MULTIPLE RESOURCE USE IN THE UPPER CLUTHA VALLEY

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AN IDEA TO BEGIN WITH

Nearly 25 years ago I approached the Upper Clutha with the same kind of imaginative enthusiasm as possessed young men like David Lilienthal caught in the romance of the New Deal and TVA. In the early Penguin Special "TVA", David Lilienthal (1944) describes the unity of land and water and men as a seamless web. "There was nothing particularly novel about the individual tasks entrusted for execution to this new agency. There were long-established precedents for government activity in flood control and navigation, in forestry and agriculture and in research. Public power systems were not an innovation. The new thing about the TVA was that one agency was entrusted with responsibility for them all, and that no one activity could be considered as an end in itself. Constructing dams or rebuilding soil, whatever the activity, it had to be treated as an inseparable part of a general programme to promote the well-being of all the men and women of the region whether they worked in offices, in factories, or in the crossroads stores, in kitchens or in the fields."

For me to whom TVA was an idea rather than a reality, single-agency control was not then a magic wand for the Upper Clutha. The essential concept of regional unity was important, true, but the real fascination of TVA was integration of activities for multiple objectives in a programme for the well-being of people. More than 20 years later, I do not hold up the Tennessee Valley experience to the people of Otago or of the Clutha Valley as the touchstone of progress. All power corrupts, as Lord Acton observed, and cheap hydro-electric power was probably no exception. I refer to the Tennessee Valley idea as an example to me of an idea integrating

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multiple resource use in a coherent programme of social development and resource rehabilitation and conservation. I should hate to think that we should model our activities closely on its practices. Instead I believe we should look to our own situation, examine our resources, our manner of using them, our needs for old uses and for new uses and our opportunities for them and then arrive at some compromises openly and fairly. I speak of compromises because of the fact of competition for resources. It is because of competition that I favour multiple-objective resource-use planning. If I may quote from "Half Time Lemons" which I offered at a seminar here in Dunedin in July 1974: "Let us recognize that multiple use is not an intrinsically good end in itself. It is good because it acknowledges that resources are not uniform, that the environment is varied, that people are individual human beings with different goals and aspirations that may be served together with harmony or the resolution of conflict."

THE SCOPE OF THIS PAPER

I am directing my remarks to the Upper Clutha proper, the valley above Cromwell, ignoring in the main the Kawarau, but not confining my attention just to that sector of the Upper Clutha Valley or drainage basin which is downstream of the Hawea and Wanaka lake outlets. The many uses which I shall consider include the conservation in natural condition of natural resources, the production of water from land, hydro-electric development, more intensive land use, farming of different kinds, industry, tourism, urban development and recreation. In so doing, I am relating the uses of the drainage-basin resources to the terms of reference of the present Clutha Valley Development Commission. I have already made clear to many in Otago my appraisal of the interim report of the Commission so far as it affects multiple use of resources. Were the final report of the Commission available to the participants in this symposium I would be glad to appraise that – hopefully more favourably than my half-time assessment. This final report is not available. My remarks then will be designed to signify what information, what organization of information, and what criteria for use of information in decision-making I would hope to find in this final report, as one concerned with the multiple-objective development of the resources of the Upper Clutha Valley. This is of course only a fraction of the information on the multiple use of resources which should be in the report because of its concern for opportunities for development in the Kawarau and for development other than hydro-electric power downstream of the Roxburgh dam. I cannot hope to

traverse all possible or actual resource uses or use combinations. What I shall outline will be not far removed from real experience, but it will serve I hope to stimulate and to illustrate a planning approach.

THE RESOURCE BASE AND PRESENT USES

Let me first outline the resource base and the present patterns of use for the Upper Clutha. The drainage basin above Cromwell comprises more than 600 000 hectares by planimeter. almost 700 000 surface hectares. The climatic and topographic classification of the land area is set out in Table 1. This table is based on Long's (1966)

TABLE 1 — Distribution of land resources as soil sets in the Upper Clutha (hectares). (After Long, 1966.)

Topography	Climatic zones				
	Semi-arid	Subhumid	Semihumid	Humid	Perhumid
Floodplains & young fans	(Paeru Fraser Gladbrook and Eweburn) 2 830	2 430	2 150	(Tasman) 1 540	(Matukituki) 8 830
Terraces and fans	(Lowburn Wetherburn Linnburn Molyneux Cromwell Drybread Waenga) 19 320	(Middlemarch Luggate Dublin pt.) 10 830	(Queenstown Dublin pt.) 3 620	(Cass Nevis Paradise) 1 340	(Polnoon) 730
Rolling land	(Clyde) 4 900	(Wanaka Blackstone Cluden) 11 260	(Maude Naseby) 4 620		
SUBTOTALS:	(27 050)	(24 320)	(10 390)	(2 880)	(9 560)
Hill land	(Conroy H.) 3 160	(Blackstone H.) 5 350	(Meyer H.) 1 500	(Paradise H.) 1 900	(Lewis Haast McKerrow) 48 640
Steepland	(Alexandra) 7 170	(Arrow) 64 310	(Dunstan pt.) 60 750	(Dunstan pt. Kaikoura Moonlight) 196 910	
Rolling upland			(Carrick H. Obelisk) 8 950		
Alpine			(Alpine) 109 030		

information from the 1:253 440 (4 miles to 1 inch) survey of South Island soils, but the climatic classification is more in keeping with that adopted by Leamy and Saunders (1967) for the Upper Clutha Valley proper. The term semihumid is used here for that zone described by them as 'subhumid to humid'. The perhumid zone is confined to the north and west of the drainage basin with a considerable proportion of steepland terrain already dedicated to biological conservation and public recreation in a National Park.

Farming Uses

Extensive pastoral farming occupies the remainder of the steeplands throughout the drainage basin, the rolling uplands, mostly on Pisa Range, together with the bulk of the hill country and a substantial proportion of the rolling country, and some fans and terraces, through all climatic zones and floodplains in the humid and perhumid zones.

The bulk of the fans and terraces and the remainder of the rolling country are used in mixed farms, involving both cropping and fat-lamb production. Orchards occupy only a small total area, principally terraces and fans in the southern semi-arid sector. Approximately 8000 ha are at present irrigated, mostly in the semi-arid and subhumid zones, irrigation use being principally for pasture and hay meadows, secondarily for cropping and orcharding. All orchards are irrigated. Dryland farming of fans, terraces and rolling lands for cropping and intensive wool and meat production is confined to the semihumid sector and the less droughty soils of the subhumid sector. Any intensive farming of terraces and fans without irrigation in the semi-arid sector, even on the better soils, tends to be sporadic.

Bottom lands have been used for gold dredging in the past to the extent of about 300 ha of tailings. Current use of the remainder of the bottom lands is semi-extensive grazing and intensive grazing and special-purpose cropping, depending on soil moisture regimes.

Residential and Recreational Uses

Principal urban settlements are on rolling land and beach terraces at Wanaka, intermediate terraces at Albert Town and the intermediate terraces at Cromwell. Smaller and scattered villages are at Hawea Flat, Luggate, Tarras, Lowburn and Makarora. Recreational use is significant throughout the drainage basin, varying from resource-based hunting, mountaineering and tramping, especially in the Mt Aspiring National Park, to intermediate and user-oriented recreation activities much closer to Cromwell and

Wanaka. Water-body and water-margin recreational activities are especially conspicuous at Lake Wanaka, but they are also significant at Hawea, Luggate, the Lindis Valley and the Clutha River about Lowburn. Holiday and/or retirement homes are probably dominant at Wanaka and Albert Town, and probably form a substantial proportion at Cromwell. An important element of recreation in the drainage basin is its integration with farming land use. A substantial proportion of holiday activity for longer-term visitors is associated with visiting local farming residents and recreational use of farm lands, especially near river margins, for fishing, picnicking and associated activities.

Industrial Uses

Industry is principally for local agricultural and rural service functions at Cromwell, with tourist service being the principal function at Wanaka. Game-meat packing and lucerne processing are of regional significance at Luggate. Water resources were developed initially by utilization of local mountain streams for gold mining by sluicing which preceded alluvial dredging, later by adaptation of these races and mining water rights for irrigation, diversion of the Lindis River for irrigation in Tarras and Ardgour, and more recently pumping-augmented irrigation and local out-of-channel storages for the Pisa Flats and at Hawea. The erection of a control dam at Hawea followed the installation of the Roxburgh generation station. Multiple use is at present operative; like Topsy it just grew.

RESOURCE DEVELOPMENT OPPORTUNITIES

What opportunities does this scene present for resource development? The possible patterns of utilization of available fall in the Clutha and Hawea Rivers for electricity generation have been well reviewed by the Interdepartmental Committee reporting to the Commissioner of Works in 1972. I have already published (O'Connor, 1972) my summary commentary on that report as it affected other resource uses. I quote: "The report on hydro-electric development effects on the Clutha Valley goes much further along the lines of rational resource planning than any of the earlier electricity generation proposals. The report illustrates some features of the orderly process of resource use planning. . . . The process of resource use planning thus begun is still far from complete, especially in evaluation of different resource use combinations. Confined in the main by its terms of reference to the floor of the valley, the Interdepartmental Committee in its published report gives little sign of genuine evaluation of the different combinations of land and

water resource uses that would be possible in the whole region subtending the Clutha River system were one or other of the hydroelectric proposals to be put into effect."

The terms of reference of the present Clutha Valley Development Commission do not limit it in the same fashion. Indeed it was called on to identify opportunities for development of more intensive land use. What are the opportunities for intensifying existing uses?

Pastoral Opportunities

The lands of the Upper Clutha drainage basin that are suitable in some degree for more intensive pastoral development comprise almost 400 000 ha. This area includes only 6000 ha of steepland soils in the perhumid zone and does not include the National Park lands, any alpine soils, nor the 40 000 ha of steepland soils related to yellow-brown earths that may be judged poorly suited or unsuited to pastoral development because of erosion risk or severe climate or slope limitations. It also excludes the 9000 ha of rolling upland soils, mostly on Pisa Range, some of which are of low suitability for pastoral development because of climatic limitations and may serve a much more valuable role in biological conservation and possibly in the management of water regimes. Within the Upper Clutha, 160 000 ha were described by Ludecke and Leamy (1972) as improvable within three years from 0.6 ewe equivalent per hectare to carry 5 to 6 ewe equivalents per hectare. Almost as much area again can be developed by similar practices of oversowing, topdressing, and grazing management of hill and steepland soils, but it is not expected that it will be so quickly responsive. The eventual level of utilized pasture production attained throughout this high-country area will be higher than this early response, being dependent on grazing management regimes applied to the induced higher-fertility grassland, as has been shown in the Waitaki by O'Connor (1966). From estimation of the full seasonal carrying-capacity potential of all of the safely developable hill and high country of the Upper Clutha catchment, I calculate a potential improved feed supply of 27 million stock unit months (Table 2). Unfortunately, little more than a million of these animal months of available feed supply can be relied on to occur in winter. It may be noted that the overall mean potential per hectare for hills and steeplands of the catchment is 90 stock unit months (7.5 stock units per hectare on a whole-year basis). Were this pasture productivity not to be reached because of inadequate fertility development, winter-available feed would probably be much less than the 4 percent indicated in Table 2.

TABLE 2 — Estimated feed supply potential of safely developable hill and high country in the Upper Clutha catchment.

Climatic zone	*Soils*	*Area (ha)*	*Estimated potential per ha (stock unit months)*	*Calculated total feed supply potential (s.u. months)*	*Estimated winter-available feed supply (s.u. months)*
Semi-arid	Alexandra	7 170	25	179 250	89 625
	Conroy H.	3 160	50	158 000	79 000
Subhumid	Arrow	64 310	125	8 038 750	803 875
	Blackstone H.	5 350	125	668 750	66 875
Semihumid	Dunstan	60 750	100	6 075 000	30 375
	Meyer H.	1 500	125	187 500	18 750
Humid	Dunstan etc.	156 330	75	11 724 750	11 725
(including perhumid)	Paradise H.	810	125	101 250	100
Total:		299 380		27 133 250	1 100 325

TABLE 3 — Percentage increase in livestock, livestock performance and output and in feed production inputs for all high-country runs in Otago 1965–67 to 1971–73 (derived from Hughes, 1974).

	Dry sector	*Moist sector*	*Wet sector*
Livestock:			
Sheep numbers	20	13	−3
Ewes to ram	38	28	3
Lambing percentage*	7	7	16
Fat lambs sold	101	112	281
Total sheep sold	48	49	71
Wool sold	34	4	3
Wool per sheep	11	−7	8
Cattle numbers	121	158	88
Breeding cows	83	129	90
Cattle sold	108	99	93
Sheep stock units	21	15	−3
Cattle stock units	111	150	90
Total stock units	29	28	20
Feed Production Area:			
Forage crops	383	242	27
Root crops	45	33	−21
Grain crops	89	71	−61
All feed crops	132	53	−28
New drilled pasture	180	174	38
New lucerne	138	329	2300
New aerial oversowing & topdressing	1312	255	780
All new pastures	900	240	454
Area of Maintenance Topdressing:			
Paddocks	37	92	219
Hill	12	27	61
* Actual increases in lambs tailed per 100 ewes put to ram were as follows:	86–92	82–88	69–80

The hills and steeplands of the Upper Clutha can be developed with present technology to support 3 million stock units over nine months. Where should we look for feed for the other three months? Increasingly, the high-country farmers of Central Otago are looking to lowland development. Table 3 summarizes the changes in six years in some of the livestock production parameters and improved feed parameters for all the high-country runs of Otago, derived from Hughes (1974). It should be emphasized that the increases in stock and stock output are large and rapid, especially in the Upper Clutha, that they are associated with large inputs for feed-production development, and that developments such as aerial oversowing and topdressing in turn demand further lowland development to correct the winter feed deficiencies.

Not all bottom lands, terraces, fans and rolling lands are available for supplementary feed production. Many of them are at present committed to crop production or to feed production for the intensive or semi-intensive livestock farming systems of farms on the valley floor. Of the area available or potentially available for winter feed production, most in the semihumid, subhumid and semi-arid zones would require irrigation to become well suited to supplementary feed production.

Irrigation Opportunity

The 62 000 ha of bottom lands, terraces, fans and rolling lands of the semi-arid, subhumid and semihumid zones of Table 1 extend beyond the sector of the Upper Clutha Valley covered in the detailed soil survey by Leamy and Saunders (1967), principally into the Lindis, Cardrona and Glendhu Bay areas. The total area of soil series listed in the text and extended legend of Leamy and Saunders approximates 60 000 ha. Table 4 presents a summary of these soil areas, deducting 2200 ha as an allowance for the area of Ripponvale and the Cromwell Flat that is outside the Upper Clutha drainage basin but adding 470 ha of tailings and old workings. Within the total area of Table 4, 58 420 ha, 5080 ha of surrounding steepland Arrow and Alexandra soils and 5020 ha of steepland terrace scarps (Letts and Koinga soils) are not arable and are unsuited or of very limited suitability for irrigation. The bulk of the bottom lands composed of Tarras, Galloway and Fraser alluvial soils are, in present conditions, of very limited suitability for irrigation, unsuitable, or not in need of it. The hill soils and some poorly drained or bouldery pockets of other soils are classified as unsuited or of very limited suitability for surface irrigation. Some 40 000 ha of the soils of the valley, principally on terraces, fans and rolling

TABLE 4 — Areas in hectares of soil series mapped by Leamy and Saunders (1967) in their survey of the Upper Clutha Valley north of Cromwell.

Terrain	Climatic zones		
	Semi-arid	Subhumid	Semihumid
Surrounding steepland	Alexandra 890	Arrow 4 190	
Adjacent hills	Clare H. 160 Conroy H. 770		
Terrace scarps	Letts 3 300	Koinga 1 720	
Rolling lands	Becks 100 Clyde 4 310	Blackstone 240 Wanaka 1 760 Pembroke 1 700	Maude 1 210
Old fans	Ardgour 2 630	Lindis 1 210	Bourke 300
High terraces	Lowburn 1 360	Luggate 4 170	
Intermediate fans	Lochar 1 460	Cluden 1 440	
Intermediate terraces	Linnburn 340 Molyneux 3 910 Cromwell 120	Queensberry 3 340 Ealy 400	Dublin 2 090
Young fans	Ripponvale 380 Waenga 3 200 Blackmans -Manorburn 450	Pigburn 2 770	Maungawera 2 230
Very young fans		Speargrass 2 350	
Bottom lands	Galloway 320 Fraser 1 340 Tarras 1 800		
Bottom lands & hillsides	tailings + old workings 470		

lands, from the lakes to Cromwell, have been assessed as suitable for irrigation from a soil viewpoint (irrigation suitability classes I–IV; Leamy and Saunders, 1967). The combination of varied soil suitability within and between terrains, potentially available water resources, expected benefit, and development need demands a thorough approach to design of a water-resource system in which the engineering feasibility of irrigating these soils would be painstakingly tested.

The Upper Clutha drainage basin holds more than 10 000 ha of fan, terrace and rolling lands in the semi-arid, subhumid and semihumid zones outside the area covered by the survey of Leamy

and Saunders (Tables 1 and 4). The total area of soils suited for irrigation and in need of irrigation for full development in the Upper Clutha catchment north of Cromwell, exclusive of hills, and of any terrain in the humid zone, is approximately 50 000 ha. More intensive assessment of water resources and their possible utilization in irrigation will be essential. This assessment of water resources should not be confined to the Clutha River itself.

Irrigation Feasibility, Acceptability and Utility

For what purposes should irrigation be promoted? Its role in supplementary feed production, especially for projected high-country flocks and herds, its role in cropping and especially in orcharding, as well as its staple role in fat-lamb farming, have all been mentioned. Irrigation development has been outlined with relation to soil features on different surfaces by G. G. Cossens in an address to a seminar at Otago University in 1972. If, in line with his findings, the mean annual dry-matter production of irrigated hay meadows was reckoned as 13 000 kg/ha and this quantity considered as providing full winter hay rations of about 100 ewe equivalents per hectare, then the projected high-country flocks and herds could commit about 28 000 ha – more than half the total potentially irrigated area, and about three and a half times the total irrigated area for all purposes in the Upper Clutha at the present time.

Let it be postulated that engineering feasibility can be established for 50 000 ha and water resources allocated for such irrigation; would it be economically feasible to irrigate these lands at the high costs expected for such a thorough commitment of irrigated land? It may be for orchards if they were climatically suited, or for critical feed supplements, or perhaps for strategic irrigation of the more valuable crops. It would probably be only marginally profitable in many situations to provide the staple irrigation required for intensive fat-lamb farming. It might be in the national interest to promote irrigation even for this last purpose if we are going to continue to ride on the sheep's back for the next forty years, despite our efforts to diversify ourselves off it during the last forty.

The outstanding opportunity for more intensive land use is probably leaf protein production as now being developed by the DSIR and the Ministry of Agriculture and Fisheries. From 40 000 ha of irrigated green crops such as lucerne could be expected a yield of pure edible leaf protein of high nutritional value at a level of 50 000 tonnes per annum (Allison and Vartha, 1973). The same crop would in addition provide, as a residue from protein extraction, sufficient bagasse for ensiling to meet the needs at twice maintenance

level of the 3 000 000 stock units wintered down from the hills (Vartha *et al.*, 1973). The integration of cropping a valuable food product with hill-country utilization as pasture would be very significant also to the transport and commercial sectors of the economy. I calculated for the Clutha Valley Development Commission that at current ratios of productivity to stock carrying, a high-country population of 3 million stock units would mean from the Upper Clutha an annual exodus for sale of more than 40 000 cattle, 10 million kilograms of wool and more than a million sheep of which as at present more than half would be fat lambs. This represents more than five times the tonnage reported as carried out at present by New Zealand Railways from the entire Alexandra–Cromwell area (Henderson *et al.*, 1972).

THE INEVITABILITY OF COMPETITION FOR RESOURCES

This exercise in estimating land-use potentials for the dominantly pastoral farming scene is intended to demonstrate that farming development and hydro-electric development are potentially in competition just as there is and has been conflict between farming and hydro-electricity elsewhere in New Zealand. There is competition for water resources, for irrigation to potential might demand more than 30 m^3/s from main and tributary flow resources. There is competition for land because of the demand for head ponds, canals, and construction work. For example, the area of approximately 1200 ha to be inundated in the Upper Clutha proper by the proposed DG7 dam at 195.1 m comprises 260 ha of tailings, 635 ha of river flats, 140 ha of low terraces, 135 ha of fans, and 65 ha of hill and steepland soils. From a survey, the local Upper Clutha study group compiled an estimate of loss of production from this land in stone fruit, pip fruit, tomatoes, pumpkins, potatoes, onions, walnuts, carrots, sheep products, lucerne and crop at $337.000 per year (Lake, 1974). The significance of this land in future potential production if irrigated where necessary and given adequate flood control in an orderly multi-purpose water-resource development is enormous. Not only might it provide a gross income considerably greater than the above estimated loss but it could provide an authentic horticultural basis for a food-processing industry right on Cromwell's doorstep.

Agriculture and horticulture may be competitive with electricity generation in one situation such as this potential site for Cromwell Lake. In other locations one form of farming land use may be in competition with another. Competition between horticulture and agriculture for soils of high suitability for orchards has generally

been resolved in favour of orchards where climate was suitable and water was available for irrigation. In the recent past. in the absence of processing facilities and with difficulties of transport. the expansion of orchards at the expense of farming with field crops and livestock has not been as rapid as the comparative value of the crop might indicate.

Planning for supplementary feed requirements for livestock from the hill country can put pressure on land formerly used for fat-lamb farming or cropping. In recent years there has been marked evidence of resolution of such conflict. In some cases hill farmers have secured lowlands. In other cases lowland farmers have acquired high-country properties. In either case an integration of the complementary functions of lowland and highland is achieved.

Conflict between pastoral agriculture and other uses such as biological conservation have also been a feature of the past. The retirement of the Pisa alpine grasslands and herbfields from grazing will not be practicable unless there is assured summer grazing developed at lower altitudes. In the Central Otago climate this demands irrigation. These are but examples of the complex and often competitive relationships between resource uses. It should be noted that they may have implications for other resources apparently remote from the area of competition.

POSSIBLE PLANNING RESPONSES TO COMPETITION

Obviously a resource-competitive situation should be met with 20/20 vision. One kind of visionary defect is to imagine that we can foresee everything. This is the mechanistic approach to planning adequately damned by Wiener (1972) by his citation from the French philosopher Alain: "These people with set ideas whom I propose to call idealists, were convinced that an enterprise in which everything had been foreseen had to succeed; results surprised them without teaching them anything. They readily realized that something was lacking in their fine schemes; and they therefore devised some new project in which this time nothing was missing; nothing was missing. in fact. that human foresight could provide. But real events. those that face us in real life situations. are made up of a myriad of details that nobody can fully predict."

From this kind of planning we have been spared while still suffering from some of its symptoms. The more common approach to planning in New Zealand. as in some other 'backward' parts of the Western world, is the classical model. This is described by Aaron Wiener as the antonym of the mechanistic one. "It assumes the prevalence", he writes, "at all levels of the socio-economic

system, of self-regulative mechanisms which through the operation of individual self-interest motivation maintains a kind of socio-economic homeostasis."

I have already warned (O'Connor, 1972) that we should not assume that we have sufficient self-regulating mechanisms in our socio-economic structure to make the classical planning model work, limiting the development programme in Wiener's words "to its heavy engineering aspects and their direct economic implications, adopting a passive laisser faire attitude to all other essential programme elements". The paradigm for such one-eyed vision is "Build the dams! She'll be right!" (She. in this context, means the seamless web of land, water and people!) No one with any detailed knowledge of New Zealand's hydro-electric power generation history can pretend that these characteristics have never been manifest.

ESSENTIALS IN PLANNING

Setting Things in Order

How to have a new model. a new image of a new reality. is the task the Clutha Valley Development Commission has had before it. Planning is so much a matter of vision. vision of our past and our future and not forgetting our present with its problems of all kinds, local. regional. national. international. Whitby and associates (1974) of the University of Newcastle-upon-Tyne in their recent manual "Rural Resource Development" list the five steps in reaching a decision:

(1) Description of the universe.
(2) Prediction of future states of that universe.
(3) Evaluation of these states in relation to social aims and objectives.
(4) Review of policies and instruments which might influence the expected outcome.
(5) Selection of preferred action.

In my assessment of these criteria, the interim report of the Commission failed adequately to describe, predict, and evaluate – so it had no adequate justification for selecting a preferred action. If its final report reinforces its central decision on dam locations and heights, the same old reality of inadequate description, prediction and evaluation will persist, no matter how novel the image presented. It will not do as rural resource development for the 1970s in New Zealand and it will not do as multiple-objective resource planning for the land, water and people of the Upper Clutha, nor for the people of New Zealand or the people overseas who expect fellow human service from us. Agricultural development and elec-

tricity generation are in competition in the Upper Clutha. The sociologic and economic significance of agriculture in our past is widely acknowledged, and the resilience of the agricultural sector under the burdens placed upon it repeatedly by our whole community is quietly and gratefully noted. Where, however, is the prediction or evaluation of any national future alternative to that agriculture?

Assigning Values

A word or two of caution before the desperate rush for slide rules and computers to calculate the benefit-cost ratios of this or any other plan. Remember that discounting rate interacts with the time horizon. The great argument of the economists might be resolved in favour of Social Time Preference if only consumption were postponed, or in favour of Social Opportunity Cost if only other investment were forgone. We can use as much sensitivity analysis as we like for coping with the uncertainty arising from time span of discounting. At the end of our chosen time span, what we will then forego from inundated or unirrigated soils will be of greater value to us and will be more clamorously needed by the world. Remember also that governments are assumed to be seeking to maximize aggregate social welfare, made up of the two elements, efficiency and distribution. As Whitby and associates point out, social welfare is the aggregate of the products of individual net efficiency benefits accruing to each individual by the weighting attached by society to an increase in welfare of each individual:

$$\text{Social Welfare} = a_1B_1 + a_2B_2 + \ldots a_nB_n$$

where B_1, B_2, etc., are the net efficiency benefits accruing to each individual and a_1, a_2, etc., are the implicit or explicit weights attached by society to an increase in the welfare of each individual. The very life-stuff of quantitative economics is putting values on human life and the means of life. I am surprised if we are so selfish or short-sighted that we can reflect and yet continue to put higher values on our inefficient electric water heating than we place on the lives of those poor who will never taste beef but will survive and grow in human dignity on extracted leaf protein produced with about 20 times the efficiency of meat. I am loathe to believe that we will attach greater value to the sight of Lowburn Bay stocked to capacity with a few water skiers on the incoming weekend tide than we will to the enjoyment of hundreds at picnics on the shade-dappled grassy banks of the rolling Clutha at Bendigo, which must be one of the most beautiful stretches of flowing water in the world.

The distribution factor is of as much significance as the net efficiency benefit. Society's weighting can only be rationally given by an informed society. The efforts that so many working with and on the Commission have made to gather and share facts, estimates, problems, and opportunities must be applauded. Likewise the efforts made by the local residents of the Upper Clutha, under their Steering Committee, to do this for themselves and to share it with the people of Otago and the rest of New Zealand are to be welcomed. This gathering and sharing of information is insufficient for effective planning if the weightings are unwisely loaded by fear, prejudice or concealment.

In the absence of a coherent structure for resource-use planning in New Zealand we might well take the problem-oriented approach to planning, starting from the bottom up, identifying the social problems, selecting appropriate means for their solution, setting targets, and ending with highly specific objectives derived from the problems to be solved. This was the central message of Waterston's (1971) memorable O'Harrow lecture to the American Society of Planning Officials. In such an approach the fully free and responsible involvement of local communities with their perception of local problems is as essential as is the availability of experts with a wide range of talents. I believe, therefore, that it would be very prudent indeed for those who must make political decisions to listen patiently and carefully to the people of the Clutha. *If it be essential to make an early decision to begin some construction, the decision should be made in favour of that single work which does most to leave open the options for multiple resource use and development.*

The future shape of electricity generation and of agriculture, even of recreation, can hardly be now predicted with well grounded confidence for the Upper Clutha. A well conceived plan for multiple use is at present well-nigh impossible because of the confusion of our values and appetites. I trust that no mistakes are so large and thorough that we have little room for options in land use and water use. I hope that the dam builders are invited to share in the first wine festival on the lower slopes of the Dunstan Range, with the pump-storage-fed generators humming up the Rise and Shine and Bendigo Gorges behind them. If that day should come, as the tail-race sends the water of life to the vineyard, I would plant in their midst a specially selected young olive, not just in peace, but to celebrate for a few more centuries that land and water and people are a seamless web indeed.

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