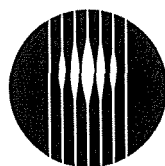


**Setting Priorities for
Research Purposes and
Research Projects**

*A Case Study Involving the
CSIRO Division of Soils*



CSIRO
AUSTRALIA

Corporate Planning Office



Preface

This document presents a report on the research priorities exercise undertaken by the CSIRO Division of Soils in early 1992. A major component of this exercise was the priorities workshop conducted in April 1992 during the first two days of a week-long Divisional Management Committee meeting.

The success of the exercise rested largely on the enthusiasm and commitment of David Smiles, John Williams and their colleagues on the management team. John in particular carried the burden of coordination and logistics which he performed in a particularly effective fashion. The priorities workshop was facilitated by Ralph Young of the CSIRO Corporate Planning Office.

The Division of Soils case study represents an important milestone in the evolution of the research priorities process in CSIRO because of its contribution to best practice, particularly in relation to project priority setting and the project priority-quality template developed by David Smiles and John Williams. In addition, the insights produced during the course of the exercise provided useful input to subsequent priorities exercises conducted in CSIRO and elsewhere.

This report was prepared by Ralph Young and benefited from valuable input from John Williams.

Don MacRae

CSIRO Corporate Planner

26 November 1993



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Introduction

The CSIRO Division of Soils seeks to benefit Australia through research and technology transfer which contributes to the sustainable and profitable management of soil and land resources. The increasing awareness of the scale and consequences of land degradation and the challenges of problems associated with urban as well as rural land use have placed increasing pressure on the Division's research managers to make the best use of the limited resources which they have available.

To make sure that the mix of research is one which maximises the benefit to the nation, the members of the Division's Management Committee (comprising the Chief, program managers and other senior managers) conducted a two stage priorities exercise in late April of 1992. This followed an assessment of national priorities by all research staff in the Division at a workshop in June 1991. The results of the assessment and indicative resource shifts between research areas are reported in the Division's Strategic Plan 1991-96. In the interim, a review of the Division had been completed by a panel of experts representing external stakeholders and the recommendations of the review had been largely accepted by the Director of the CSIRO Institute of Plant Production and Processing in which the Division of Soils resides.

The priorities exercise in April 1992 was designed to:

- refine the set of research purposes or areas of research opportunity (ARO's) from the 1991 workshop with the aim of eliminating overlap;
- identify research priorities for the Division; and
- determine project priorities.

The Process

The stages of the process and the steps taken to complete the exercise are outlined in Annex A. These covered a preparatory phase in which supporting data and information were collected and processed, and the necessary administrative tasks and logistics planning begun. The second stage covered the workshop, while the third stage covered post-workshop drafting of documents and resource allocation. Each stage is discussed in the sections below.

The outcomes of the priorities process in the Division of Soils were agreement to and ownership of research priorities and project priorities for the Division by the Management Committee. The outputs of the exercise are a set of role statements for each area of research opportunity which delineate the strategies and resource decisions for each ARO. In addition, the set of project priorities provided a substantial basis for making decisions on resource allocation at the project level.

Preparation

There were two major tasks to be performed in the preparation phase. These related to data/information support and to administration/logistics.

The administration and logistics activities concerned scheduling of tasks and events, including arrangements for venues, provision of equipment and distribution of information to the participants. The focal coordination point for these activities was Dr John Williams, the Deputy Chief and subsequently acting Chief of the Division. The Chief of the Division at the time, Dr David Smiles, was also actively involved. By demonstrating support at this level, it was made clear that the exercise was being taken seriously by the senior management of the Division.

The second major task concerned the preparation of supporting documentation for use by the Divisional Management Committee members who would be participating in the priorities assessment exercise. The data and information support was provided in the form of:

- Data and evaluation sheets for each area of research opportunity (ARO);
– illustrative copies of the data and evaluation sheets for a selected ARO are shown in Annex B.
- A set of project proposals for each project being assessed. Each proposal contained information on project title, description of project, specific objectives, milestones, staff, collaboration, progress of the project to date, research plan and resources/funding.
- A list of ARO's from the 1991 workshop which formed a working set for the 1992 exercise (Annex C).
- A worksheet listing an agreed set of criteria for scoring projects (Annex D).

In addition there were a number of relevant supporting documents which were made available to participants. These included:

- Division of Soils, Five Year Strategic Plan 1991-96, Feb 1992.
- D J Reuter and D E Smiles, An analysis of National and Industry Perspectives Used to Support the Development of the Strategic Plan (1991-96) for the CSIRO Division of Soils, Division of Soils, 1991.
- Recommendations from the Report of the External Review of the Division of Soils, and Director's responses to the Report and its Recommendations.
- Determining Strategic Priorities in the Division of Soils, CSIRO Corporate Planning Office, 1992.

The Workshop

The priorities workshop was held as part of a week-long Divisional Management Committee Meeting at the Division of Soils in Adelaide from 27 April to 1 May. The participants comprised the Divisional Management Committee, numbering ten senior research and research support managers including the Chief, Deputy Chief and program managers. A copy of the agenda is at Annex E. The first day was devoted to the assessment of Divisional research priorities, and the second day to the determination of project priorities. The following sections describe the key elements of the priorities process.

Identifying Areas of Research Opportunity

The working set of ARO's developed at the Division's 1991 workshop on national priorities provided a useful starting point for identifying a Divisional set of ARO's. It was critical to get these right, because the ARO's form a keystone on which the rest of the priorities exercise depends. An important characteristic to aim for in identifying ARO's is that they are mutually exclusive, otherwise overlap between ARO's would result which would lead to double counting of potential benefits and R&D potential as well as confusion in the minds of assessors during the scoring process.

A related issue which needed to be resolved was whether the set of ARO's should be derived from the CSIRO classification of research by socio-economic objectives (SEO's) which form the basis of the priorities process at the corporate and Institute levels, or whether it should represent the set of problems being addressed by the Division's research. These problems in effect also represent the set of research opportunities facing the Division.

To resolve these issues, the first half day of the workshop was taken up with the identification and assessment of a list of SEO-based ARO's, and a list of the major problem areas being addressed by the Division's research. In generating the two lists of possible ARO's, factors which were considered were:

- both current and future areas of research opportunity should be included;
- the ARO's should not overlap; if overlap was present, then the individual ARO's should be defined or bounded to eliminate overlap;
- the ARO's should be broadly based so as to break the linkage with existing projects – this would encourage Division participants to wear Division hats rather than be in the position of defending project territory;
- the ARO's should be outcome or client/user oriented as far as possible – this would make it easier to assess potential benefits as well as demonstrate to stakeholders that their interests were being given due consideration.

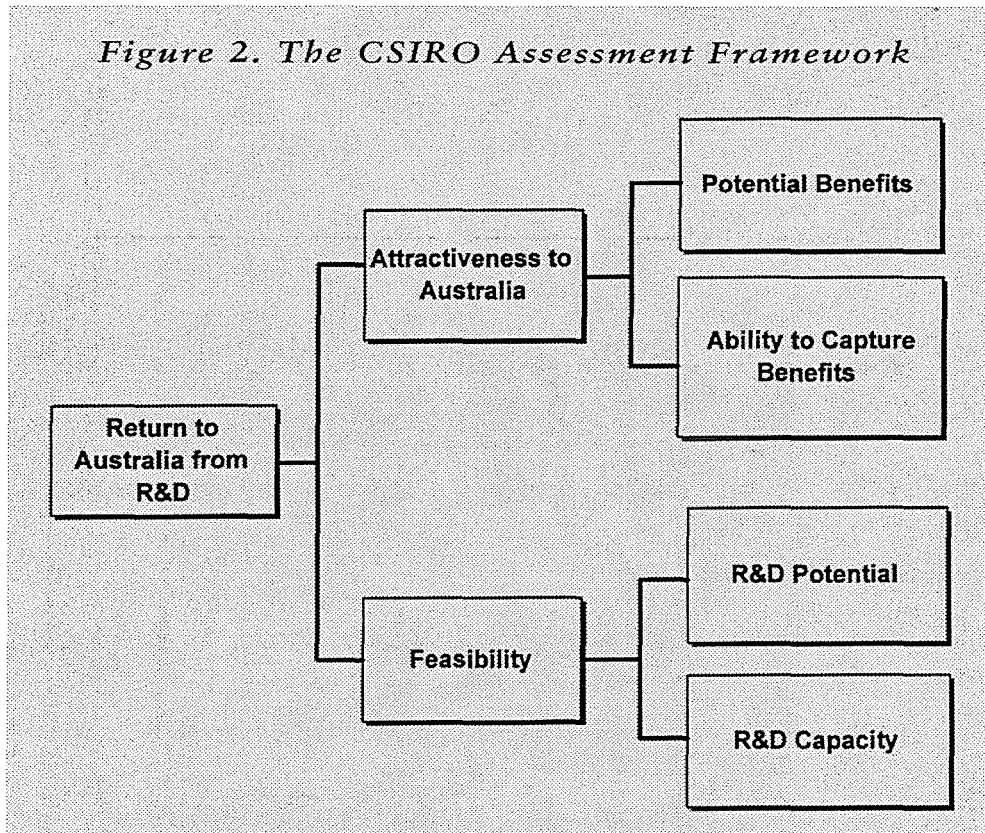
The two listings of possible ARO's were then subjected to a matrix analysis by the group of participants, with each cell of the matrix being assigned a high/medium/low or zero rating to reflect the interaction between the problem area and the SEO. The results are shown at Annex F.

Following the matrix analysis, the management team decided to run with the SEO-based ARO's with each ARO being "defined" in terms of the problems/opportunities being addressed by the research targeted at that ARO. The resulting list of nine ARO's and associated research problems/opportunities appear at Annex G. Further reflection and discussion on the ARO's led the group of participants to split two of the original nine ARO's partly because they were too broad and contained heterogeneous components and partly because one

*Figure 1. Attractiveness, Feasibility and
Return to Australia Screens*

1. **Field Crops** – Identification and alleviation of soil constraints which limit achievement of high quality, profitable and environmentally sustainable production in monocultural and rotational cropping systems
2. **Forestry** – Development of ecologically sustainable management systems to improve forest production and reforest degraded landscapes by management of soil fertility, plant health and water use.
3. **Pastures** – Development of ecologically sustainable management systems to improve pasture production and quality by amelioration of soil constraints.
4. **Water Quality** – R&D to maintain and improve quality of freshwater, determined by its passage through and over soil.
5. **Horticulture** – To develop horticultural systems which minimise soil degradation and maximise production for nursery, vegetable, trellis and tree crops and to assess environmental suitability for new industries.
6. **Land Use and Resource Assessment** – Research and development to enhance the matching of land capability to land use by improved methods of describing Australia's soil and land resources.
7. **Terrestrial Ecosystems** – Soil R&D to understand the functioning and role of terrestrial ecosystems and the maintenance of biodiversity in sustainable production and conservation of the environment.
8. **Land Disposal of Waste** – Research and development into the sustainable land-based management of nutrient-rich effluents.
9. **Site Rehabilitation** – Research and development to minimise the impacts on land by mining and industry and to rehabilitate the disturbed and contaminated site that may result.
10. **Tourism and Recreation** – Soil research and development to enhance the use of land for recreational activities with particular emphasis on minimising degradation of the land and water resource.
11. **Mining and Industrial Production** – R&D to improve efficiency and industrial product quality by the development of better methods of soil, clay and mineral and fertiliser analysis.

Figure 2. The CSIRO Assessment Framework



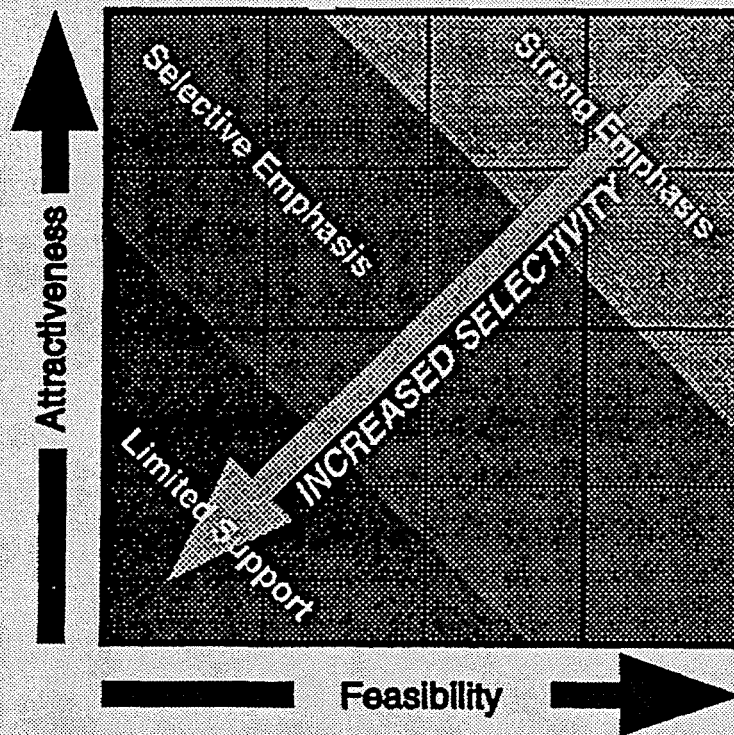
potential research area was being excluded. In consequence “mining” was divided into “site rehabilitation” and “mining and industrial production”, and “tourism/land use” was split into “tourism and recreation” and “land use and resource assessment”. The resulting set of eleven ARO’s is shown in Figure 1. The final step in the identification of ARO’s was to nominate “champions” for each ARO from the group of participants. The task of each ARO “champion” would be to lead the discussion in the review of scores for each ARO.

Priority Scoring

Following agreement on the set of Divisional ARO’s, the stage was set for a round of preliminary scoring of the ARO’s against the four assessment criteria. The preliminary scoring was undertaken out of session (during lunch) and was preceded by a review of the other key elements in the assessment process – the four criteria and the scoring procedure.

Past experience indicates that lack of a clear understanding of the definition of each criterion can cause confusion and lead to the need to go over ground already covered. Some time was therefore spent reviewing the definitions and associated key discriminant questions for each criterion – see Annex H. The priorities framework is shown in Figure 2. Discussion of potential sources of confusion among criteria is contained in Annex A.

Figure 3. Attractiveness-Feasibility Screen



In reviewing the scoring procedure, emphasis was placed on the aim of achieving a relative ranking of ARO's and the fact that the scores are relative rather than absolute. It is not necessary therefore for a participant to agonise over whether a particular ARO should get a 4 or a 5, but to focus on whether one ARO should get a higher score than another.

The procedure followed was to deal with one criterion at a time. The first step is to identify the one or more ARO's which would be assigned the highest score for the particular criterion e.g. potential benefits, and to give it/them a score of ten. The second step is to identify the one or more ARO's which are to receive the lowest score and to award them a score of one. The third step is to rank the remaining ARO's in between the highest and lowest scoring ARO's i.e. the ARO's with a score of ten and one respectively, by assigning them a score between one and ten as appropriate. This procedure is repeated for each of the four criteria in the priorities framework.

The scoring sheet used by the participants contained a list of the agreed ARO's together with a brief description of each – see Figure 1.

Reviewing Priority Scores

A major objective of the priorities workshop is the sharing of information by the participants. To make a judgment about the relative priority ranking of the ARO's, each participant relies on their own knowledge base as well as the supporting data and information. The knowledge base about each ARO can be expected to vary between participants, and in order to arrive at a point where each is operating off a similar information base, an interactive review of the preliminary scores is undertaken.

The procedure followed at the Division of Soils workshop was to take one criterion at a time, and, beginning with potential benefits, to undertake the following steps:

- brief presentation by "champion";
- explanation by person(s) with highest score(s) if two or more points above group average, indicating reasons for high score(s);
- explanation by person(s) with lowest scores(s) if two or more points below the group average, indicating reasons for low score(s);
- group discussion;
- revision of scores as appropriate.

These steps were repeated for each ARO. Once the review of scores for the potential benefits criterion was completed, the same steps were followed for each ARO for each of the other three criteria in turn. The revised scores for individual participants were then averaged for each criterion to produce a group score for each ARO for each criterion. The translation of the group average scores to graphs or screens enabled the participants to review the ARO ranking and to sign off on these as representing the view of the group.

Results of Research Priorities Assessment

The average ARO scores for each criterion formed the basis for the Management Committee's priority ranking of ARO's. The group average scores for each criterion are shown in Table 1.

When these scores are translated into graphical form, ready comparison can be made of the ARO's against each criterion. The Attractiveness Screen compares Potential Benefits with Ability to Capture and the Feasibility Screen allows comparison of R&D Potential with R&D Capacity. By taking the product of the Potential Benefits score and the Ability to Capture score for each ARO, a measure of the relative Attractiveness of each ARO is generated; similarly, the product of the R&D Potential and R&D Capacity scores from each ARO

Table 1. Group Average Scores for ARO's

		ATTRACTIVENESS		FEASIBILITY		RETURN TO AUSTRALIA	
		ATC	PB	RDC	RDP	Feas	Attract
1	Field Crops	7	10	9	7	60	68
2	Forestry	4	6	3	5	16	25
3	Pastures	5	7	7	5	31	36
4	Water Quality	7	8	5	7	36	58
5	Horticulture	5	6	6	6	34	27
6	Land Use/Res Assess	7	9	8	8	60	56
7	Terr Ecosystems	3	6	3	6	20	17
8	Land Disposal – Waste	8	7	8	8	57	59
9	Site Rehabilitation	8	5	8	8	63	42
10	Tourism and Recreation	5	3	4	4	15	15
11	Mining/Indust Prodn	5	3	3	3	9	13

Note: Because of rounding, the Return to Australia scores shown do not equal exactly the products of the component scores shown under Attractiveness and Feasibility.

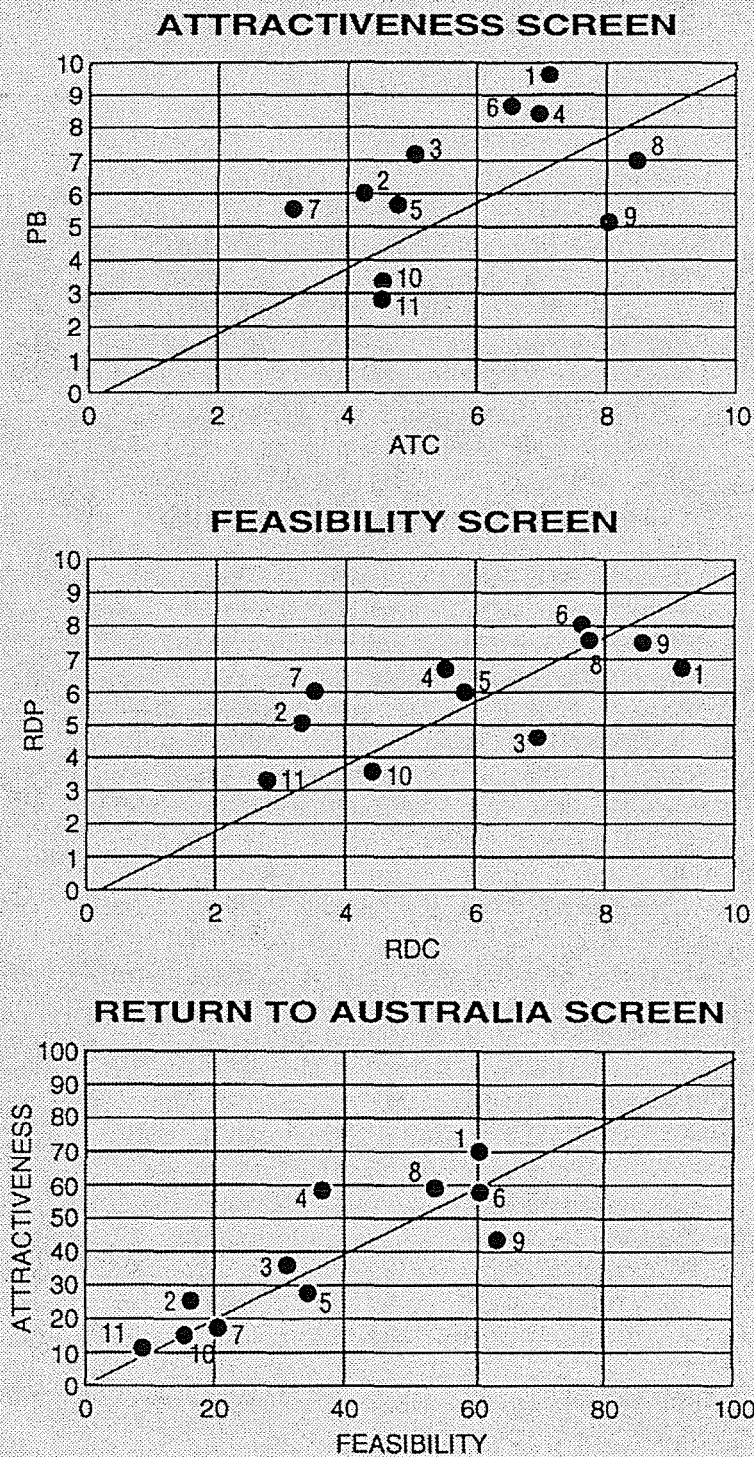
provides a Feasibility score. The Attractiveness and Feasibility scores can also be presented graphically in a Return to Australia Screen, and this screen provides the basis for the overall priority ranking of ARO's.

To interpret the priority ranking on the Return to Australia screen it must be borne in mind that ideally, all of the ARO's in which the Division conducts research should be in the top right hand corner of the screen. Conversely, it would be desirable to avoid doing research in ARO's which lie in the bottom left hand corner, except under specially mitigating circumstances. Between these two polar cases, lies a large area in which judgment must be exercised. The screen shown in Figure 3 depicts these options. The three screens containing the results of the research priorities exercise are shown in Figure 4.

In the Return to Australia screen, the ARO's appear to form into three natural groupings – a high priority group comprising Field Crops, Land Use/Resource Assessment, Land Disposal of Waste and Site Rehabilitation, a medium priority group containing Water Quality, Pastures and Horticulture, whilst the remaining ARO's form a “low” priority grouping.

It should be stressed that because the priority ranking of ARO's is relative rather than absolute, it does not mean that the low priority ARO's should not be the subject of research. What it does imply is that research project proposals directed at the low priority ARO's need to be carefully scrutinised to ensure that the benefits and feasibility of the project research match as far as possible those of the high priority ARO's. Similarly, because a project is directed at a high priority

Figure 4. Research Priorities Screens for ARO's



Williams Fig. 4, D/100, 8.7.93, DLS

ARO, it should not be automatically concluded that funding will be provided, because the project may not generate the level of benefits and feasibility assessed for the broader ARO as a whole. The topic of project assessment is covered in the next section.

A point of interpretation is that a high priority rating may not automatically mean additional funds, and a low priority rating does not necessarily imply less funds because the priority ranking of ARO's needs to be compared with the existing distribution of research effort. If the ARO's assessed as high priority are already assigned a high priority in the current distribution of research effort, then it may be a case of business as usual for these ARO's. A similar point can be made in the case of low priority ARO's. Where the implied priority ranking in the current distribution of research effort does not match the assessment in the priorities exercise then a judgment will be required about the appropriate level of allocation of resources to that ARO.

A further issue of interpretation of results is nicely illustrated by ARO No 4 – Water Quality. This ARO is in the middle group in the Return to Australia screen but its Attractiveness rating is high, being only just below the highest rated ARO – Field Crops, and level with two other ARO's on the second highest rating. Because the Return to Australia screen is very much a summarised version of the results, further information is needed to assist in the interpretation of the results. In particular, it is helpful to refer to the other screens and to the Data and Evaluation Sheets.

It is worth noting that of the four criteria, R&D Capacity is the only one in which direct influence can be exerted by the Division. When the Feasibility screen is examined, it can be seen that Water Quality is assessed at the same level as Field Crops for R&D Potential, but much lower for R&D Capacity. This suggests that if R&D Capacity could be improved, for example by directing additional resources into it via staff recruitment or by collaboration with another Division or other research body, then the Water Quality ARO might join the high priority group.

In the case of ARO 9, the reverse situation appears to apply – a very high Feasibility assessment and a rather lower Potential Benefits rating. A question which arises in this context is whether this ARO is over-resourced relative to potential benefits, and this may in turn have implications for funding.

The focus of the priorities exercise is on the allocation of appropriation funds. If a particular ARO is judged to be over-resourced in terms of appropriation funds, then an alternative option is to seek a greater proportion of funding from external sources to justify continuation of the same level of effort.

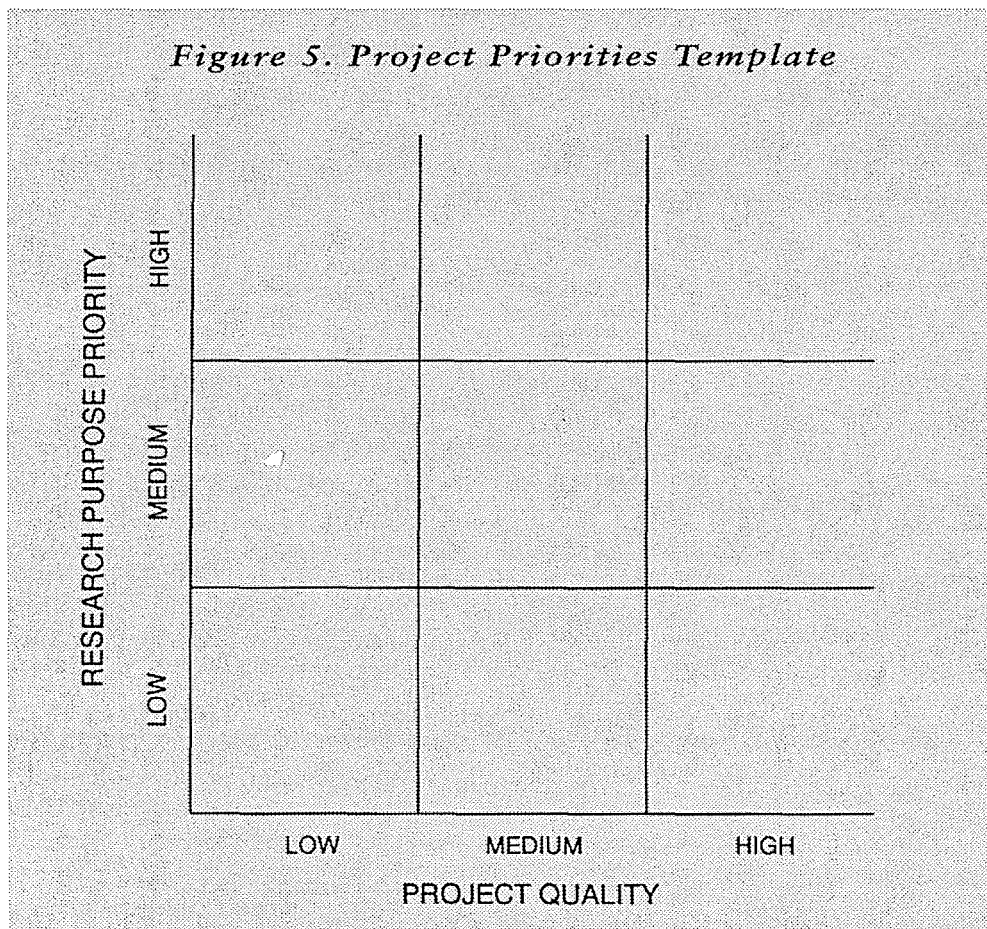
Project Evaluation Criteria

It has become clear that the priorities process in CSIRO is one which is evolving over time as new insights arise and new developments in best practice occur. It is in the area of project assessment that a particularly innovative approach was devised by the Division of Soils. This approach is wholly consistent with and complementary to the determination of broad strategic research priorities described in the preceding sections.

Two steps were introduced to the assessment of project priorities. These were to review existing projects and new proposals in terms of:

- project priority; and
- project quality

To present the priority and quality assessments for each project in graphic form, a template or screen was developed by John Williams and David Smiles to enable ready identification of project priorities – see Figure 5. The interpretation of project rankings on the template are similar for those on the Attractiveness-Feasibility screen. In the ideal situation, all of the Division's projects would be



located in the top right hand box, reflecting high priority and high quality. For projects located in the bottom left hand box, a judgement is needed about whether the project should continue.

The priority score is essentially predetermined by the ARO ranking, and hence any project with a low priority would require a high quality rating to offset the priority ranking. Again a judgement would be required about whether such projects which are out of step with the strategic directions of the Division should be resourced from appropriation funds. In those cases, where a project received a high priority rating but was assessed to have a low quality rating, then some analysis would be needed of individual criterion scores to determine whether those factors which are under the Division's control could be influenced to yield a higher quality score which would give added justification for resourcing the project with appropriation funding.

The project priority of each of 36 projects was determined by assigning a project to one or more ARO's on the basis of identifying which sectors would be the beneficiaries of the project's research output. If all of the benefits of a project accrued to a single ARO, then the project's priority would be the same as that for the ARO – high, medium or low depending in which priority group the ARO was located. If a project was expected to generate benefits to more than one ARO, then a “weighted average” priority was identified based on the distribution of expected benefits amongst the relevant ARO's.

The project quality of the 36 projects was assessed by judging each project against a set of ten criteria agreed to by the management team – see Figure 6. Nine of the ten criteria relate to one or other of the four Attractiveness/Feasibility criteria and hence the assessment of project priorities is highly consistent with the strategic research priorities process described in earlier sections.

The assessment of projects was undertaken on the second day of the workshop, and the procedure adopted was to do a preliminary “out of session” scoring by individual participants, and then to review and discuss the preliminary scores. A score of 1 to 5 was assigned to each criterion for each project using a scoring sheet (Annex D). Ideally, the scoring procedure used should be the same as that followed for the scoring of ARO priorities, viz. take one criterion at a time, identify highest and lowest scoring projects, and rank the others in between. Because there were 36 projects to be assessed against each of ten criteria, it proved in practice to be simpler to complete a scoring sheet for each project in turn. This meant that greater reliance would be placed on the interactive review of project scores to achieve the relative rankings of projects than was the case for ARO's.

Figure 6. Project Quality Criteria

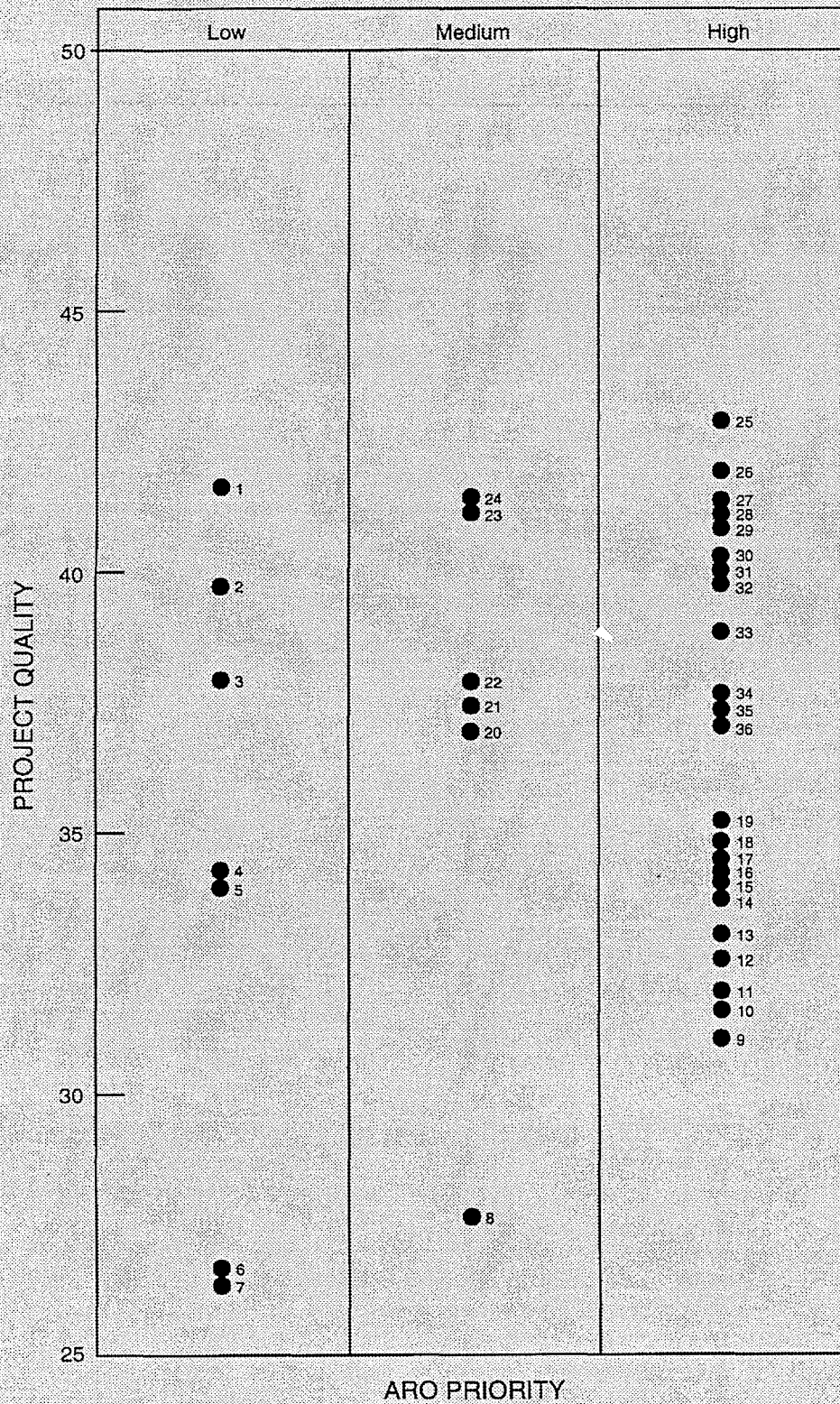
- 1. PROJECT GOALS**
The project has clearly defined objectives, outcomes and timetable.
- 2. SIGNIFICANCE**
The economic, environmental and social benefit of this project to Australia.
- 3. CONTRIBUTION TO OTHER PROJECTS**
The extent to which the project influences the outcomes or effectiveness of collaborative or related projects.
- 4. CLIENT INTERACTION**
The extent to which the project addresses agreed client needs and the degree to which results are likely to be adopted.
- 5. COMMUNICATION**
The extent to which the project has an adequate plan for communication and technology transfer.
- 6. R&D POTENTIAL**
Does the project address a fertile research area? Where is the current technology on the sigmoid curve?
- 7. PROBABILITY OF SUCCESS**
The extent to which the project is likely to achieve its technical objectives on time and within budget.
- 8. DIVISIONAL RESOURCES**
The requested resources are appropriate and available from the Division.
- 9. EXTERNAL RESOURCES**
The proposed project is highly likely to attract external resources.
- 10. PREVIOUS PERFORMANCE**
The project team members met previous targets.

Reviewing Project Scores

The review of project scores proceeded at two levels – the aggregate quality score for each project and the individual criterion scores for each project. The scores for each criterion were summed on each participant's scoring sheet, and the individual totals gave a quality score for each project from each of the ten participants. The totals were then averaged to give a quality score for each project across the group of scorers. A "champion" for each project was nominated from the group of participants – normally the program manager associated with the project, and following a brief presentation from the champion, the "outlier" scores were invited to explain the reason for their high or low scores.

This usually required a review of the participants' project scores for each criterion to identify the source of differences at the aggregate level. In this way, a process of information sharing took place at the project level, similar to that for

Figure 7. Project Priorities Results



the assessment of ARO priorities. At the conclusion of the discussion of the scores for each project, participants were given the opportunity to revise their scores and the process of reviewing project quality scores was repeated for each project. The agreed group average score of project quality for each project was compared with the project priority scores and graphed on the template or screen. The spread of plots is shown in Figure 7.

There is a reassuringly large number of projects in the upper right hand box of the template in Figure 7, and overall, the majority of projects are located in high priority ARO's and achieve a medium to high quality rating (>30). The half dozen projects which reside in low priority ARO's are spread over a wide range of quality scores and provide a core set which merit further review. Those, for example, with a low quality score may need to be looked at critically in the short term whereas those with higher quality scores may need to be reviewed over the longer term in terms of their contribution to the strategic directions of the Division. If, for example, projects in a low priority ARO but which achieve a high quality score are to continue, then the question arises as to whether such projects should be funded from appropriation or whether such projects should be funded by those receiving the benefits, if the beneficiaries represent a narrower group than the community at large.

The results shown in Figure 7 provide a basis for making quite specific decisions about resource allocation within the Division. By taking on board further relevant information from the priorities assessment, the quality assessment and the project proposal forms, such decisions can be validated as the outcome of a rational process informed as far as possible by relevant data and other supporting information. If the information on which the decisions are based and the process used to reach the decisions can be effectively communicated to the staff of the Division then the ownership of and commitment to the outcomes are likely to be greatly enhanced.

The products of the workshop consisted of a set of priority ARO's and a set of research project priorities agreed to by the Division's management team. The next steps to build on these products were completed after the workshop.

Post-Workshop Action.

The information contained in Figure 7 brings together for each Divisional research project a judgement of project priority, in terms of it's alignment with Divisional priorities and a measure of the quality of the project in terms of both scientific merit and resource management.

The Division recognised that the process of focused discussion which is involved in arriving at Figure 7 is perhaps as valuable as the information contained in the

figure itself. The process provides the opportunity for analysis and debate with a clear set of criteria against which to test prejudice. The outcome for the Division was substantial agreement on both Divisional priorities as well as the strengths and weaknesses of the current portfolio of research projects.

Figure 7 provides a basis for decisions on project termination, redirection and allocation of appropriation funding. The process provided a basis for the development of business plans around key projects in order to obtain both CEO priority funding and external industry support. The development of effective strategies and business plans to secure a significant increase in external funding was of paramount importance at this time because the Division was faced with a serious budget deficit. The process gave rise to a clear vision of direction and greater focus of research effort and this contributed to a significant extent to the Division achieving very substantial increases in the level of external support and access to CEO priority funding. The methodology has provided the basis for rational decision-making and allocation of scarce resources. The opportunity to develop these concepts and principles in the future will take place as the Division develops its next strategic plan under the direction of the new Chief.

The Future

In the context of the research priorities process as an evolving mechanism which incorporates insights gained from each succeeding research priorities exercise, there are a number of areas in which the Division of Soils exercise made a significant contribution and there are some issues which were identified which could lead to further improvements.

- Research purposes (ARO's) – the matrix analysis provided a useful approach to building a foundation for the assessment of ARO priorities. Not only were a range of research opportunities identified, but the significant research issues which each would address were also identified.

To the extent that this analysis provided guidance for the collection of data for the assessment of priorities, then this would suggest that such an analysis should be conducted in advance of the main workshop. For example, the range of issues or problems identified provided pointers to the scope for potential benefits, ability to capture and the two feasibility criteria, and hence implied that data relevant to those issues could usefully be incorporated in the Data and Evaluation Sheets. This suggests therefore that it would be valuable to conduct a preliminary workshop covering research purposes/ARO's and data requirements prior to the main priorities workshop.

- Data: the preparation of data sheets and evaluation sheets for ARO's involves a major effort, and the availability of data is often a binding constraint.

Because the priorities exercise is one which looks into the future, the provision of time series data for key variables together with trend projections and forecasts would give substantial guidance to participants in assessing ARO's against the four Attractiveness/Feasibility criteria.

For project priority assessment it would clearly aid participants if project sheets contained an assessment for each of the quality criteria, similar to the assessments in the evaluation sheets for ARO priorities assessment.

- External Input: A major objective of CSIRO research is to generate benefits for Australia, and hence to provide a return on the public investment in CSIRO research. It would therefore seem logical in setting research priorities to take account of external stakeholders perspectives in setting the Division's research priorities. This might be done by inviting stakeholder representatives, for example from the Division's Advisory Committee, to participate in the research priorities scoring exercise. Such an initiative would be in line with the recommendation of the Foley Committee (*CSIRO's Research for the Rural Industry*, CSIRO, 1992) that rural industry, other research providers and research funding organisations are effectively integrated into the CSIRO strategic planning process.

In conclusion it should be said that at the time the priorities workshop was undertaken, the development by the Division of the project priorities quality criteria and template placed it at the cutting edge of best practice priority setting. The insights gained from that exercise have provided valuable inputs to subsequent research priorities exercises in CSIRO and elsewhere. In addition, the enthusiasm and commitment of the Division Chief and the Division's Management Team did much to ensure the success of the exercise and the laying of a foundation for the future research directions of the Division.

Annex A.

Determining Strategic and Project Priorities in the Division of Soils

Introduction

Strategic planning is a process of choosing our future. A strategic plan sets out where we want to be in say five years time, and describes how we are going to get there by documenting key goals and strategies.

By comparing that future with where we are now, gaps can be identified, and the required changes determined in order to move from here to there.

Because resources are limited and competing opportunities are many, it is important to choose those research activities that offer the highest expected return to the nation. In determining research priorities, the limited resources can be allocated to the identified priority activities.

By following this path in an open and systematic manner it becomes possible for participants to own the outcome of the process, and to justify the outcome to the stakeholders that Divisions are accountable to. It is a means of demonstrating competency of management as well as identifying the research activities that will generate the greatest benefit to the nation.

THE STEPS

1. *Prepare a list of research “purposes” relevant to the Division*
 - this will encompass current research areas plus any other areas that potentially offer opportunities to generate benefits for the Division’s research users.
 - the preferred approach is to prepare the list *ab initio* - as if the Division was starting from scratch with a clean slate.
2. *Collect supporting information and data for each research purpose relating to current situation and outlook (the Data Sheets), and covering each of the four criteria in the priorities framework: viz., potential benefits; ability to capture; R&D potential; and R&D capacity (the Evaluation Sheets)*
 - examples of the Data and Evaluation Sheets are given in Attachment 1 of what was done at the corporate level for the plant and animal research purposes.
 - outlook information, industry and commodity data provided in ABARE documents will be particularly valuable.
 - key benchmark references will be Divisions’ own vision statements and planning documents.
 - reference can also be made to other relevant documents such as the CSIRO Strategic and Operational Plans and the strategic plans for IPPP and relevant CSIRO Divisions such as Water Resources, Plant Industry etc.
 - other relevant reference points will be the priorities identified by bodies such as AWRC and RIRF’s.
3. *Apply the priorities framework ie assess each research purpose against each criterion in the light of the supporting data and information and award a score (1-10) to each criterion for each research purpose*
 - two or more iterations may be required to advance from preliminary scores to final scores.

4. *Draft role statements for each research purpose*

- copies of relevant corporate role statements are at Attachment 2
- items to be covered include background information, goals, priority assessment and strategies for research, transfer and funding.

5. *Draft a strategic plan for the Division on the basis of the role statements*

- strategic plans based wholly or in part on the foregoing process include those for the Divisions of Water Resources and Tropical Crops and Pastures.

6. *Implement the strategies and priorities by determining resource allocations for each research area*

- a comparison will be required of the present distribution of effort with the one implied by the identified priorities five years down the track.

The Process

There are three broad stages to be gone through:

Stage 1 covers preparation and encompasses steps 1 and 2 above, plus a preliminary scoring of each research purpose against each of the four criteria of the priorities framework independently by the participants who will later do the scoring as a group.

- it is envisaged that information covering the classification/listing of research purposes, data and evaluation sheets for each research purpose, and the procedures to be followed will be circulated say a month in advance of the retreat to allow time for scoring, and processing of scores.
- in doing the scoring, it is important that participants do not agonise over whether a particular research purpose should get a score of say 5 versus 6, and as a result of the time and effort spent in scoring, become attached to their own scores. Ball park scores based on a perusal of the information provided plus the participant's own knowledge are all that are needed. With the sharing of information at the retreat, participants need to retain the flexibility and option to revise their scores as new information is received.
- it is also important for participants to wear their Division hats, rather than just be staunch defenders of their own programs and projects. This could be assisted in a number of ways, eg by classifying research purposes fairly broadly so that the direct link between a research purpose and a particular program or project is weakened, ie they are not identical (see suggestion below); a second option could be to allow program managers to champion a particular research purpose but not to contribute to the scoring for that purpose so that the role of the champion is limited to presenting objective information that is persuasive and will guide other scorers. Emphasis might also be given to the interests of the Division's research users and to industry linkages.

Stage 2 covers the group situation and encompasses steps 3 and 4. Preliminary scores would be reviewed in the light of presentations on each research purpose by the nominated champion for that research purpose, and discussion of data and scores, and revised if necessary. A second aim would be to prepare draft role statements for each research purpose. This will involve systematically setting out relevant information on background (eg information relating to each of the four criteria for the research purpose), the research goal, the priority assessment, and strategies to be pursued in the light of the priority assessment relating to research, transfer and funding.

- the primary focus of the exercise is on developing a basis for the allocation of

appropriation funding to each research purpose, but it may also be relevant to specify external funding targets for each research purpose.

Stage 3 represents the completion of the exercise, encompassing steps 5 and 6, and achieving a sign off by the participants on the identified priorities and the role statements. This may require a final review session attended by the participants. The final step will be the drafting and finalisation of the Division's strategic plan, and communicating the contents to stakeholders.

- the contents of the strategic plan could cover statements of mission, goals, the research environment, key issues identified for example by the Advisory Committee, a brief report on the priorities process and results, the set of agreed role statements, and a statement on resource allocation comparing for example the 1997 target profile of research effort with the existing one, plus any additional information on organisation and management.
- the strategic plan for the Division of Tropical Crops and Pastures is a useful role model in this context.
- a particularly useful follow through step might be to conduct a joint priorities workshop with the Division's major external funding agencies to demonstrate to them where you have got to, and to establish rapport and obtain feedback. At a minimum it would be desirable to provide them with a presentation of the process and outcomes of the Division's priority exercise.

Implementation Suggestions

List of research purposes

- one of the first tasks
- needs to cover all current and potential areas of the Divisions' research
- it is desirable not to draw up a list with inconsistent or overlapping classes eg a mix of research areas and disciplinary areas will lead to confusion because of the overlap. The current thrust of priority setting and planning in CSIRO is towards outcome oriented and user oriented classes, and a listing consistent with that focus would be preferable. One option would be to use class level groupings from the Socio-Economic Objectives classification used in the corporate level priorities exercise.

Supporting data

- the sharing of information among participants, so that each operates off the same information base is a major aim of the priorities exercise.
- it is probably most efficient if data and evaluation sheets are drafted by the nominated champion for each research purpose.
- in relation to provision of data, ABARE's Commodity Statistical Bulletin, the Agriculture and Resources Quarterly, and papers from the National Agricultural and Resources Outlook Conference would meet most of your needs; other sources might include Bis-Shrapnel, Syntec and others.
- copies of relevant papers presented at the 1992 Outlook Conference would provide a useful mechanism for shifting the focus from the present to the future.
- Corporate Planning Office is happy to assist with any remaining gaps and with benefit assessments.

The Priorities Framework Criteria

- past experience in Divisions indicates participants frequently get confused about the

-
- definitions of the criteria, and results in inconsistent and invalid scores
- the four criteria are intended to be independent so that double counting is avoided
 - in particular, the assessment of potential research benefits should be unconstrained by less than 100% take up rates by the target group of users, leakages of the technology to competitors, or by the feasibility of doing the research. It should assume successful research and full uptake. The constraints are covered by the other three criteria.
 - R&D potential is also confused frequently with R&D capacity.
 - it will be important to ensure as far as possible that participants are quite clear about the definitions of each criterion and how it is applied before they undertake preliminary scoring. An initial review session for this purpose is recommended.

Scoring

- definitions of what the values 1 and 10 represent need to be agreed on prior to preliminary scoring to achieve consistency and avoid confusion.
- a decision needs to be made who will be responsible for scoring, ie whose scores are to count in the identification of priorities
- to the extent that implementation will require ownership and commitment by all line managers then it would be desirable to have their participation
- but the actual scoring may be restricted to the group with responsibility for determining priorities and allocating resources. In the corporate level exercise, this group comprised the Executive Committee, although input was received from each Division. A similar arrangement might apply within the Division.

Advisory Committee Input

- useful advice may be obtainable from Institute and Division Advisory Committees on key issues and research areas of significant potential benefit.
- the Division of Animal Health made use of the Advisory Committee in its priorities exercise.
- a case study report is available on request from the Corporate Planning Office.

Attachment 1

National Priorities Data Sheet

1. Subdivision: Plant Production & Primary Products

2. Key Statistics (1987-88 unless specified otherwise)

Size:

GVP	\$9200 million
Value Added	\$3851 million (forestry n.a.)
Av Protection	12% for all agriculture (excl. forestry)
Exports	\$4792 million
Imports	\$1443 million
World trade in cut flowers	(\$18 billion)

R&D:

National R&D (1986/87): \$267.67m – 9.5% Aust R&D
CSIRO R&D (1988/89): \$53.6m – 11.3% CSIRO R&D
SCA Inventory (30.6.89): 1730 professionals – CSIRO 20%
Quick and Booth

3. Other Relevant Information

- The government statement “Research, Innovation and Competitiveness” highlights the need to remain competitive and focus on sustaining the resource base.
- RIRC R&D plans

4. Key Issues and Amenability to R&D

Constraints:

- Environmental/sustainability issues – degradation/pesticides/chemicals
Transport and transport infrastructure.
- Access to native forests for wood supply industry and lack of on-shore pulping facilities.
- Commonwealth/State coordination issues. Pricing policy. Commodity approach to research funding.
- Training.

Opportunities:

- Product quality. Product specification. Product development, packaging and presentation.
- Sustainable land management systems which also improve productivity.
- Application of new biologies. Opportunities to increase crop productivity and reduce losses from diseases, pests and weeds.
- Technology transfer/extension
- Better post-harvest technology to improve transportability of perishable products.

National Priorities Evaluation Sheet

1. Subdivision: Plant Production & Primary Products

2. Attractiveness to Australia

Potential Benefit

- Increased export earnings and import savings, particularly in forestry and horticulture
- Strategic investment in new biologies will have major impact on competitive position of the agricultural, forestry and biotechnology industries. Competitive production essential for competitive value adding for Australia.
- Capacity to shift nature of plant products to match global market shifts, especially to SE Asia.
- Production efficiency increases substantial
 - field crops – 2% pa – yields \$100m GVP; \$80m exports
 - horticulture – 4% pa – yields \$80m GVP; \$8m exports
 - 22forestry – reduction in area of native forests for wood supply from 7m ha to 1m ha in 30–40 years

Ability to Capture Benefits for Australia

- RIRFS actively contribute to priority formulation and allocate funds in line with industry problems
- Financial benefits will be captured by Australians. Vertical integration of Australian owned businesses will increase benefit to Australia. Products have well established marketing infrastructure. Field crop producers have a good record of innovation and adoption of new technologies. Horticultural industries less so, apart from grapes.
- In forestry, extent of investment in processing facilities by Australian companies will determine benefit captured in Australia.

3. Feasibility

R&D Potential

- 20% increases achievable by year 2000 provided current research capacity at least maintained and advances in science applied.
- Proven ability to cope with changing markets.
- High probability of achieving sustainable land use systems and reducing pesticides and chemicals to acceptable levels, providing capacity in the economic/environment subdivision is maintained.
- New biologies starting to enter a rapid growth in application research

R&D Capacity

- The problems are unique to Australia and must be addressed in Australia.
- Currently a lot of attention being given to improving the agricultural extension system to speed up adoption rates.
- Fragmentation of research effort between CSIRO, State departments and universities being overcome.

National Priorities Data Sheet

1. Subdivision: Animal Production & Primary Products

2. Key Statistics (1987-88 unless specified otherwise)

Size:

GVP	\$12003 million
Value Added	\$6195 million
Av Protection	12% for all agriculture
Exports	\$7399 million
Imports	\$97 million

R&D:

National expenditure (1986/87): \$262m – 9.3% of total

CSIRO expenditure (1988/89): \$86m – 18.2% of total

Major performers: CSIRO, State departments of Agriculture, universities

3. Other Relevant Information

4. Key Issues and Amenability to R&D

Constraints:

- Competition from heavily subsidised products from EEC and USA
- Competition with NZ post-1992 for domestic markets
- Continually declining terms of trade
- Declining productivity of soils and pastures
- Competition from synthetic and other fibres in apparel wool market
- Association of dietary animal fat with diseases of affluence tends to limit consumption of red meats and dairy products in western countries
- Increasing discrimination by customers on the basis of quality and purity (freedom from residues)
- Most Australian fisheries fully exploited

Opportunities:

- Greater market penetration and higher price by quality control and product specification
- Improve yield, marketability and quality (including leaner carcasses) through genetic, nutritional and immunological manipulation
- Increase proportion of high value finer wools in the national clip
- Cheaper, more effective and environmentally benign ways to control pests and diseases, especially through new vaccines
- Better ways to prepare primary animal products through the processing and marketing chain
- Increase range of products (eg cashmere) and species (eg goat, buffalo, native species)

National Priorities Evaluation Sheet

1. Subdivision: Animal Production & Primary Products

2. Attractiveness to Australia

Potential Benefit

- Expanding markets, especially for beef but also for flavour-modified lamb in Pacific rim countries (AMLC forecast 1990 – Japan 100,000 tonnes, Korea 65,000 tonnes).
- Cost reductions and increased product value through the application of new technologies to improved pest and disease control, increased growth rates, absence of pesticide residues, improved carcass composition.
- Environmental damage minimised and health enhanced through reduced pesticide usage
- Production efficiency increases of only 1% pa would yield \$130m GVP, \$74m exports. Could also lead to less pressure on grazing lands – greater sustainability.

Ability to Capture Benefits for Australia

- Demand for results attested by RIRF's willingness to fund and farmers' willingness to increase levies.
- Grazing industries are internationally competitive and depend strongly on Australian research to maintain their position.
- Good track record of technology transfer to farmers.
- Conservational management of fisheries depends on local research.
- Benefits to Australian community mainly through export earnings and assured supply of quality food at reasonable prices.
- Some leakage to overseas competitors, but a substantial part of research addresses problems specific to Australia.

3. Feasibility

R&D Potential

- Track record suggests good prospects for success, and heavy investment by RIRFs indicates they expect a good pay-off.
- In the last decade, advanced technologies (including genetic engineering, advances in immunology, gene mapping) have opened up new horizons in livestock research. Substantial benefits are emerging at an accelerating rate.

R&D Capacity

- Many problems and opportunities unique to Australian environment and production systems.
- Long history of successful research and well established skills and facilities to continue.
- CSIRO, State departments and universities are now developing a coordinated approach to major problems.

Attachment 2

Role Statements

1. PLANT PRODUCTION AND PRIMARY PRODUCTS

(Field Crops, Horticultural Crops, Forestry, Primary Products from Plants)

Indicators of Research Prospects

Major export earner, high research potential and a well-developed R&D infrastructure: Produced 1.7% of the nation's GDP and generated 10% of Australia's total exports in 1988-89. Adoption of new technologies and techniques have helped industries to become internationally competitive. Field crops have been most successful and horticulture least, except for the grape industry. Although horticulture has a high R&D intensity, spread over many products and regions, capture of research benefits is low. Overall, research potential for the sub-division is high, especially for plant improvement through advances in molecular genetics. Supported by a well-developed R&D infrastructure involving the States, Commonwealth, R&D Corporations and industry.

National Research Priority Rating

Attractiveness and feasibility of research were rated sufficiently high to yield an overall rating of "strong emphasis" on the "Return to Australia" screen.

CSIRO Response

CSIRO provides major strategic focus; scope for improved efficiency and effectiveness in research: In 1986-87 8.6% of Australia's total R&D effort was for plant production and primary products. In 1989-90 11% of CSIRO's total expenditure was for this sub-division (of which 20.2% was externally funded). At around 20% of the national R&D effort CSIRO provides the major strategic focus on national research issues affecting field crops, horticulture and forestry. It has an increasing role in molecular biology and provides the major effort for integrating forestry with forest product needs. It has an important role in developing crops which are new to Australia and which have been shown to have potential. Australia's research effort could be more effective if resources were better directed toward national objectives, through regional alliances between States and a wider role for universities. CSIRO will increase its collaboration with other agencies, assembling teams to tackle major national and regional problems facing plant industries.

CSIRO Strategy

Greater selectivity, and redeployment of resources to environmental aspects of production: CSIRO's research effort will be selective, addressing such objectives as enhancing exports and import replacement; improving product quality; developing practices and systems that result in efficient, sustainable production; and improving disease and pest control while minimising use of harmful chemicals and reducing contaminants. In the short term, experienced research staff will be redeployed to environmental aspects of plant production in response to national and CSIRO research priorities (see 11. Economic Development - Environmental Aspects).

Horticulture and forestry priorities to be reassessed: Particular account will be taken of moves to improve horticultural industry efficiency and commitment to research, and of government decisions on forestry resources over the next two years. External funding of horticultural and forestry research will be expected to increase substantially.

Decision

Proposals to be selective; priority of field crops confirmed but horticulture and forestry will be reassessed within the next two years with particular account being taken of changes in horticultural industry performance and government decisions on forestry resources; proportion of external funds for horticulture and forestry expected to increase substantially.

2. ANIMAL PRODUCTION AND PRIMARY PRODUCTS

(Livestock, Fishing, Primary Products from Animals)

Indicators of Research Prospects

Major export earner, high research potential, well-developed R&D infrastructure: Contributed 2.5% of the nation's GDP and generated 17% of Australia's total exports in 1988-89. Wool and meat dominate, with high proportions of production exported. Potential benefits are high, especially in wool and meat. Ability to capture research benefits is high reflecting Australia's strong track record in exploitation of new technology and the unique needs of Australian production conditions. Research potential and capacity are high, with internationally competitive research, and support from a well-developed R&D infrastructure involving the States, Commonwealth and industry R&D Corporations.

National Research Priority Rating

The attractiveness and feasibility of this research effort were rated sufficiently high to yield an overall rating of "strong emphasis" on the "Return to Australia" screen.

CSIRO Response

CSIRO provides major strategic focus: In 1986-87 8.3% of Australia's total R&D effort was for Animal Production and Primary Products. In 1989-90 CSIRO devoted 15.7% of its total expenditure to this sub-division. At around 30% of the national R&D effort CSIRO undertakes strategic research on animal and pasture production and first stage processing of animal products, and applied research in collaboration with relevant State government departments. Its efforts are concentrated on the major extensive livestock industries, wool, sheep meats, beef and dairy as well as fisheries, pasture production and to a lesser extent the major intensive industries. Rural industry R&D Corporations and other external funds provide 29% of CSIRO funds for this sub-division. Public support is warranted because individuals cannot appropriate sufficient benefits from research to cover costs, particularly strategic research. CSIRO will seek closer collaboration with relevant Commonwealth and State government departments and industry to improve research uptake, to improve understanding of industry needs, and to build more effective multi-disciplinary research teams to tackle major issues.

CSIRO Strategy

Greater focus on product quality and marketability and more resources to environmental aspects of production: External funding will continue at or above the CSIRO target level. CSIRO will increase research on techniques for measuring and improving product quality and on the efficiency and quality of first-stage processing. Pasture research will focus on sustainable pasture management. CSIRO will focus appropriation support for research into aspects of prediction and management of fish stock abundance and distribution. Livestock production research will receive relatively less support, with resources shifted to sustainability aspects of intensive and extensive livestock production (see 11. *Economic Development - Environmental Aspects*).

Particular areas of emphasis will include biotechnology for genetic improvement of plant and animal productivity, and pest and disease resistance; biotechnology to improve pest and disease control, with particular regard to sustainability, product quality and cost-effectiveness; and relevant developments in information technologies.

Decision

Proposals should be selective, focusing particularly on product quality and marketability as well as sustainable production systems. Industry funding should increase in fisheries; external funding should remain at or above the CSIRO target level.

11. ECONOMIC DEVELOPMENT - ENVIRONMENTAL ASPECTS

(Rural Production, Minerals, Energy Resources and Supply, Manufacturing, Construction, Transport, Commercial Services, Economy)

Indicators of Research Prospects

High economic benefits, high research potential, low national research capacity:

The contribution to GDP of environmental aspects of economic development is difficult to measure as markets do not exist for all environmental products, and as yet estimates are not included in the national accounts. But, the net economic benefit from R&D for environmental aspects is likely to be high, given that it relates to every production activity in the economy. Adoption of environmentally safe and friendly technologies is expected to increase. Consumption of environmentally safe commodities is also expected to increase, with increasing public awareness and concern for environment, health and safety. The three-tiered system of government has impeded uniform technology adoption, but initiatives such as the Murray-Darling Basin Commission, ecologically sustainable development strategies and greenhouse gas emission targets reflect growing cooperation between State and Federal governments. R&D potential is high with many problems yet to be solved. The current capacity of R&D at the national level is inadequate, although an R&D infrastructure is emerging.

National Research Priority Rating

Attractiveness and feasibility of research were rated high and medium, respectively, yielding an overall rating of "strong emphasis" on the "Return to Australia" screen.

CSIRO Response

CSIRO to take a national lead: In 1986-87 1.8% of Australia's total R&D effort was devoted to Economic Development - Environment Aspects. In 1989-90, 8.9% of CSIRO's total expenditure was for this sub-division (of which 19.6% was externally funded). At almost 75% of the national R&D effort CSIRO is the major R&D performer, particularly for rural, industrial, and minerals and energy production. This is considered appropriate and necessary for the sub-division. With its high research capacity, CSIRO is positioned to take a national lead in research, being active in technologies for economic development and scientific understanding of environmental processes which underpin economic activities or are affected by them. There is scope for greater collaboration within CSIRO, especially on waste management control, and externally with private firms, government agencies and universities in Australia and overseas.

CSIRO Strategy

Appropriation and external funding to increase, especially in rural production, minerals, energy and commercial services: CSIRO will increase its proportion of appropriation funds, with short-term redeployment of experienced staff from production to environmental aspects to respond rapidly to national and CSIRO research priorities, especially in rural production (including fisheries), mining, energy and commercial services industries. At the same time CSIRO will actively seek increased funding from external sources. The research effort in estuarine and coastal environments, and waste management will expand, while the effort in pollution abatement will be maintained. Emphasis will be on sustainable development: eg attention will be given to integrating physical, biological and ecological components in sustainable agricultural production systems. Inter-divisional programs are anticipated. Efforts will be increased to improve technology transfer.

Decision

Appropriation funding to increase by a small amount in the confident expectation that this will produce external funds by aggressive "marketing"; external funding to increase from 20% to at least 30% of total effort. CSIRO to take a national lead.

12. ENVIRONMENT

(Climate, National Ecosystems, Oceans, Land Use, Atmosphere, Water Resources, Environmental Impact and Protection nec, Other Environment)

Indicators of Research Prospects

High potential benefits and ability to capture, but low research capacity: The environment's contribution to Australia's GDP is not yet included in the system of national accounts, reflecting the difficulty of assigning economic values to the environment (mostly non-priced values). However, the potential benefits of research are likely to be large, as it provides the knowledge and understanding which underpins the use and conservation of natural resources, as covered in 11. Economic Development - Environmental Aspects. Legislation to protect the environment and increasing public concern encourage the adoption of research for the environment. The field of research is highly fertile and most research issues are unique to Australia. Despite having a basic research infrastructure, Australia's current capacity is low, which limits the research effort, especially long-term baseline monitoring studies which are so important to the more applied research for the environment, such as that associated with resource development. Basic environmental research is predominantly funded by the Commonwealth government, with State governments funding more applied or industry related research areas, such as pollution control.

National Research Priority Rating

Attractiveness and feasibility of research were rated sufficiently high to yield an overall rating of "strong emphasis" on the "Return to Australia" screen.

CSIRO Response

CSIRO provides the major strategic focus: In 1986-87 3.3% of Australia's total R&D effort was devoted to research for the Environment. In 1989-90 CSIRO devoted 10.2% of its total expenditure to research for the Environment (of which 17.8% was externally funded). With almost 48% of the national research effort, CSIRO provides the major strategic focus for the sub-division. The largely public good nature of research for the environment suggests a large public sector role in R&D and a high proportion of appropriation funding within CSIRO. CSIRO's role is such that should the Organisation reduce its effort the likelihood of it being taken up by other research organisations is very low.

CSIRO Strategy

Total research effort to increase largely from growth in external funding: CSIRO will maintain its proportion of appropriation funds, but the total effort in the area is expected to increase. Growth is expected to come from external sources, especially from client State and Commonwealth government instrumentalities, by way of specific contracts and commissions. CSIRO should take a long-term view. The Organisation's major role is in understanding the dynamics of natural systems in order to develop ecologically sound management principles and tactics. Securing access to, and assessment of data from a new generation of earth orbiting satellites, and the application of molecular biology to aspects of research for natural ecosystems warrant special attention. Other important considerations in future research include technology transfer and the public interest. CSIRO will maintain an involvement in natural resource accounting which will be useful in demonstrating the economic value of environmental research as well as its policy implications.

Decision

Total appropriation effort to be maintained through specific proposals in priority environment areas; any growth in CSIRO's effort to be largely from external funds; external funding could be less than the CSIRO target level.

Annex B.

CSIRO Division of Soils National Priorities

Data Sheet

Subdivision: Economic Development – Environmental Aspects (110 000)

1. CLASS: (1) – SOIL EROSION AND SOIL STRUCTURE LOSS – Research and development to minimise, ameliorate and rehabilitate degradation due to soil erosion and damage to soil structure.

- Definition: Soil erosion by water and wind, and damage (physical and chemical) to soil structural condition. Salinity, acidity, pollution, water quality and issues relating to fertility decline are covered in other classes.

2. KEY STATISTICS

- It is estimated soil structural decline cost \$145 million in lost production in the Murray Darling Basin in 1987.
- 800,000km² of Australia's grazing lands have a soil erosion problem; 150,000km² severely eroded.
- In 1978 numbers of \$600 million was estimated as the cost of controlling erosion.

3. OTHER RELEVANT INFORMATION

- 8 bags of soil lost per bag of wheat exported.
- The number of Landcare Groups in Australia has increased ten fold to over 1100 in the last three years. Many have erosion and structural damage as their key concern.

4. KEY ISSUES AND AMENABILITY TO R&D:

(a) Constraints

- Collaborative work between the division and remote state authorities is hampered by distance and travel costs.
- There is no wind erosion research group in the division.
- Scale of the structural damage problem is unclear on a national scale.
- Linking between the importance of understanding process and management decisions are not firmly established in the funding agencies' minds. The importance of predictive models as management tool is not appreciated, by funding and action agencies.
- Uncertain estimation of the cost/benefit of better management.
- Low farm profits reduce landholders' ability to implement landcare action.
- Lack of political will to legislate the use of scientifically based soil conservation measures.

(b) Opportunities

- Process work gives broad application of understanding and management soil degradation.
- The community through the media has increasing awareness of the importance of the problem – 90% of Australians believe our environment is threatened (up from 45-50% in 1985/86).

-
- Land-user community is becoming more receptive to investment in land degradation research including soil erosion and structural damage.
 - The established state and territory soil conservation authorities in collaboration with CSIRO and University can act as a vehicle for technology transfer.
 - Erosion and surface degradation associated with urban, forestry, mining and recreational lands is a relatively untapped area of research in Australia. These problems offer high value protection schemes, proximity to laboratories and a high public profile.
 - The division's broad skill base makes it capable of undertaking multi-disciplinary research projects.

Examples of areas in need of further research

- compacted and sodic B-horizons
- mechanisms of surface crusting and hard setting
- surrogate measures of erodibility and structural degradation
- biological drilling
- the role of surface roughness in managing surface runoff
- the effect of soil conditioners on aggregate stability
- the influence of compaction on crop production

CSIRO Division of Soils National Priorities

Evaluation Sheet

*Subdivision: Economic Development –
Environmental Aspects (110 000)*

1. CLASS: (1) – SOIL EROSION AND SOIL STRUCTURE LOSS – Research and development to minimise, ameliorate and rehabilitate degradation due to soil erosion and damage to soil structure.

2. ATTRACTIVENESS TO AUSTRALIA:

(a) Potential benefit

- Managing erosion and soil structure damage has benefits to Australia on both economic and environmental grounds. As such it is attractive to industry and the public.
- Management of soil erosion and structural degradation has direct benefits for water quality.
- The division's work in this area can lead to a firmer definition of sustainable land use.
- Work has benefit to community in both the short and long term.
- By taking a national role in soil erosion and soil structure research CSIRO Soils can avoid duplication across state boundaries (which currently occurs).
- Of the "western" nations Australia's environment is most similar to many large developing nations. Thus the research is readily transferable and marketable in such nations.

(b) Ability to capture benefit for Australia

- Infrastructure which enables soil degradation research to be transferred to end users has been developed through the 1980's through the formation of a network of Land Care Groups, the National Soil Conservation Program and the Soil and Water Conservation Society of Australia.
- Current external funding guidelines encourage closer collaborative links with user agencies enhancing the transfer described above.
- Technology addressing soil degradation problems which Australia shares with other countries can be of benefit to Australia by fostering environment-based industries with an international market. Examples of this are agricultural implements, soil monitoring instruments and soil management software. Environment-based industry is a growth area overseas e.g. Soil Moisture Inc USA, which has demonstrated the profitable marketing, both overseas and in Australia, of Australian research products.
- The benefits of research into degradation problems specific to Australia (e.g. hard setting soil) are returned directly to Australia.

3. FEASIBILITY

(a) R&D Potential

- Much of the process research that has, and is, been conducted within the division has great potential within a modeling framework. Usable information in a systems framework with risk analysis is only possible with such modeling.
- Major issues in the area of soil erosion remain. For example, it is well known that soil cover reduces erosion. However, the appropriate type and configuration (clustered or uniform, anchored or unanchored) of the cover is poorly understood.

-
- Land management policy requires clear definitions of environmentally sustainable land use.
 - Structural decline has been identified as an area where degradation is economically reversible.

(b) R&D Capacity

- The division's modeling capability is improving. Closer links with other divisions would greatly enhance this.
- Some valuable long term field experiments are in place.
- Established facilities, such as Canberra's raintower, enable research unique in Australia.
- Current funding provides some external support to soil degradation research.
- Transfer of research outcomes is greatly enhanced by secondments from state authorities.
- Industry links to mining, forestry, urban and recreational land users remain relatively undeveloped.

Annex C.

CSIRO Division of Soils

Areas of Research Opportunity from 1991 Workshop

1. **Soil erosion and soil structure loss** – research and development to minimise, ameliorate and rehabilitate degradation due to soil erosion and damage to soil structure;
2. **Salinity** – research and development to identify risk minimise and ameliorate salinity;
3. **Water quality** – research and development to minimise the impact of rural production on water quality;
4. **Chemical residues in soils, plants and water** – research and development to minimise the impact of chemical residues on our environment;
5. **Soil acidity** – research and development to identify risk, minimise soil acidification and ameliorate the impact of soil acidity on plant production;
6. **Mine site rehabilitation** – research and development to minimise, ameliorate and rehabilitate the impact of degradation arising from mineral production;
7. **Field crops research** – research and development with cereals, grain legumes and oil seeds to benefit their production and the maintenance of the resource base;
8. **Sugar** – research and development to benefit ecologically sustainable production of sugar;
9. **Horticulture** – research and development to benefit the ecologically sustainable production of nursery, vegetable, trellis and tree crops;
10. **Pastures** – research and development to benefit ecologically sustainable pastures production.
11. **Forestry** – research and development to benefit ecologically sustainable forestry production.
12. **Land use and resource assessment** – research and development to enhance the matching of land capability and land use, particularly in farmland and the coastal zone;
13. **Terrestrial ecosystems** – research and development to understand the functioning and role of terrestrial ecosystems in sustainable production and biodiversity;
14. **Land disposal of wastes** – research and development into the ecologically sustainable management of nutrient rich effluents from sewage and rural based industries.

Annex D.
CSIRO Division of Soils
Project Evaluation 1992/93

Project No. _____

Project Title: _____

A. PROJECT PRIORITY ASSESSMENT (H, M or L)

ARO Category

1. Soil Erosion/Structure
2. Salinity
3. Water Quality
4. Chemical Residues
5. Soil Acidity
6. Mine Site Rehabilitation
7. Field Crops (Wheat/Barley/Oilseeds etc)
8. Sugar
9. Horticulture
10. Pastures
11. Forestry
12. Land Use and Resource Assessment
13. Terrestrial Ecosystems
14. Land Disposal of Wastes
15. Mining Production/mineral analysis

B. PROJECT QUALITY ASSESSMENT Score 5 – Yes or High 1 – No or Low

1. PROJECT GOALS The project has clearly defined objectives, outcomes and timetable.	
2. SIGNIFICANCE The economic, environmental and social benefit of this project to Australia.	
3. CONTRIBUTION TO OTHER PROJECTS The extent to which the project influences the outcomes or effectiveness of collaborative or related projects.	
4. CLIENT INTERACTION The extent to which the project addresses agreed client needs and the degree to which results are likely to be adopted.	
5. COMMUNICATION The extent to which the project has an adequate plan for communication and technology transfer.	
6. R&D POTENTIAL Does the project address a fertile research area? Where is the current technology on the sigmoid curve?	
7. PROBABILITY OF SUCCESS The extent to which the project is likely to achieve its technical objectives on time and within budget.	
8. DIVISIONAL RESOURCES The requested resources are appropriate and available from the Division.	
9. EXTERNAL RESOURCES The proposed project is highly likely to attract external resources.	
10. PREVIOUS PERFORMANCE The project team members met previous targets.	
Total Score /50	

ATTRACTIVENESS: Benefits Categories 2,3
 Capture Categories 4,5

FEASIBILITY: Potential Categories 6,7
 Capacity Categories 8,9,10

Annex E.

CSIRO Division of Soils

*Divisional Management Meeting, Adelaide.
27 April – 1 May 1992*

Provisional Agenda

MONDAY: 8.30am-5.00pm

Workshop to confirm, clarify and prioritise areas of research opportunity (ARO) for the Division. This will be facilitated by Dr Ralph Young of the Corporate Planning Office.

Ralph Young will present us with a context for priority setting using ARO and the part this plays in establishing the strategy for the Division.

Attached is our working set of ARO's.

All projects must be able to be classified within these ARO's. Some projects may contribute to more than one ARO.

Outcomes

- Clarification and endorsement of Divisional ARO's.
- Prioritisation of ARO's based on CSIRO evaluation procedures (attractiveness, feasibility).
- A priority grouping of ARO's which will form an essential component in project evaluation.

TUESDAY: 8.30am-5.00pm

Ranking of all Divisional project proposals.

We will use the attached worksheet, based on previously agreed criteria merged with the CSIRO priority methodology.

There are two discrete components of project evaluation:

- The project priority.
- The project quality.

All Program Managers must use the sheet to assess ALL projects (including AA, AB and AX), but pay particular attention to those projects in their own program and be prepared to clarify details as necessary.

Outcomes

- Project quality will be ranked by assigning a score out of 50.
- Projects will also be assigned a priority (high, medium, low) based on the priority of the ARO to which they contribute.
- Projects will be located on a diagram which plots Priority against Project Quality.
- This diagram will provide a basis for ranking, approval and allocation of resources to projects.

WEDNESDAY and THURSDAY MORNING

Develop provisional resource allocation 1992/93:

1. Global Divisional Budget.
2. Divisional support services needs and plan.
3. Communication/technology transfer plans.
4. External funding/target and project funding plans.
5. Personnel deployment/training/PPE.
6. Capital/MIE/building plans

THURSDAY AFTERNOON

Presentation and endorsement of:

- Program Reports.
- Performance Report 1991/92.
- Operating Plan 1992/93

FRIDAY

Performance Report and Operating Plan presentation to the Director:

- Chief's Overview
- Program Manager presentations:
 - Research Programs(E,F,M,R,S)
 - Communication and Business Development (AX)
 - Administration (AB)
 - Technical Development and Analysis (AA)
- Report from the Director

*DE Smiles
Chief of Division
13 April 1992*

Annex F.

CSIRO Division of Soils

Matrix Analysis of Research Opportunities

SEO	Erosion	Salinity	Water Quality	Acidity	Land use/ Assessment	Terr Eco Systems	Chem Residues	Soil Fertility	Plant Health	Water Use
Field Crops	+++	+++	++	+++	+++	+++	+++	+++	+++	+++
Pastures	+++	+++	+	+++	+++	+++	+++	+++	+++	+++
Horticulture	++	+++	+++	++	+++	+++	+++	+++	+++	+++
Forest	++	—	+	—	+++	+++	—	+++	+++	+++
Mining	++	—	++	—	—	+++	—	++	—	—
Tourism	++	—	++	—	+++	+	—	—	—	—
Const. Urban.	+	—	+	—	+	—	+++	+	—	—
Conserv/Env Prot	—	+	++	+	+++	+++	+++	—	+	+++
Water Industry	+++	+++	+++	+	+++	++	+++	—	+	+++
Waste Disposal	+	++	+++	++	+++	++	+++	+++	—	+++

Annex G.
CSIRO Division of Soils
Areas of Research Opportunity

CROPS	Erosion/ Salinity/ Water Quality/ Acidity/ Land Use/ Terrestrial Ecosystems/ Soil Fertility/ Chemical Residues/ Plant Health/ WaterUse
PASTURES	Erosion/ Salinity/ Water Quality/ Acidity/ Land Use/ Terrestrial Ecosystems/ Soil Fertility/ Chemical Residues/ Plant Health/ WaterUse
HORTICULTURE	Erosion/ Salinity/ Water Quality/ Land Use/Terrestrial Ecosystems/ Soil Fertility/ Chemical Residues/ Plant Health/ Water Use
WATER	Erosion/ Salinity/ Water Quality/ Land Use/Terrestrial Ecosystems/ Soil Fertility/ Chemical Residues/ Plant Health/ WaterUse
WASTE MANAGEMENT	Erosion/ Salinity/ Water Quality/ Land Use/ Terrestrial Ecosystems/ Soil Fertility/ Chemical Residues/ Plant Health/ Water Use
CONSERVATION/ ENVIRONMENTAL PROTECTION	Water Quality/ Land Use/ Terrestrial Ecosystems/ Chemical Residues/ Water Use
FORESTRY	Land Use/ Terrestrial Ecosystems/ Soil Fertility/ Plant Health/ Water Use
MINING	Erosion/ Water Quality/ Terrestrial Ecosystems/ Soil Fertility
TOURISM/LAND USE	Erosion/ Water Quality/ Land Use

Annex H.

Research Priorities Criteria

Key Discriminant Questions

POTENTIAL BENEFITS

(Maximum economic, environmental and other social returns possible for Australia from technical improvement in the Sub-division.)

- Who are the potential users and customers and how will they benefit?
- What parts of industry and/or the community will benefit from successful research?
- How will R&D contribute to industry growth and improved competitiveness?
- What is the size of potential markets in Australia and overseas, in value terms, and what are their growth prospects over the medium to long term?
- Are there any other important benefits, direct and indirect- environmental (degradation avoided), social (social amenity, health, safety), employment creation?
- Are there spillover benefits to other industries?

ABILITY TO CAPTURE BENEFITS

(Ability of Australia's companies, utilities and organisations to convert technical progress into commercial or other returns)

- How will successful research be captured in Australia; what is Australia's ability to exploit the results?
- Are there potential commercial partners?
- Can the benefits from the research output be protected?
- What are the incentives/imperatives for adoption by commercial or public sectors?
- What is the industry's and/or community's commitment to R&D and technical innovation?
- Can Australian users compete internationally?
- Are there factors and conditions likely to promote or impede uptake, such as regulations, industry structure, physical conditions, ethical, cultural/social, environmental or political factors?

R&D POTENTIAL

(The technical potential of relevant areas of research and development: maturity of the fields; closeness of the technical and physical limits; breakthrough prospects)

- How close are the physical and technical limits in the relevant R&D?
- Are fields mature or developing? (Where is current technology on the S-curve?) – i.e., is the rate of change rapid, moderate or slow?
- What are the prospects for developing commercially valuable intellectual property, scientific breakthroughs, or major improvements in mature technologies and fields?

R&D CAPACITY

(A measure of the national research ability, in terms of the quality and quantity of resources, to achieve the R&D Potential and technical goals in a timely way)

- Would the proposed research effort (in terms of the quantity and quality of resources – critical mass and quality of researchers) be internationally/nationally competitive in the research field?
 - What is the competitive advantage(s) of Australia's (CSIRO's) research effort?
- Who are the major international (national) research competitors?
- Does Australia/CSIRO have the capacity to deliver the research, in terms of adequate skills, facilities, and time frame for effective application?

CSIRO Planning Reports, Papers and CSIRO Plans

Copies of the following reports, papers and plans can be obtained from the CSIRO Corporate Planning Office at PO Box 225, Dickson ACT 2602, or phone (06) 276 6177, email: cpo@cpo.csiro.au

Planning Papers - general

CSIRO Corporate Planning Office (1989), *A Preliminary Situational Analysis for CSIRO*, November.

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- Pik, A.J. (1991), *Priorities? What priorities?* CoResearch, No., September, p.5.
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- Blyth, M., MacRae, D., and Young, R. (1991), *Setting Priorities for an R&D Organisation*, paper presented to AIC Conference, The Role of Management in Commercialising Research and Technology, Sydney, December.
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