and future water supplies of the area.

Elobeid is a town of some 140 000 inhabitants in western Sudan. It lies 320 km to the south-west of Khartoum across semi-desert which extends round Elobeid in all directions. Annual rainfall is low: in some years only about 100 mm falls during a short season of high intensity precipitation. With maximum daytime temperature up to 40°C losses by evaporation are high.

Housing in the municipality is divided into four classes depending on the plot size. Buildings in the first and second class areas are of good quality, and water is provided by

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house connections from the public supply. The medium-density third class areas are sub-divided into three groups:

(1) class 3A have piped water to the compounds;
(2) class 3B have mixed supplies; and
(3) class 3C rely on public standpipes.

The fourth class areas are congested with the majority of the houses of substandard or temporary construction, mostly with mud walls. Their inhabitants rely on public standpipes, unprotected local sources; or water vendors. In the municipality as a whole only 41 per cent of the houses have piped water connections.

To relate the living conditions to water consumption, a total of 235 households were selected as representative of the different types of household in the town. Questions were prepared for obtaining data by household interviews, and return visits were made to ascertain significant changes in the household. Data about the accessibility of water and the age, education, occupation, and other personal details of members of the household were noted during the first visit, together with information to give an indication of the standard of living. For households with piped connections, the actual consumption was obtained from meter readings. For other households the number of tins of water brought every day was used to estimate the consumption. By studying the parameters which cause variation in water use between the dwelling units, it was hoped to:

(*a*) discover the extent of uniformity in water use within the study sample;
(*b*) investigate differences in water use, by special group classification;
(*c*) discover those factors which are best correlated to water consumption;
(*d*) estimate the present water demand and project the increase in demand in future; and
(*e*) predict the consumption of a household for charging of revenue if meter systems are not installed.

The basic data on water use are displayed in Table I.

TABLE I. Per Capita Consumption in l/person/day

Area	Winter consumption	Summer consumption	Rainy season consumption	Average consumption
First class	237	289	185	242
Second class	82	117	84	95
3 A class				
Petrol	52	70	52	58
Elguba	60	82	63	68
Quarters	61	79	58	66
3 B class				
Falusteen	42	43	41	42
Elradeef	47	42	35	41
Elmayrum	45	54	46	48
Fellata 3	19	15	18	17
3 C class				
Elnazir	—	16	20	18
Radeef extension	—	19	24	22
Elashara	27	23	27	26
Mayrum extension	—	17	18	18
4 class				
Fellata 4	—	15	17	16
Zindia	—	13	14	14
Kareima	—	17	21	19

RESULTS OF THE STUDY

The main parameters studied included; accessibility of water, standard of living, income, water-using habits, and some demographic characteristics. The role of these factors is examined by reviewing their association with the volume of water used among all dwellings, then separately among those with piped supplies and those without piped supplies. The relationship between the parameters investigated and household water use, was examined with the aid of a computer (SPSS). The data were analysed first by Pearson correlation and the chi-square and contingency tests, in order to review the relation of the parameters to water consumption (Table II). Further tests were carried out using partial and multiple correlations to reveal the distinctive relationship of the parameters to water use, since a considerable amount of interdependance between most variables was noted (Table III).

The partial and multiple correlations for various combinations of factors for all households are given in Table IV. After removing the effect of variation produced by the interdependance of the variables, the most influential factors (according to Table IV) are, in descending order:

TABLE II. Correlation of Per Capita Consumption and Aspects of the Living Environment

Variable	Pearson correlation			Chi-square test		Contingency coefficient
	Pearson coefficient *r*	*N*	Sig.	Chi-square χ^2	*DF*	*C*
Accessibility of water						
All cases	0.8519	235	0.001	448.65210	168	0.8100
Cases with 0-6 outlets	0.8132	195	0.001	311.8830	100	0.7841
Cases with 4-12 outlets	0.3434	40	0.001	40.58889	48	0.7069
Standard of living						
All cases	0.8355	235	0.001	572.07997	280	0.89192
Trees and garden watering						
All cases	0.7861	235	0.001	438.89298	112	0.80702
First and second classes	0.7895	102	0.001	183.48702	96	0.80170
Cost per litre						
All cases	−0.6284	202	0.001	229.05627	84	0.72896
Level of education						
Classes 3A to 4	0.6239	195	0.001	99.87007	80	0.845
Classes 1 and 2	0.2491	40	0.001	292.03931	150	0.77435
Toilet flushing						
Clases 1, 2, and 3A	0.5437	102	0.001	74.69592	48	0.65018
Car washing						
Clases 1, 2, and 3A	0.4626	102	0.001	57.00443	48	0.59876
Animal watering						
Classes 3C and 4	0.3789	87	0.001	55.05838	24	0.62256
Household size						
All households	−0.2628	235	0.001	129.19303	112	0.59560
Children percentage						
All households	−0.1824	235	0.003	164.30325	140	0.64146

TABLE III. Correlation Matrix of Some Variables Constituting the Multiple Correlation Models

	Household size	Accessibility of water	Standard of living	Percentage children	Level of education	Income per person	Trees and garden watering
	1	2	3	4	5	6	7
1	1.0000						
2	0.2470	1.0000					
3	−0.1915	0.3505	1.000				
4	0.1854	0.1105	0.0403	1.0000			
5	0.0722	0.1170	0.0998	0.1582	1.0000		
6	−0.1347	0.2093	0.4711	−0.3571	0.3885	1.0000	
7	−0.0748	0.4167	0.0873	0.0910	−0.0291	0.0641	1.0000

(i) **Trees and garden watering (Partial coefficient 0.4489 Significance 0.001)**

This parameter appears to be the most significant. In dry seasons garden watering uses a large amount of water. Also, during hot periods lawn sprinkling is practised in many places in the Sudan. Households with gardens obviously use more water per capita than those without them. If the per capita consumption is calculated for the dry season only, the variation of water use with regard to trees and garden watering may overshadow the other variations. It is of interest to note that tree planting is encouraged in Elobeid despite the acute shortage of water during the dry season. Residential areas compete in tree planting and prizes are given in annual festivals.

(ii) **Standard of living (Partial coefficient 0.3973 Significance 0.001)**

The results show that the standard of living is strongly associated with water use. The standard of living is primarily a measure of the household wealth. In this sense it is the assessed valuation of the owned house and cars, employment of domestic servants, the ownership of tools and equipment, etc. The use of some of this equipment is associated with habits of water withdrawal. Houses with separate kitchens and bathrooms are encouraged to use more water; rooms with plaster floors need more water for washing; and large and spacious houses need more water for cleaning, etc. The importance of the standard of living in influencing water consumption acords with the hypothesis that the need for domestic water supply varies with the level of economic development. This is discussed above where countries with high level of GNP per capita are said to use more water for domestic and industrial purposes.

TABLE IV. Partial and Multiple Correlations of Per Capita Consumption and Aspects of the Living Environment for All Residences

Variable	Partial correlation		Variables	Multiple correlation		
	Partial coefficient	Significance		Multiple R	B	F
Trees and garden watering	0.4489	0.001	Percentage children	0.17124	−0.30520	2.104
Standard of living	0.3973	0.001	Accessibility	0.84457	1.34554	21.289
Household size	−0.2778	0.001	Standard of living	0.88121	0.56979	14.268
Accessibility	0.2188	0.001	Trees and garden watering	0.90866	2.29218	44.768
Cost per litre	−0.1951	0.003	Cost per litre	0.91336	−1.59351	9.649
Percentage children	−0.1630	0.011	Level of education	0.91549	0.42896	4.866
Level of education	0.1469	0.020	Toilet flushing	0.91566	0.59486	0.713
Car washing	0.1264	0.038	Car washing	0.91740	1.64787	4.346
Animal watering	0.0611	0.197	Animal watering	0.91777	0.43085	1.020
Toilet flushing	0.0212	0.384	Household size	0.92307	−1.06634	12.592
			Constant		8.92005	

R square = 0.85206
coefficient of variation ≃ 16%

MS regression = 1083.343 with 10 as DF
MS residual = 9.848 with 191 as DF
Standard error = 3.13820

Multiple R = 0.92307
Significant at F = 110.003

(iii) **Household size (Partial coefficient 0.2778 Significance 0.001)**

The household size appears to be one of the important parameters affecting water consumption. It is inversely related to water use. It is thought that because some water-using activities like washing of cooking utensils, cleaning of toilets, watering of gardens and animals are shared, the greater the number of household population the smaller the per capita withdrawal. It is also likely that a large household population reduces the accessibility of the occupants to water, and hence decreases the per capita consumption.

(iv) **Accessibility (Partial coefficient 0.2188 Significance 0.001)**

Here the number of outlets are used as an index for measuring accessibility of water. Those who are obliged to carry water, or buy it from vendors, have no outlets because water is not supplied to their houses. The correlation coefficient indicates that making water accessible is accompanied by a significant increase in water consumption. The possession of more multiple plumbing facilities than are needed does not lead to the same high levels of increased consumption. This is noted when only the first and second class areas are considered. However, the variation in water use is distinct between those consumers who depend on public taps and those with individual house connections. In areas served by public taps, the distance of the standpipes from the houses of those who cannot afford to buy water from vendors affects the volume of water they carry. The longer the distance carried, the less water would be consumed.

(v) **Cost per litre (Partial coefficient −0.1951 Significance 0.003)**

Unlike other commodities, water pricing in Elobeid varies between areas inside the town. This is because water is only cheap where it is accessible. Thus, the basic charge for a cubic metre of water in areas served with piped supply is 5 piastres (7p) and in areas where water is brought from vendors the cost of a 4 gal tin varies from 1.5 to 3 piastres. The partial correlation indicated that a negative relationship exists between water consumption and cost of water where a downward trend in water use is linked with an increase in water cost.

(vi) **Children as percentage of household (Partial coefficient −0.1630 Significance 0.011)**

The number of children in a household does not influence water consumption as much as the factors noted above, but it correlates inversely to water use. It seems reasonable to assume that a large number of children reduces the level of per capita consumption. This is because children are thought to require less water than adults.

(vii) **Level of education (Partial coefficient 0.1469 Significance 0.02)**

The level of education seems to be closely related to water use, particularly in areas where people carry water. This may be because basic education in these areas is helpful: where teachers emphasize personal hygiene and cleanliness, and inspect children's clothes, appreciation of sanitary benefits and hence, water consumption increases. Also, older children and adults who have graduated from advanced schools are of better occupational status and consequently they are in contact with colleagues who live in areas with better conditions. It follows that basic education which exposes the person to health and social teaching is closely linked with per capita consumption.

(viii) **Other water-using habits (car washing, toilet-flushing, animal watering)**

The results suggest that car washing influences water consumption. The other parameters, toilet flushing and animal watering, are weakly linked with water use. It should be emphasized that tree and garden watering is also a water-using habit but since it is highly significant, it is listed separately.

The results of the multiple regression shown in Table IV help in estimating the dependent variable, which is the per capita consumption, when only the aspects of the environmental conditions (independent variables forming the model) are known. The regression analysis explains the normal change in the corresponding independent variable for regions that have the same value for the other independent variables taken separately. The multiple correlation coefficient is used as a measure of predictability. In the table the multiple *R* is 0.92307 (significant at the 1 per cent level). A coefficient of determination as high as 0.85206 is sufficiently large to promise high predictability. This is perhaps because the interdependence between the variables is not strong enough to offset the predictability of the model. The coefficient of variation is about 16 per cent. It should be noted that the first four variables are the main determinant of the per capita consumption (i.e. tree and garden watering, standard of living, household size, and accessibility explain most of the variation in consumption).

The last three variables (car washing, animal watering, and toilet flushing) add little to the predictability of the model. These results strengthen the conclusion that the demand for water for domestic consumption is strongly associated with the social, economic, and demographic characteristics of the living environment that prevails in each dwelling.

The small part of the variation which remains undetermined by the independent variables employed, may be due to differences in income, religion, and, of course water pressure. Other differences in attitudes or personalities which are difficult to analyse may also have their effects.

No further improvement in the model is gained when the households using piped water are separated from those carrying water. Table V shows that the multiple coefficient is 0.87793 and that trees and garden watering remains the most significant variable in determining the per capita consumption (Partial coefficient 0.5090, significance 0.001). It is also the most significant constituent of the multiple correlation. In areas served by piped water where the cost of water per litre is nearly the same at different localities, the annual income per person as a parameter is closely related to the level of water use. The level of education, the household size, and the standard of living are also closely linked to the level of water use (coefficient 0.2016, −0.1865, and 0.1849, respectively) and their relationship with water consumption is significant at less than 4 per cent. However, car washing and toilet flushing

TABLE V. PARTIAL AND MULTIPLE CORRELATIONS OF PER CAPITA CONSUMPTION AND ASPECTS OF THE LIVING ENVIRONMENT FOR RESIDENCES WITH PIPED SUPPLIES

Variables	Partial correlation		Variables	Multiple correlation		
	Partial coefficient	Significance		Multiple R	B	F
Trees and garden watering	0.5090	0.001	Percentage children	0.10768	−0.19297	0.331
Annual income	0.2930	0.002	Annual income	0.71248	0.53015	4.424
Level of education	0.2016	0.024	Standard of living	0.75229	0.39776	2.239
Household size	−0.1865	0.034	Trees and garden watering	0.85873	2.22700	28.222
Standard of living	0.1849	0.035	Cost per litre	0.86023	−0.96937	0.662
Car washing	0.1746	0.044	Level of education	0.86621	0.68491	3.756
Toilet flushing	0.1540	0.066	Toilet flushing	0.87029	0.31758	0.156
Cost per litre	0.0987	0.168	Car washing	0.87250	1.14095	1.735
Accessibility	0.0782	0.223	Accessibility	0.87282	0.41885	1.010
Percentage children	−0.0407	0.346	Household size	0.87793	−0.82983	3.552
			Constant		2.41851	

R square ≈ 0.77076 | coefficient of variation ≃ 22%
MS regression = 349.05988 with 10 as DF | MS residual ≈ 11.40831 with 91 as DF | Standard error = 3.377762
Multiple R = 0.87793 | Significant at F = 30.59699

seem to be strongly associated with water consumption among those receiving piped water.

The cost per litre, accessibility measured in the number of outlets, and percentage of children in households, show weak relationships with water use. They also show no significance in the constituents of the multiple correlation. This may be because the cost per litre is almost the same throughout this section of the town. Also, since water is piped into houses, the possession of multiple plumbing facilities may not necessarily lead to increased level of water consumption. The coefficient of determination is 77 per cent leaving 23 per cent of the variation in per capita consumption unexplained. The unexplained variation must undoubtedly be caused by differences in water pressure, which varies from area to area, and the rationing of water during periods of shortage.

The model constructed to enquire into the nature of the per capita consumption in areas using standpipes is presented in Table VI. The outstanding feature of the correlation analysis is the omission of the accessibility of water, since water is not piped into houses, and the omission of those factors like tree and garden watering, car washing, and toilet flushing which are not prevalent in these localities.

The standard of living, animal watering, and the distance of the house from the standpipe (shown in Table V) are distinctly related to water consumption (coefficient 0.4157, 0.4038, and 0.3054, respectively) and their association with water consumption is significant at less than 2 per cent level. They also represent the major constituents of the regression model. The distance of the house from the water source, is used in the model as a partial expression of the accessibility of water. The longer the distance of the house from the standpipes the more inaccessible the water. The level of education, as a variable, appears to influence water use, and its relationship with the level of consumption is significant at the 9 per cent level (coefficient = 0.1918). The cost per litre seems to be negatively linked with water. The income and the demographic characteristics of households in areas without pipe connections tend to have little relationship to consumption. However, the price elasticities are greater than the income elasticities. It is not surprising to note the poor relationship between water use and household size. Consumption in these localities is so minimal that it may not be

TABLE VI. PARTIAL AND MULTIPLE CORRELATION OF PER CAPITA CONSUMPTION AND ASPECTS OF THE LIVING ENVIRONMENT FOR RESIDENCES WITH PUBLIC SUPPLIES

Variables	Partial correlation		Variables	Multiple correlation		
	Partial coefficient	Significance		Multiple R	B	F
Standard of living	0.4157	0.001	Percentage children	0.25133	0.04965	0.058
Animal watering	0.4038	0.001	Annual income	0.48900	0.05059	0.138
Distance of house from standpipes	−0.3054	0.014	Standard of living	0.67752	0.55882	10.205
Level of education	0.1918	0.087	Cost per litre	0.68170	−0.31038	0.337
Cost per litre	−0.1077	0.224	Level of education	0.68607	0.29829	2.264
Percentage children	0.0409	0.387	Distances of house from standpipe	0.70057	−0.36960	5.386
Income	0.0364	0.399	Animal watering	0.75806	0.80306	9.233
Household size	0.0141	0.460	Household size	0.76033	0.18887	0.392
			Constant		4.96688	

R square = 0.57810
MS regression = 15.19300 with 8 as DF | MS residual = 1.84795 with 48 as DF
Multiple R = 0.76033 | Significant at F = 8.22154

influenced by the household size, since water is not accessible anyway.

The results of the multiple correlation suggest that the unexplained variation of the per capita consumption is too great. This may be caused by the difficulty of recording the accurate consumption of households. Others factors such as accessibility or the use of rain water during rainy seasons may have an effect. An attempt has been made to test the model developed for all residences and to check its stability. It shows that the conditions upon which the method of least squares fit (which forms the basis of the regression analysis) is based do not appear to be invalidated. Because these conditions are fulfilled, the results of the regression analyses described above are considered to be satisfactory. When the analyses are performed on 50 per cent of the cases taken at random, the correlation coefficients are affected slightly, e.g. the standard error (coefficient of variation) increases by 3.7 per cent. When the model from the first 50 per cent of the cases is used to predict the consumption of the remaining 50 per cent the coefficient of variation rises from 16 to 21 per cent. This margin of error, although not small, is acceptable. It follows that the predictability of the model is reasonable, and its stability could be accepted for the purpose of this report.

CONCLUSIONS

From the above discussions the factors affecting water consumption may be generalized into the following groups of characteristics:

(1) Water-using activities.
(2) Housing conditions.
(3) Accessibility of water.
(4) Price and income levels.

The water-using activities, i.e. watering trees and gardens, car-washing, watering animals, and flushing toilets when considered together appear to be the most significant group. The housing conditions, i.e. the standard of living, household size, and level of education, are the second important determinant of water consumption. The accessibility of water, i.e. the possession of piped connections, multiple plumbing facilities, and the distance of houses from standpipes, is the third significant group in water use prediction.

Earlier studies have shown that price and income affect water consumption, and this conclusion is reinforced by this latest investigation. Lee[2] has shown that the accessibility of water is the most significant factor in the level of water consumption. In Kalyani and New Delhi he recognized the quality of housing or the living environment as the most important single factor related to the level of water use. White et al.[3] considered that the total use of water was a function of the size of household i.e. the number of rooms or inhabitants, and the inverse of cost per litre and the equipment index as measured by water heaters.

The dependence of water consumption upon social, economic, and environment factors, described by this investigation, introduces new dimensions of complexity into the problems of designing efficient urban water systems in developing countries. These dimensions are generally not considered in the engineering and utility management literature.

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LAND DRAINAGE—ITS PROBLEMS AND SOLUTIONS*

By R. H. MIERS, OBE, MSc, MICE *(Member)*†

A NEW ERA FOR LAND DRAINAGE

IF THE COUNTRY'S water supply failed, people could die within a few days; without sewerage there could be an epidemic within weeks, and without land drainage there would be floods. But to many, floods are events which occur elsewhere and are soon forgotten. Most British people are now three or four generations removed from the land and to them the origin of food is the supermarket and the corner shop. They do not realize that agriculture has the best post-war record of all British industries. To this urban majority the countryside is a place for relaxation, created by nature in which they have inalienable rights. Anglers from the towns line the river and drain banks; in growing numbers boaters sail along natural and man-made land drainage channels increasing the maintenance costs, whilst canoeists trespass into private waters. Nor is there any greater respect for the natural sea-defences which protect our best agricultural land. Worst of all, since the Amberley Wild Brooks Inquiry, some conservationists and environmentalists keep repeating "Is land drainage necessary?".

For 50 years land drainage authorities have been responsible for the improvement and maintenance of rivers and drains in England and Wales. Although great achievements have been made, land drainage now finds itself relegated to a junior partnership in some water authorities. In addition, new pressure groups make it increasingly difficult to carry out work. It is understandable that those who secure the continuance and development of agriculture through land drainage are suspicious of the dominance of water and sewerage interests in water authorities and resent those outside influences which oppose their work. Central Government has followed a very far-sighted policy of encouraging land drainage for 40 years and it is to be hoped that this will continue.

The land drainage engineer may feel aggrieved but he must not be blind to changing circumstances. He has to adapt himself, as his predecessors did, to the upsurge in the use of water-power and the modification of drainage systems to aid navigation. It is no longer sufficient for him to be a good hydraulics engineer, he must also have knowledge of fisheries, angling, amenity, recreation, and conservation. He will have to be able to convince the dominant urban interests that they not only benefit from flood alleviation works, but that land drainage is essential to their future food supply.

PROCEDURES HOME AND ABROAD

GENERAL

It is not only in England and Wales that the rights of people to drain their own land and the rights of drainage authorities to make this possible are being challenged. In fact the UK probably falls behind countries like the USA, Canada, West Germany, and Austria who have already worked at procedures which are intended to ensure that as many interests in rivers and drains as possible are safeguarded.

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