SENSITIVITY ANALYSIS FOR RESEARCH PRIORITY SETTING WITH MULTIPLE OBJECTIVES AT ICRISAT[1]

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ABSTRACT

The determination of the priority research portfolio of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is based on a structured, analytical priority-setting framework where a composite index is derived to reflect its multiple research objectives. An analysis of the data set generated in the process of determining ICRISAT's priority portfolio features the strengths and weaknesses of the priority setting approach adapted, where two issues are addressed, namely:(1) bias in the generation of data; and (2) disparity between the commodity-level priorities set by ICRISAT and those by the CGIAR. Clarification of these issues is attained by analyzing the tradeoffs involved under different scenarios regarding the relative importance of the specified objective-related criteria.

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by

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1. Introduction

The determination of ICRISAT's priority research portfolio is based on a structured, analytical priority-setting methodology where a composite index is derived to reflect its multiple research objectives. A set of measures is established for each of the following criteria: economic efficiency, equity, internationality and sustainability. Of interest is the rich data set generated in the process marking research objectives, estimated yield losses due to production constraints, expected yield gains achievable via research, probability of success, rates of adoption, adoption ceiling, research time lags, and adoption time lags for each of the 110 research themes defined for ICRISAT's research portfolio plan. The resulting database lays a foundation for a systematic priority-setting exercise across the various disciplines covering all research programs.

Analysis of the above data set provides an opportunity to illustrate the analytical power and usefulness of the methodology and data generated during the above-mentioned planning exercise. Its strengths and limitations are examined, addressing in particular two issues, namely: (1) bias in the generation of data or apparent lack of consistency in estimates across programs; and (2) disparity between the commodity-level priorities set by ICRISAT and those by the CGIAR.

Clarification of these issues is attained by analyzing tradeoffs involved under different scenarios regarding the relative importance of the specified objective-related criteria. As research management pays particular attention to tradeoffs among themes at the low end of the priority spectrum most likely to be affected by budget cut-off, analysis is focused on research themes clustering around potential budget cut-off points. An examination of these clusters finds significant shuffling among themes around the budget cut-off points even with marginal changes in parameter estimates or weighing system used.

2. Objectives and measurable criteria

The CGIAR mission statement reads:

> "Through international and related activities, and in partnership with national research systems, to contribute to sustainable improvements in ways that enhance nutrition and well-being, especially for low income people" (TAC Secretariat, 1992).

Like other sister institutions within the CGIAR, ICRISAT's regional and global mandate is well-defined by this mission. Her geographic regional mandate is the semi-arid tropics, where the world's poorest and hungriest people live. The global crop mandate includes six food crops - sorghum, pearl millet finger millet, groundnut, pigeonpea and chickpea - mainly grown by the poor in the harsh and undependable environments of the world.

The objectives of ICRISAT as expressed by the mission statement above may be translated into a set of measurable criteria, namely: economic efficiency, equity, internationality and sustainability. A brief discussion of the measurements (ICRISAT, 1992) used for each criterion follows.

Economic efficiency. Discounted net benefit cost ratios were calculated to estimate the efficiency of research investments. Net present value of research benefits was calculated as follows: The expected annual value of yield gains which would be achieved should the research be successful was obtained by using yield loss data and anticipated percentage yield improvement from research, applied to the known production within the targeted domain(s). This figure was subsequently discounted according to probabilities of success, ceiling rates of adoption, and time value (discounted cash flow) relating to anticipated research and adoption lags to generate the present value of benefits. An aggregation of all net present values over a specified time horizon for which benefits continue to accrue provides the total benefit in present value terms or the total net present value.

Research investment costs were obtained by accounting for human capital cost plus value of capital items. For each theme, the discounted value of principal scientists' cost and of special capital cost were calculated for each year that active research was projected, with the sum of these figures providing the total ICRISAT cost in present value terms.

Having computed the total cost and total benefit (in present value terms), with adoption levels and probability of success taken into account, the net benefit/cost ratio was obtained by dividing the net benefit (total discounted benefit less the discounted cost) by the discounted cost.

Equity. Two proxy variables, poverty and female literacy, were used to measure the distribution of benefits obtained from research. The first was measured by the total number of poor in the primary domain(s) for which the research was targeted; and the second by the number of female illiterates. This latter figure is an indication of human welfare development, and also a measure of the potential impact of the research on the gender issue.

Internationality. The 'internationality' of a research theme was considered significant, i.e., an IARC such as ICRISAT should have its activities weighted towards projects of greater international impact, leaving purely national projects to the NARSs. To indicate 'internationality', the Simpson Index of Diversity was used.

Simpson Index of Diversity:

$$I_i = 1 - \sum_j \left(\frac{S_{ij}}{100}\right)^2$$

where S_{ij} = share of total yield gain resulting from research theme i which is realized in country j. In this case, a higher factor indicates greater internationality.

Environmental sustainability. Research themes were given a rating of 1 to 5 to indicate their contributions to sustainable agriculture. A low rating of 1 relates to a research theme which makes no, or only negligible, contribution to sustainable agriculture. On the other extreme, a rating of 5 would be given to a theme where primary focus of the research is the enhancement of the natural resource base.

Database for research evaluation. Calculation of measures of the four criteria identified requires an extensive database. The resulting database, built up in the medium-term planning process conducted by ICRISAT, contains comprehensive data for each of the 110 research themes on research objectives, target research domain, estimated yield losses, expected yield gains, probability of success, adoption rate and ceiling level, research and adoption lags, expected output, and required manpower and capital requirements. This database is an invaluable benchmark for research evaluation of future projects relating to the research themes identified.

The datafile structure, shown in Figure 1, indicates the relationship among the variables underlying efficiency, equity, internationality and sustainability. It shows their linkages with each other and with the four measurable criteria. The diagram depicts a composite index derived as a weighted average of these four parameters. The simulations discussed in this paper are facilitated by the systematic linkages established.

3. Research portfolio: description of priorities

ICRISAT's portfolio of (ranked) research themes is presented in Table 1. This set of priorities in the Medium Term Plan, representing the situation where efficiency, equity, sustainability and internationality are given equal weights, is taken as benchmark for this analysis. Figure 2 depicts the composite index - cumulative cost mapping of the 92 research themes slated for core funding arranged in order of their priorities. The distinct mark assigned to each commodity or unit clearly shows the commodity/unit level distribution of priorities. Figures 3 and 4 give a pictorial

summary of the standing of each commodity or unit. The budget cutoffs indicated on the right hand side of these composite index - cumulative cost mapping explicitly show the number of themes affected in alternative budget scenarios. The figures clearly indicate that Genetic Resources Unit (GRU) and groundnut research comprise the highest priority themes where none drops out in any of the funding schemes; chickpea, Resource Management Program (RMP) and sorghum lose at most only three themes each in a constrained funding situation: while a significant number of pigeonpea and pearl millet themes is expected to be dropped in a constrained funding situation.

4 Lack of Consistency or Bias?

This section examines the issue of bias or apparent lack of consistency in the data underlying the composite index across programs. The generation of the data was a year-long process where every scientist from each of the programs of the Institute was involved. To minimize differences in judgments across programs, ICRISAT conducted an internal review of each of the program estimates and the judgments are taken as the best available from the Institute during that time.

The estimates of the measurable criteria underlying the computation of the composite index were examined. Figures 5 and 6 summarize the information depicting the averages of estimates of parameters (e.g. probability of success, adoption ceiling, research costs and adoption lag) used in calculating the efficiency index (net benefit cost ratio). This type of information assists in identifying which factors account for the priority setting of themes classified by commodity group or research unit. Comparison of the data for probability of success and ceiling level of adoption at the commodity group/research unit level of disaggregation (see figures 5c and 5d) does not confirm the bias of estimates that is commonly perceived.

Figure 7 illustrates the relative position of commodity groups/research units ranked by the composite index and the five indices from which it is based (net benefit cost ratio (NBCR), poverty, gender, internationality and sustainability). The composite index shown in panel (f) explains the following priority ranking by commodity group/research units: 1) GRU; 2) GN; 3) CP; 4) RMP; 5) SG; 6) PP; and 7) PM. The relative positions of the commodity/unit groups with respect to the five measurable criteria shown in panels (a) to (e) explicitly clarify the basis of the priorities set in the medium term plan (MTP) research portfolio.

The GRU group of themes stands out (see Figure 7f) with clear advantage in all respects, i.e., NBCR, poverty, gender, internationality and sustainability. Inspite of its low NBCR figure, groundnut is ranked second as it gains advantage over the other five groups with respect to poverty, gender, internationality and sustainability. Figure 7a (net benefit cost ratio) features the superior advantage of chickpea themes over all other crops in terms of their potential net benefit cost ratio.

Pearl millet and pigeonpea are shown as two commodity groups competing for the last drops from the CG-bucket. Pearl millet themes rank lowest with respect to four indices: NBCR, poverty, gender and sustainability. The relative high standing of pigeonpea themes with respect

to efficiency, poverty, gender and sustainability is overcome by its very low rating on internationality.

If lack of comparability is perceived in these variables, then clarification of this issue may be attained by checking how the priority sequence shifts when the weights assigned to these criteria are changed. Thus, the following set of cases was considered:

Set A:	Case 1.	Zero weight for efficiency
	Case 2.	Zero weight for sustainability
	Case 3.	Zero weight for internationality
	Case 4.	Zero weight for equity

where the composite indices were recalculated with one-at-a-time changes to the weights of the four criteria. In all of the above cases, the other three factors are given equal weights. Pairwise comparisons of the implied priorities of the four criteria show independence, i.e. the priority ranks with respect to one criteria is not the same as that of the other three; thus, inclusion of all criteria in the composite index is meaningful.

How do the priorities change with changes in the weighing system? Figures 9(a-d) present the results where a comparison between the research priorities set in the MTP equal-weight benchmark and those implied when each of the four criteria is given a weight of zero. Tables 2 to 5 contain a list of the themes with rank comparisons between the benchmark and the cases highlighted in the last two columns.

The correlation between the benchmark and case 1 indices is relatively low (0.77). Refer to the correlation summary given in Table 11. When the efficiency criterion is given a weight of zero in the case 1 simulation, six themes are observed to drastically shift from high priority to low priority rank. These themes all have high efficiency indices and are shown as the 'outliers' in Figure 9(a). All six are legume themes: 5 representing chickpea (drought, aschochyta blight, insect damage, wilt and root rot) and 1 for pigeonpea (genetic yield potential). This observation suggested a review of the set of technical information available for the chickpea themes. The data behind these "outlier" themes were re-examined by the legumes program, and the original judgments on benefit/cost ratios were validated. They relate to themes on which much work has already been done, so probabilities of success are hig' and on-going incremental costs are low. Refer to Figure 5 (c and f). Two factors are identified to account for the above observation. These are (1) number of scientists required to achieve research objective; hence the cost of research; and (2) market price. The substantial price differentials among commodities as shown in Figure 8 account for the higher NBCR valuation for the chickpea themes. Some technical information documented in Appendix 1 are valuable in understanding the estimates provided.

Greater congruence is observed by the pairwise comparison between the indices of the benchmark and cases 2, 3, and 4. High degrees of correlation (with coefficients equal to .95, .96 and .92, respectively) are shown in Figure 9(b-d). These results indicate that there are no significant

changes in the MTP priority rankings when each of the three criteria (sustainability, internationality and equity) is ignored in computing the composite index.

The four simulations show that the priority sequence shifts substantially only in the case where zero weight is assigned to efficiency. The assignment of zero weight to each of the three other criteria did not significantly change the MTP priority rankings.

5. Disparity between the commodity level priorities set by ICRISAT and those by the CGIAR

Consideration of the internationality criterion raises questions regarding continuing research investment on pigeonpea by an international organization, given the fact that pigeonpea is a commodity primarily grown in India. The difference in the commodity level priorities set by the Center and by the CGIAR may be examined by considering greater weight to the internationality criterion. In this case, Case 5, the internationality index is given a weight three times the weight for each of the other factors. This idea stems from the fact that ICRISAT is an international research organization and thus research management must consider the internationality nature of a commodity as a critical variable in research evaluation.

A complete list of the priorities implied by case 5 with comparisons with the MTP rankings is given in the last two columns of Table 6.

Analysis based on the magnitudes of the composite index illustrates considerable clustering of themes with near identical composite indices around the potential cut-off points (mean and mean-10%), such that although rankings change only a little, there are significant changes in themes which fall (just) below the cut-off points. Figure 10 illustrates the results of this exercise. Also, refer to Table 7.1(a); and compare Figure 10 (a and b). At the mean level, tripling the weight of internationality has the effect of moving 2 pearl millet and one chickpea themes above the cut-off at the expense of 4 pigeonpea themes which drop out. This is an important information for research management in deciding cases around the cut-off point.

Let us examine the implication of the above exercise on pigeonpea. First, note that the relative advantage of pigeonpea over pearl millet in the benchmark case can be accounted for by recalling the information contained in Figures 5 to 7. The driving variables are the same variables that drive the chickpea index, namely: (1) number of scientists required (hence the costs: average of .22 million dollars for pigeonpea versus .52 million dollars for millets); and (2) the market price ($478/ton for pigeonpea versus $114/ton for pearl millet). By giving more importance to the internationality criterion, the composite index corresponding to all pigeonpea themes declined as expected. As a consequence, 4 additional pigeonpea themes are to be dropped if a budget equivalent to the MTP mean resource envelope is provided.

The analysis presented so far gives indications of the priority shifts that occur at the low end of the priority spectrum. It brings to the fore the importance of assuring consistency and comparability in the generation of data.

6. Implication of alternative research envelopes: A comparison of the priority benchmark with alternative scenarios

Aside from the cases already considered, two sets of simulations were further undertaken. These are:

Set B. Four cases where each factor is given twice the weight of the other three factors, i.e.

Case 6:	Internationality index given twice the weight of other factors
Case 7:	Sustainability index given twice the weight of other factors
Case 8:	Efficiency index given twice the weight of other factors
Case 9:	Equity index given twice the weight of other factors

Set C. Four cases where each criteria is given one half the weight of the other three factors, i.e.

Case 10:	Internationality index given one half the weight of other factors
Case 11:	Sustainability index given one half the weight of other factors
Case 12:	Equity index given one half the weight of other factors
Case 13:	Efficiency index given one half the weight of other factors

The above weighing changes are much less drastic than those used in Cases 1 to 5.

Of significant interest to research management is the set of research themes which are potentially at risk under the various scenarios in consideration. Table 7.2 presents a summary of results for all simulations containing the list of themes that fall below two budget "cut-off" margins, namely: a) mean resource envelope; and b) mean minus 10%.

Another summary table, Table 8, gives the number of research themes that drops out given the two alternative funding situations. For example, given the mean resource envelope, a total of 11 to 14 themes drops out under the thirteen cases considered. To illustrate the information contained in the summary table, Table 7.2a for the mean resource envelope situation (columns 4 and 5), 7 themes are common in the benchmark and case 1 situations. Five themes (1 PM, 2 PP, 2 RMP) move above the cutoff margin as a result of assigning a weight of zero to the efficiency index. Meanwhile, 6 themes (1 GN, 2 CP, 3 RMP) drop out of the priority list.

Between the benchmark and case 5 situations, 9 themes are common. Two pearl millet and one chickpea theme move up the priority list while four pigeonpea themes drop out.

A summary of the research cost involved is given in Tables 9 and 10. Table 9 indicates the expected gains and losses of each program as a result of following the various scenarios. Referring to column 2 of Table 9(a), the Legumes Program expects to gain $.44 million dollars for 2 pigeonpea themes (water logging and podfly) but loses $.36 million dollars for 2 chickpea themes (aschochyta blight and wilt) and 1 groundnut theme (adaptability). The Cereals Program

gains .3 million dollars for one theme (head caterpillars). The RMP Program gains .31 million dollars for two themes (seed distribution and institutional and human resources) but loses .51 million for three other themes (characterization of environment, farmer's preferences and research impact).

Table 9 (a and b) illustrates the budget implications following the case 5 scenario. It features the significant gain of pearl millet and chickpea research ($.59 and $.19 million, respectively) at the cost of research on pigeonpea ($.64 million).

For Case 7 at the mean resource envelope, doubling the weight for sustainability criterion brings one sorghum research theme (drought-SG) out of funding in favor of two pigeonpea (water logging and podfly). This involves a gain of $.44 million for water logging and podfly research in pigeonpea at the cost of $.85 million for drought-SG research.

Overall, a significant degree of congruence is observed between the priority indices for the benchmark and the various scenarios. This is shown in Table 11, which contains the correlation coefficient for all cases. The extent to which priority shifts occur within the critical band is determined from the correlations computed for the themes falling around the critical margin, eg. those themes with rank greater than 62 or those ranks between 62 and 83. A significant decline in the correlation is noted in the former group; and a more drastic decline in the latter group.

The above information regarding tradeoffs under the different scenarios provides research management a basis for resolving the issue regarding the difference perceived between the commodity level priorities set by ICRISAT and by the CGIAR.

Figure 1. Data File Structure for ICRISAT's Research Portfolio

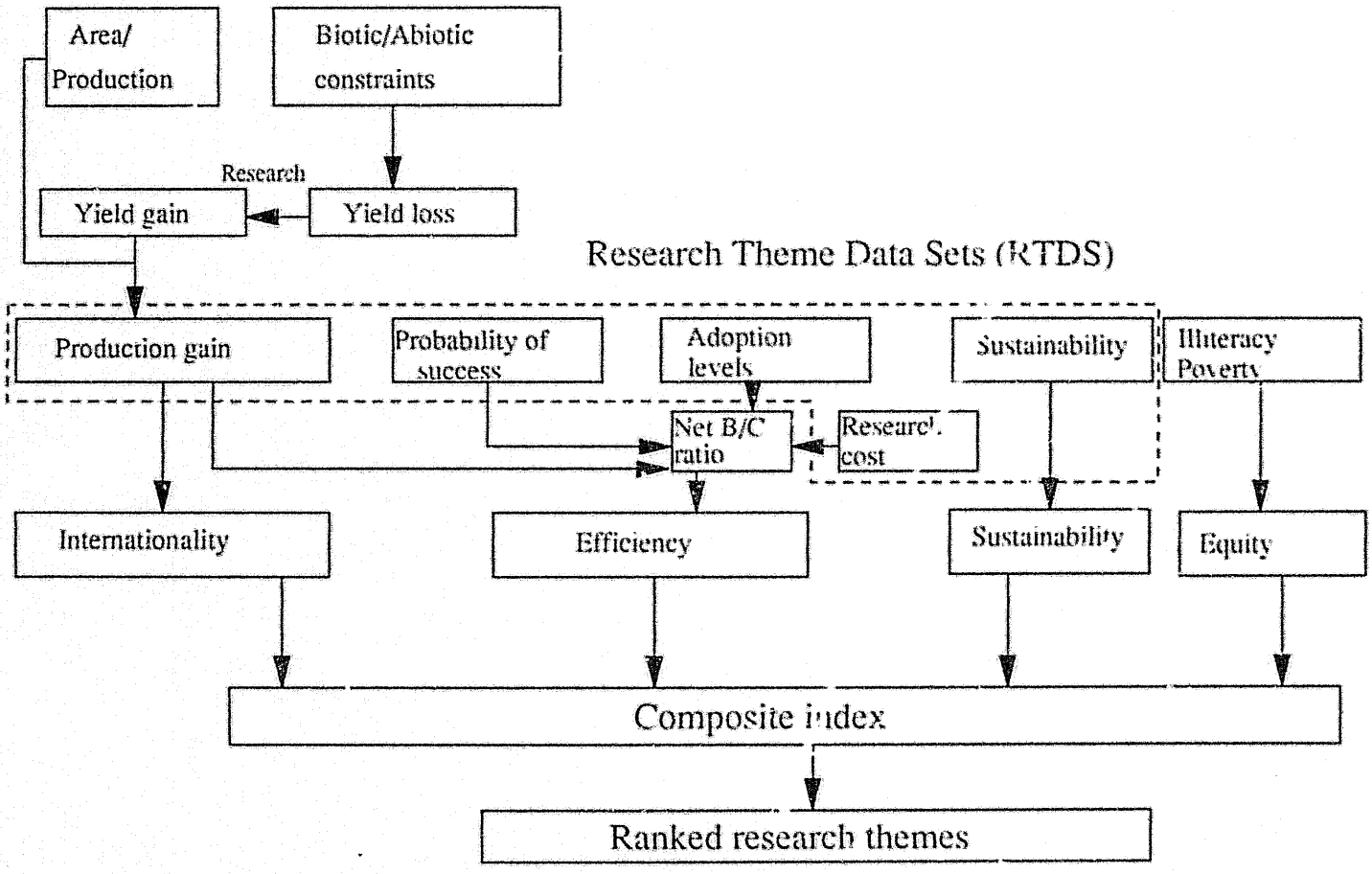


Figure 2. Cumulative cost vs Composite index
(based on benchmark - for all themes)

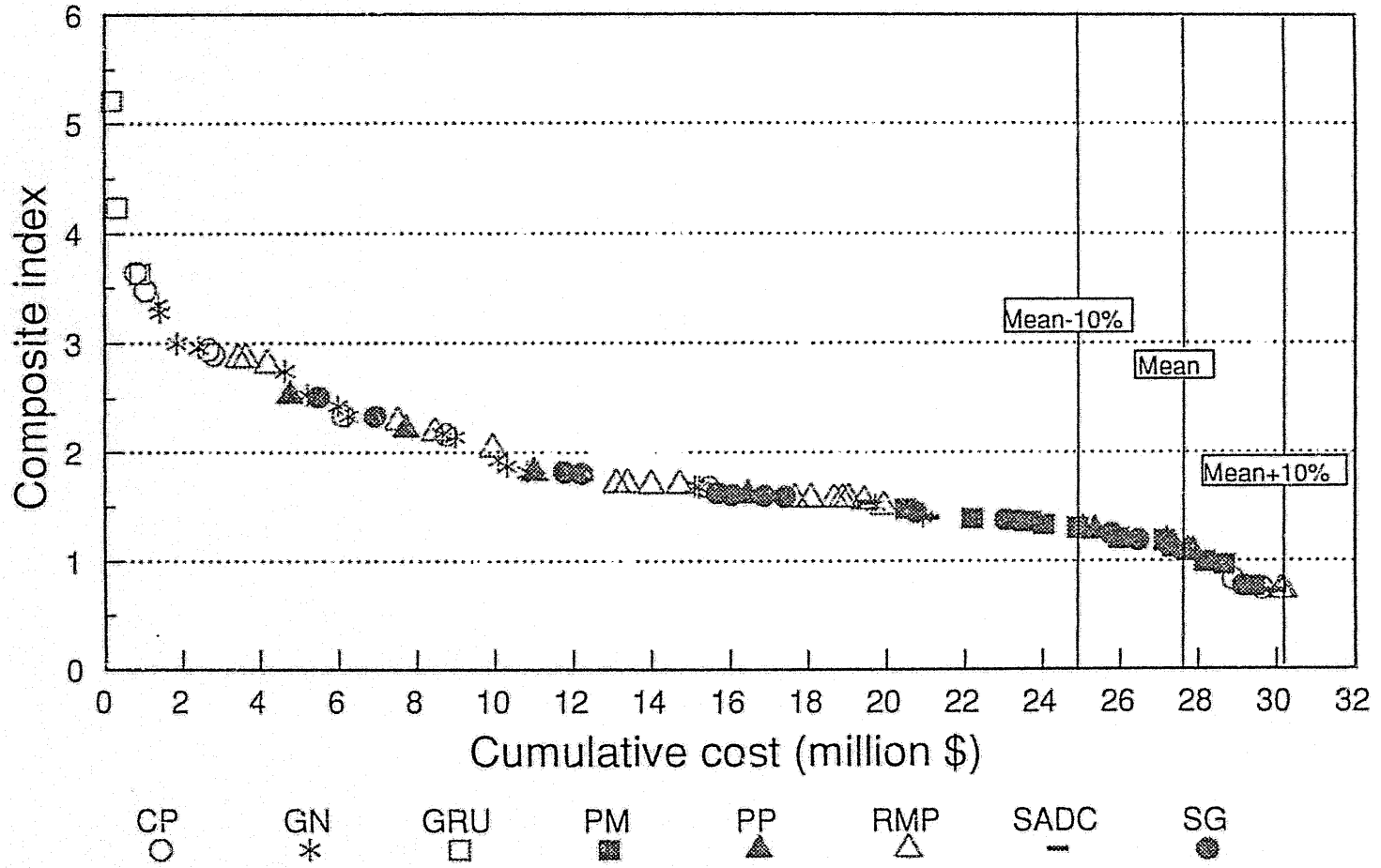


Figure 3. Cumulative cost vs benchmark composite index

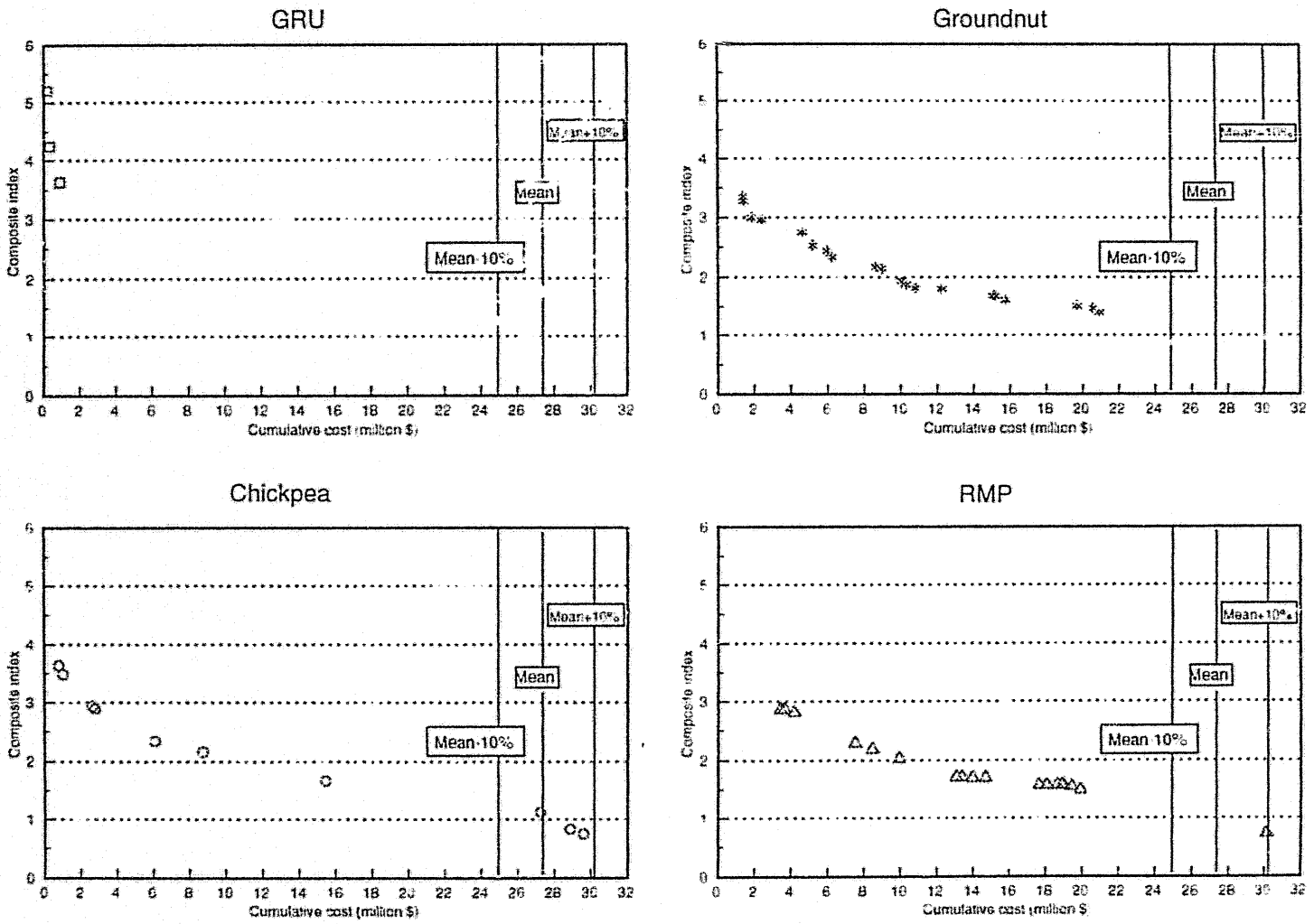


Figure 4. Cumulative cost vs benchmark composite index

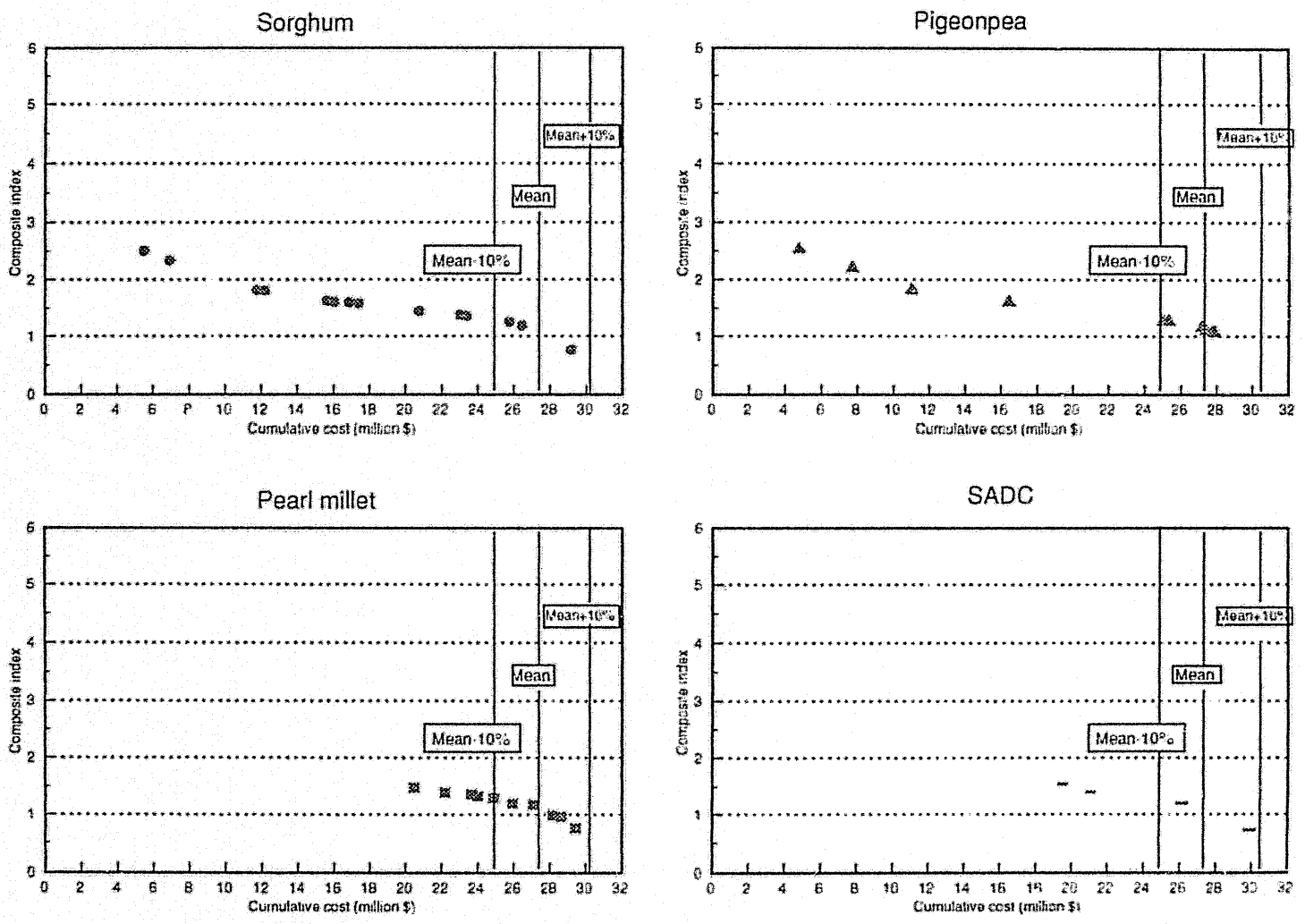
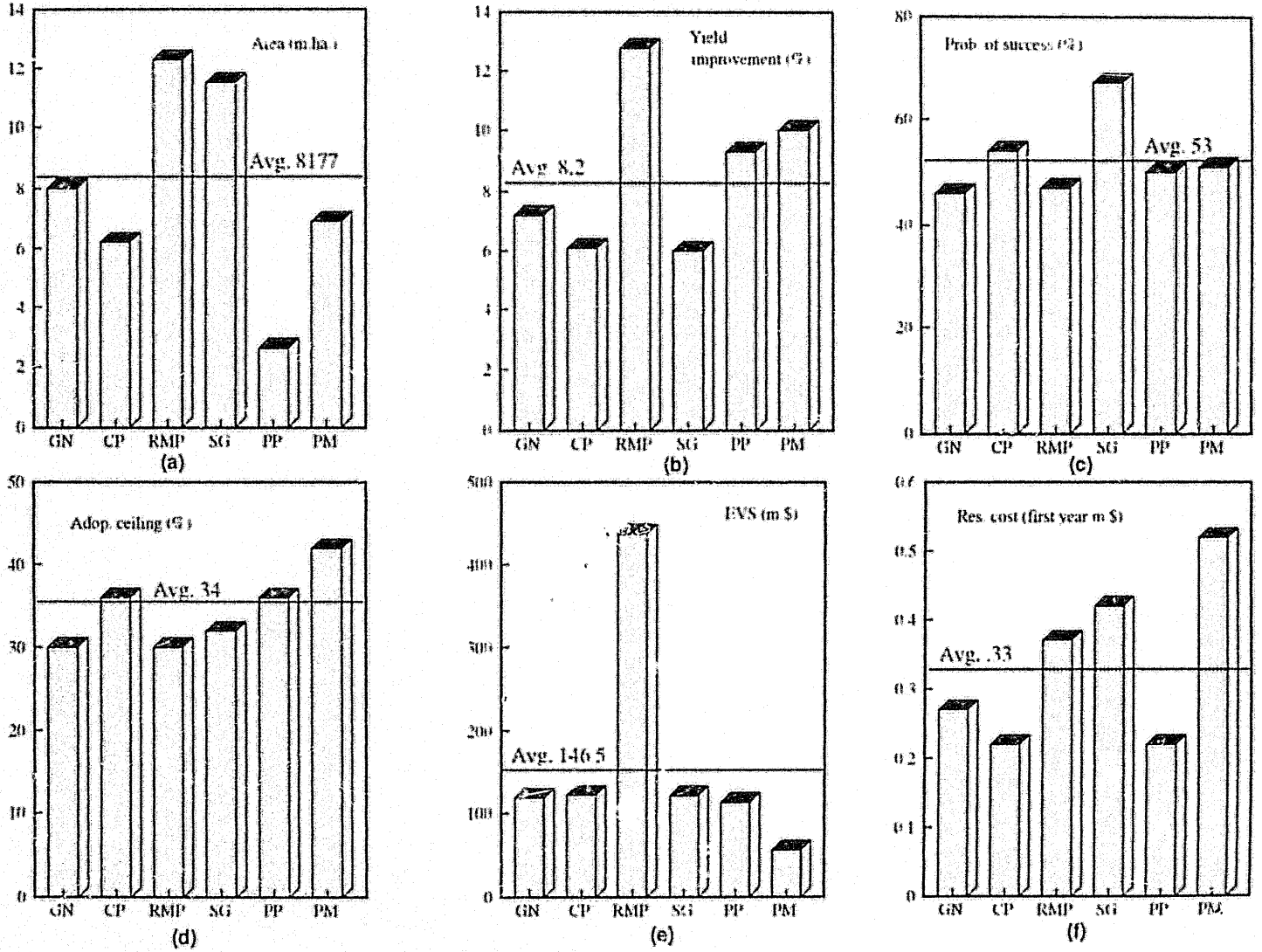


Figure 5.
Averages of efficiency parameters, by commodity groups/research units
for 92 themes of the ICRISAT MTP 1994-98



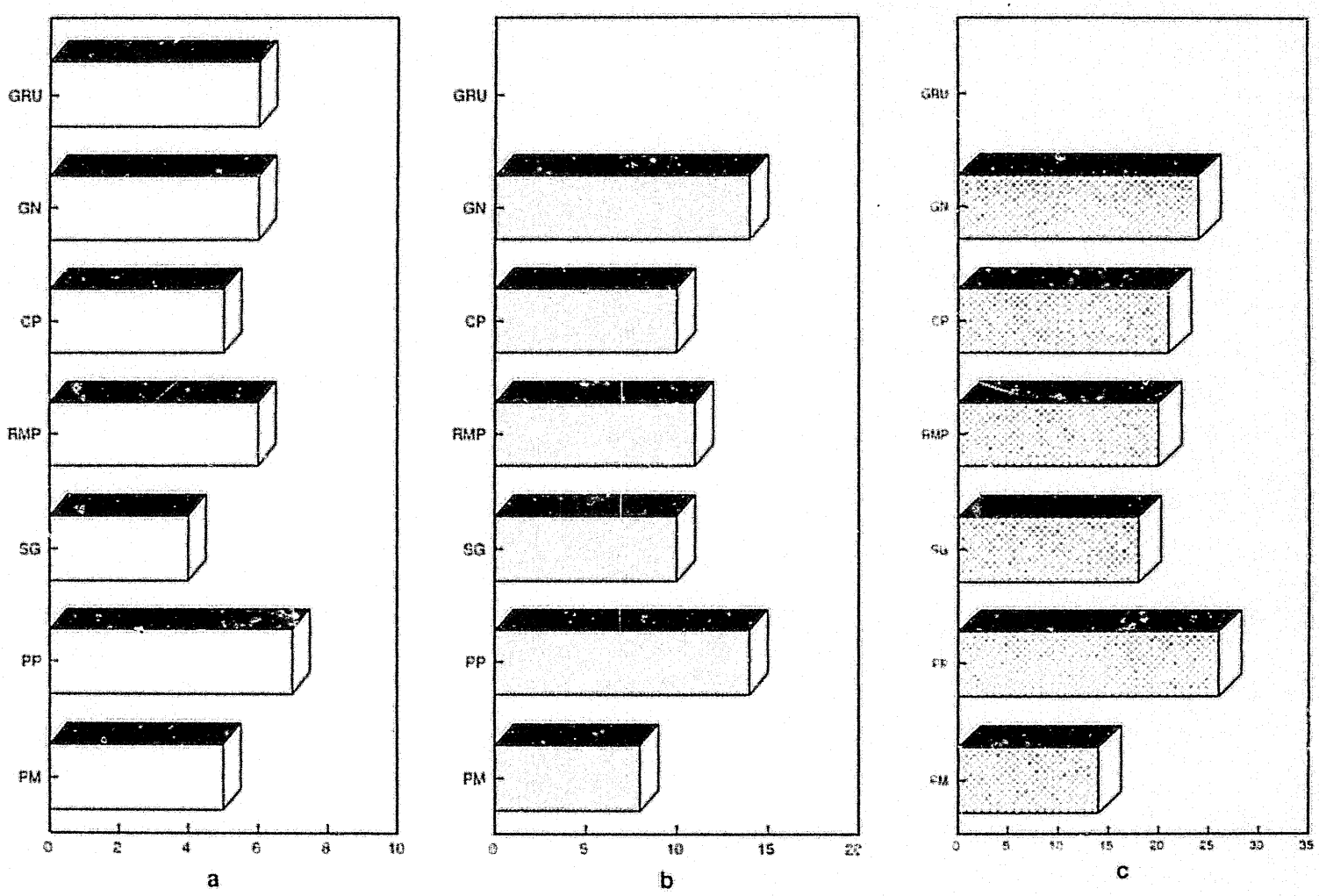


Figure 6. Adoption lag (years)

Figure 7.
Averages of research evaluation criterion grouped by commodity/research units : ICRISAT MTP 1994-98

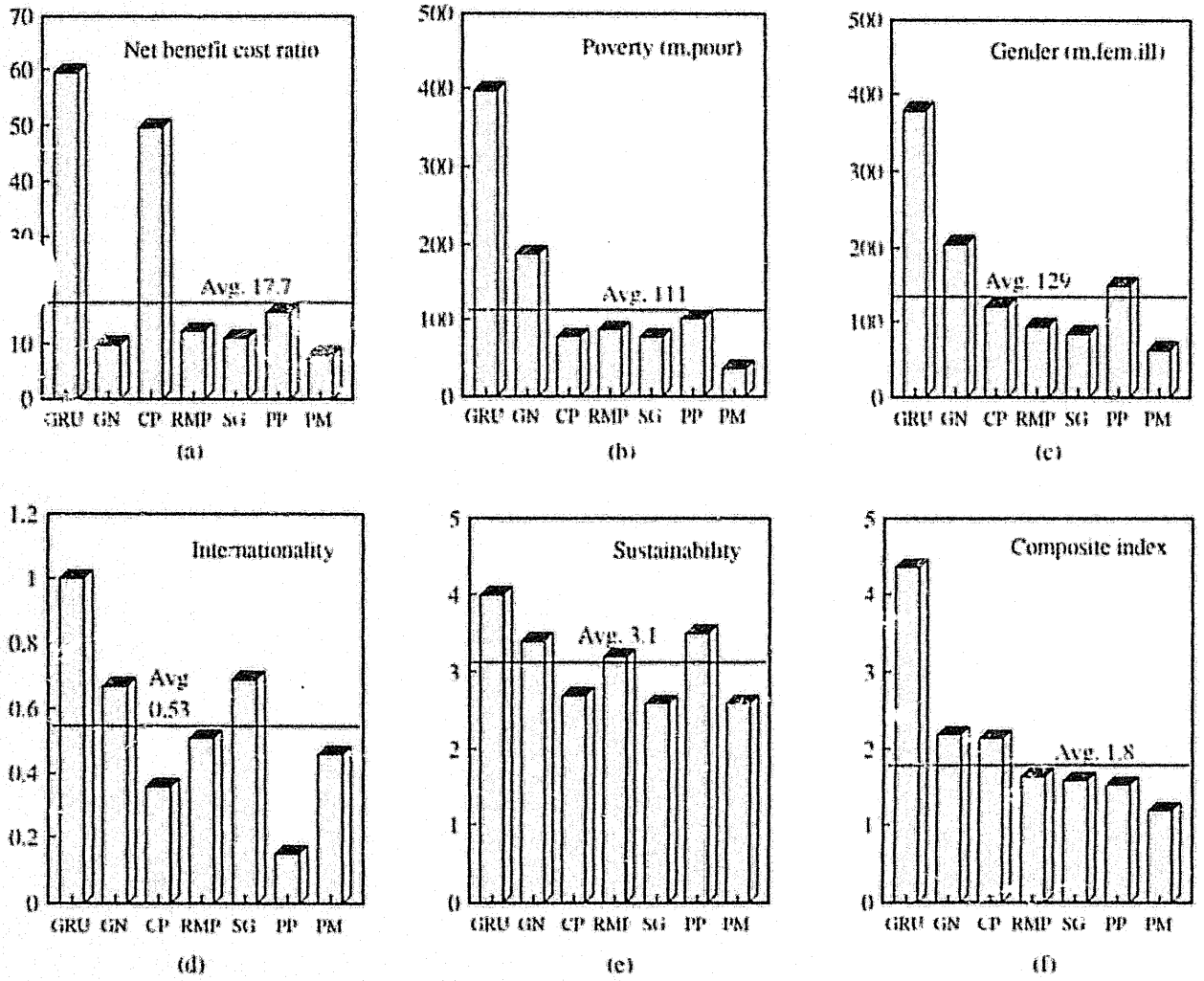
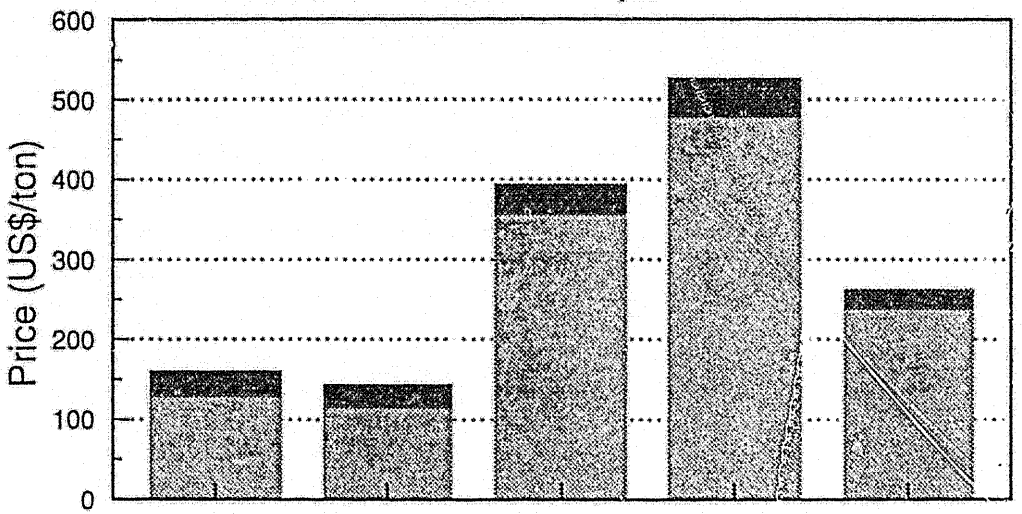
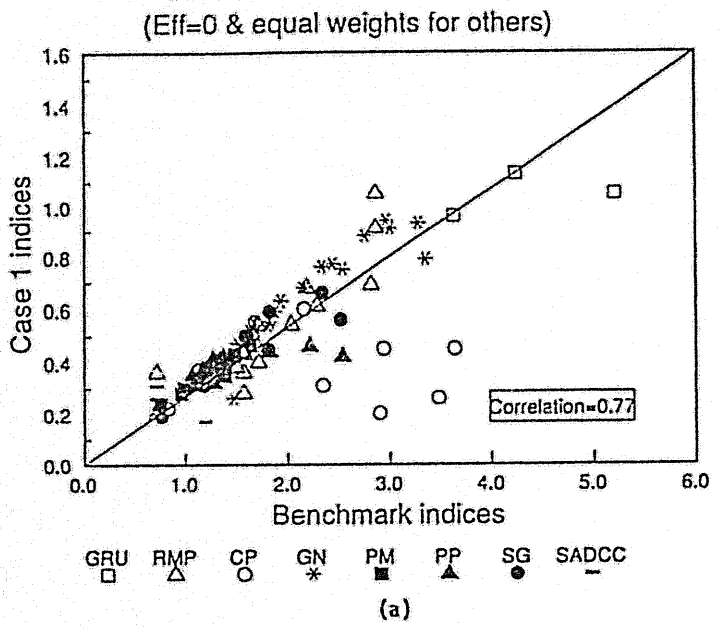


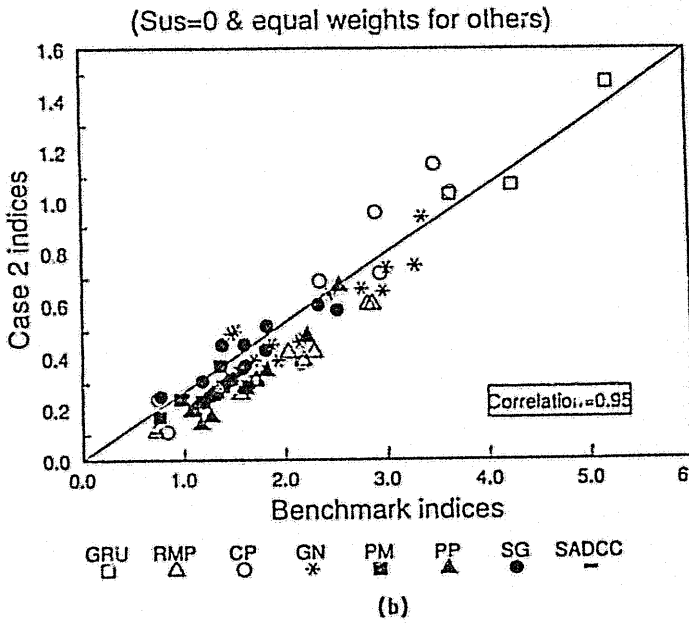
Figure 8.

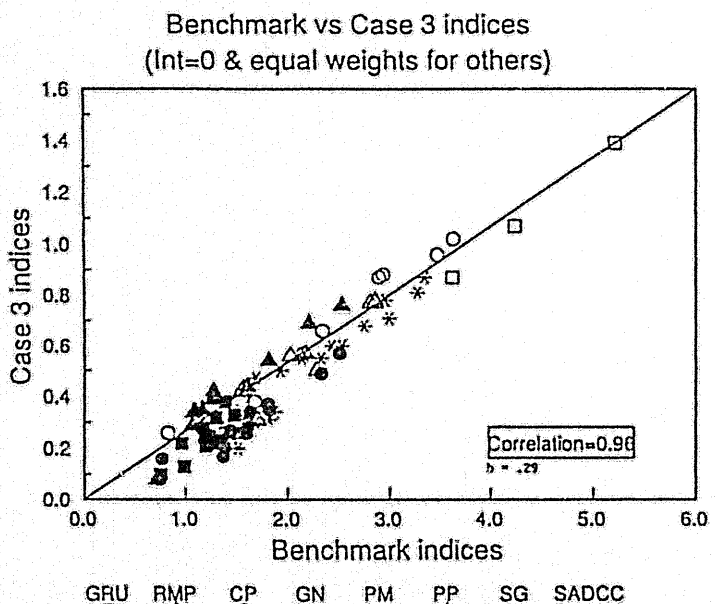
Prices of ICRISAT crops



	Sorghum	P.Millet	Chickpea	Pigeonpea	Groundnut
Grain	128	114	357	478	238
Fodder	32	29	36	48	24


(Eff=0 & equal weights for others)
Case 1 indices
Benchmark indices
Correlation=0.77
GRU RMP CP GN PM PP SG SADCC
(a)


(Sus=0 & equal weights for others)
Case 2 indices
Benchmark indices
Correlation=0.95
GRU RMP CP GN PM PP SG SADCC
(b)


Benchmark vs Case 3 indices
(Int=0 & equal weights for others)
Case 3 indices
Benchmark indices
Correlation=0.98
GRU RMP CP GN PM PP SG SADCC

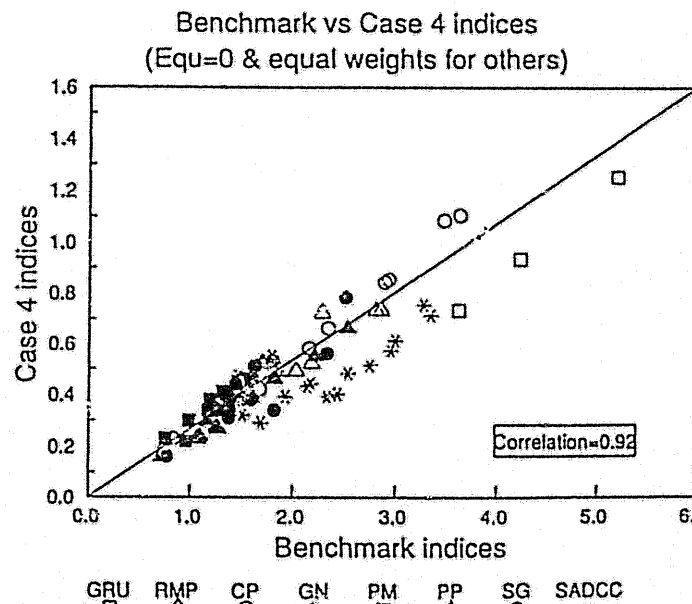
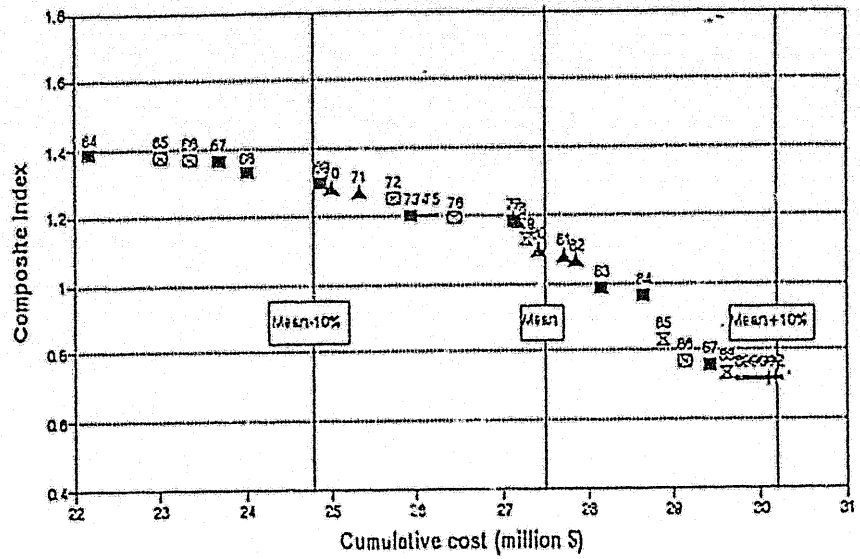
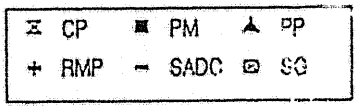

Benchmark vs Case 4 indices
(Equ=0 & equal weights for others)
Case 4 indices
Benchmark indices
Correlation=0.92
GRU RMP CP GN PM PP SG SADCC

Figure 10.

(a)

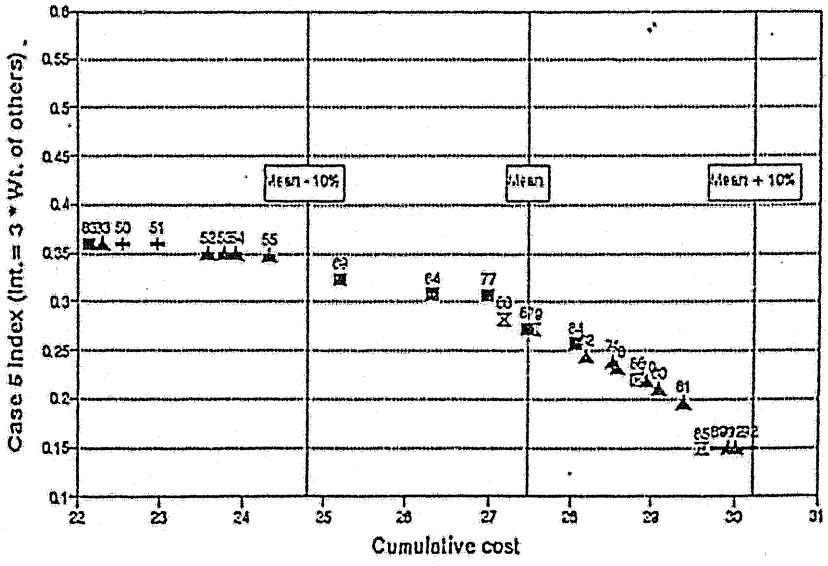
Cumulative cost vs composite index
(based on benchmark)





(b)

Cumulative cost vs case 5 indices
(Internationality=3*wt of others)



Core Funding

Table 1. ICRISAT's Portfolio of (ranked) Research Themes

Rank	Pro-gram	Center(s)/location(s)	Constraint/theme	Efficiency: NPV ($mill)	Efficiency: Net B/C ratio	Efficiency: IRR %	Research cost: First yr ($mill)	Research cost: Av'ge 94-98 ($mill)	Equity: Poverty million poor	Equity: Gender million fem ill	Inter-nation-ality	Sust-aina-bility	Normalized values: Net B/C (1.0)	Normalized values: Poverty (0.5)	Normalized values: Female illiter's (0.5)	Normalized values: Inter-nation'y (1.0)	Normalized values: Sustain-ability (1.0)	Comp-osite Index	First year cost	Cum-ulative cost
1	GRU	IC	Germplasm evaluation	70.1	101.9	-	0.19	0.13	337.0	378.0	1.00	4	2.04	1.59	1.26	1.00	0.75	5.21	0.19	0.19
2	GRU	IC	Germplasm collection	24.5	40.7	-	0.14	0.15	337.0	378.0	1.00	5	0.81	1.59	1.26	1.00	1.00	4.24	0.14	0.33
3	LGM	IC	Drought CP	265.2	113.7	47.2	0.48	0.42	60.6	115.5	0.35	3	2.27	[illegible]	0.40	0.35	0.50	3.64	0.48	0.81
4	GRU	IC	Germplasm maintenance	15.3	35.5	-	0.10	0.03	337.0	378.0	1.00	3	0.71	1.59	1.26	1.00	0.50	3.63	0.10	0.91
5	LGM	IC	Ascochyta blight CP	23.2	124.7	44.0	0.14	0.09	31.1	94.4	0.67	1	2.50	0.12	0.51	0.67	0.00	3.46	0.14	1.05
6	LGM	IC/ISC/SADCC	Rust GN	65.9	47.0	33.0	0.13	0.20	217.0	510.0	0.70	3	0.76	1.75	1.03	0.70	0.50	3.35	0.13	1.18
7	LGM	IC	Aflatoxin GN	7.0	23.1	23.3	0.05	0.04	245.0	296.6	0.82	5	0.48	0.53	1.00	0.82	1.00	3.28	0.05	1.23
8	LGM	IC/ISC/SADCC	Late leaf spot GN	22.7	12.4	24.0	0.43	0.36	320.0	202.0	0.84	4	0.25	1.72	1.01	0.84	0.75	3.03	0.43	1.66
9	LGM	IC/ISC	Aflatoxin (MGT) GN	15.3	6.1	13	0.56	0.47	56	25	0.60	5	0.13	1.44	1.03	0.60	1.00	2.56	0.56	2.22
10	LGM	IC	Insect damage CP	76.1	78.5	47.2	0.25	0.16	63.2	107.0	0.25	4	1.37	0.25	0.56	0.26	0.75	2.04	0.25	2.47
11	LGM	IC	Wilt CP	63.0	114.2	57.0	0.14	0.03	63.2	107.0	0.26	1	2.26	0.33	0.55	0.26	0.00	2.99	0.14	2.61
12	RMP	IC	Adopt. assess./imp. eval.	-	-	-	0.13	0.12	75.9	114.1	0.00	3	-	0.33	0.35	0.00	0.50	-	0.13	2.74
13	RMP	IC	Res. resource alloc'n	-	-	-	[illegible]	0.15	337.0	378.0	1.00	4	-	1.59	1.26	1.00	0.75	-	[illegible]	[illegible]
14	RMP	IC	Soil nutrients	120.3	35.9	43.4	0.94	0.45	167.9	162.2	0.49	5	0.72	0.67	0.24	0.49	1.00	2.81	0.94	[illegible]
15	LGM	IC/ISC/SADCC	Early leaf spot GN	0.8	4.4	21.2	0.45	0.37	245.0	313.0	0.70	4	0.03	1.28	1.04	0.70	0.75	2.75	0.45	4.53
16	LGM	IC/EARCAL	Genetic potential CP	64.0	63.5	41.5	0.13	0.11	125.2	165.2	0.23	3	1.27	0.50	0.56	0.23	0.50	2.53	0.13	4.76
17	LGM	IC/ISC/SADCC	Yield potential GN	70.6	17.3	23.4	0.44	0.37	274.2	359.4	0.71	3	0.25	0.94	1.21	0.71	0.50	2.53	0.44	5.20
18	CRL	IC/WASIP/EARCAL/SADCC	Striga SG	70.7	41.4	46.2	0.19	0.22	31.5	43.8	0.80	4	0.83	0.13	0.15	0.80	0.75	2.51	0.20	5.40
19	LGM	IC/ISC/SADCC	Drought GN	14.5	5.2	20.5	0.10	0.42	320.0	276.0	0.62	3	0.10	1.23	1.00	0.62	0.50	2.43	0.10	[illegible]
20	LGM	IC	Root rots CP	41.3	70.3	47.1	0.14	0.09	63.2	107.0	0.23	3	1.41	0.25	0.26	0.23	0.25	[illegible]	0.14	[illegible]
21	LGM	IC	Bud necrosis virus GN	4.0	4.2	13.0	0.42	0.41	205.9	275.1	0.65	4	0.02	1.29	1.09	0.65	0.50	2.33	[illegible]	6.35
22	CRL	IC/WASIP/SADCC	Grain & stover yld SG	47.5	16.5	21.7	0.40	0.52	100.0	109.2	0.85	3	0.53	0.72	0.56	0.25	0.50	[illegible]	0.48	[illegible]
23	RMP	IC/WASIP	Soil fertility	36.4	21.3	20.1	0.30	0.48	16.8	37.9	0.76	5	0.42	0.07	0.13	0.76	1.00	2.20	0.18	[illegible]
24	LGM	IC	SL mosaic/Fu. wilt PP	58.5	40.4	33.5	0.21	0.17	125.2	165.2	0.12	4	0.81	0.50	0.56	0.12	0.75	2.20	[illegible]	[illegible]
25	RMP	IC	Soil structure	20.4	5.9	22.0	0.14	0.62	167.9	162.2	0.46	5	0.12	0.67	0.54	0.46	1.00	2.18	0.14	8.45
26	LGM	IC	Leaf miner GN	8.7	6.0	20.6	0.19	0.16	125.7	206.6	0.46	4	0.12	0.78	0.90	0.46	0.75	2.17	0.10	8.65
27	LGM	IC	Biolog. N fixation CP	0.6	16.6	30.4	0.10	0.09	38.2	133.7	0.43	5	0.03	0.35	0.45	0.43	1.00	2.16	0.10	8.75
28	LGM	IC	Leaf miner (MGT) GN	4.0	[illegible]	21.3	0.73	0.19	125.7	206.6	0.46	4	0.09	0.78	0.90	0.40	0.75	2.14	[illegible]	9.05
29	RMP	IC	Water deficit	122.8	10.1	22.0	0.19	0.70	154.4	151.4	0.24	4	0.35	0.62	0.50	0.24	0.75	2.14	0.55	[illegible]
30	LGM	IC	Spodoptera GN	0.7	0.6	13	0.14	0.12	174.7	215.6	0.40	4	0.52	0.70	0.83	0.40	0.75	[illegible]	0.14	10.07
31	LGM	IC	Peanut clump virus GN	[illegible]	4.9	21.0	0.73	0.18	114.3	124.0	1.04	3	0.10	0.46	0.41	0.84	0.50	1.87	0.73	[illegible]
32	LGM	IC/ISC/SADCC	Rosette virus GN	20.8	8.6	22.1	0.53	0.39	71.0	71.4	0.89	3	0.27	0.22	0.24	0.89	0.50	1.83	0.53	10.83
33	LGM	IC	Helicoverpa (IM,T) PP	26.0	23.8	29.7	0.17	0.14	96.2	126.4	0.17	4	0.48	0.30	0.45	0.17	0.75	1.82	0.17	11.00
34	CRL	IC/WASIP/EARCAL/SADCC	Stem borer SG	8.4	1.6	16.1	0.16	0.63	222.7	101.2	0.75	3	0.03	0.03	0.04	0.75	0.25	1.82	0.16	11.16
35	CRL	IC/WASIP/EARCAL	Grain mold SG	16.0	21.5	[illegible]	0.45	0.35	51.2	57.2	0.65	3	0.43	0.20	0.19	0.65	0.50	1.81	0.45	[illegible]
36	LGM	ISC	Millipedes GN	3.0	8.0	23.8	0.04	0.03	27.3	37.2	0.77	4	0.16	0.11	0.12	0.77	0.75	1.80	0.04	[illegible]
37	RMP	IC/WASIP	Water deficit SG,GN	22.0	3.3	10.4	0.83	0.65	24.1	42.0	0.76	4	0.05	0.10	0.14	0.76	0.75	1.71	0.83	[illegible]
38	RMP	ISC/WASIP	Tech. assess./imp. eval.	-	-	-	[illegible]	0.74	24.1	42.6	0.83	2	-	0.10	0.14	0.83	0.25	-	[illegible]	[illegible]
39	RMP	ISC/WASIP	Agroforestry	16.7	3.5	[illegible]	0.80	0.55	24.1	42.6	0.78	4	0.07	0.10	0.14	0.76	0.75	1.70	0.80	13.97
40	RMP	ISC/WASIP	Charact. of prod'n envt	-	-	-	0.72	0.60	24.1	42.6	0.76	3	-	0.10	0.14	0.76	0.50	-	0.72	[illegible]
41	LGM	IC	Nematodes GN,PP,SG	[illegible]	8.0	21.0	0.41	0.24	127.7	260.0	0.27	3	0.12	0.72	0.85	0.27	0.50	[illegible]	0.41	15.10
42	LGM	ISC	Termites GN	[illegible]	2.4	16.7	0.11	0.09	27.3	37.2	0.37	4	0.05	0.11	0.12	0.37	0.75	[illegible]	0.11	15.21
43	LGM	IC	Suboptimal yield CP	0.3	0.5	12.0	0.25	0.21	83.2	133.7	0.52	4	0.01	0.25	0.45	0.52	0.75	[illegible]	0.25	15.46
44	CRL	EARCAL	Low temperature SG	1.6	5.6	13.4	0.19	0.17	32.7	11.6	0.60	4	0.19	0.13	0.04	0.60	0.75	[illegible]	0.19	15.65
45	LGM	ISC	White grubs GN	[illegible]	5.6	15.8	0.11	0.09	27.3	37.2	0.72	4	[illegible]	[illegible]	0.02	0.72	0.75	1.62	0.11	15.76
46	CRL	IC/WASIP	Head bug SG	12.8	7.1	21.7	0.27	0.22	43.2	74.8	0.76	3	0.14	0.07	0.25	0.76	0.50	1.61	0.27	16.03
47	LGM	IC/EARCAL	Drought PP	19.7	7.7	24.0	0.41	0.25	58.2	106.4	0.28	4	0.15	0.29	0.45	0.28	0.75	1.61	0.41	16.44
48	CRL	IC/WASIP/EARCAL/SADCC	Anthracnose SG	12.5	4.6	25.5	0.43	0.36	126.7	110.8	0.82	2	0.09	0.41	0.22	0.82	0.25	1.60	0.43	16.87
49	CRL	IC/WASIP/EARCAL	Midge SG	[illegible]	4.1	19.4	0.52	0.43	56.6	47.1	0.87	3	0.08	0.23	[illegible]	0.87	0.50	1.59	0.52	17.39
50	RMP	IC	Char'zation of environ.	-	-	-	0.25	0.21	75.9	114.1	0.00	3	-	0.30	0.28	0.00	0.50	-	0.25	17.64
51	RMP	IC/EARCAL	Microecon studies	-	-	-	0.41	0.41	-	-	-	-	-	-	-	-	-	-	0.41	18.05
52	RMP	IC	Natural resources	-	-	-	0.60	0.50	75.9	114.1	0.00	5	-	0.30	0.38	0.00	1.00	-	0.60	18.65
53	RMP	IC	Supply & demand	-	-	-	0.21	0.17	75.9	114.1	0.00	4	-	0.30	0.28	0.00	0.75	-	0.21	18.86
54	RMP	IC	Farmers preferences	-	-	-	0.14	0.12	75.9	114.1	0.00	3	-	0.30	0.38	0.00	0.50	-	0.14	19.00
55	RMP	IC	Beneficial organisms	27.5	13.3	27.4	0.41	0.34	62.4	104.9	0.27	4	0.23	0.25	0.25	0.27	0.75	[illegible]	0.41	19.41
56	[illegible]	SADCC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12.4	0.70	[illegible]	[illegible]	0.13	0.04	0.70	0.50	[illegible]	0.08	19.49
57	LGM	IC	Peanut mottle virus GN	3.0	[illegible]	10.6	0.21	0.18	147.2	135.7	0.01	[illegible]	0.07	0.59	0.46	0.01	0.00	1.51	0.21	19.70
58	RMP	ISC/WASIP(M)	Cons./demand studies	-	-	-	0.21	0.17	24.1	42.6	0.76	2	-	0.10	0.14	0.76	0.25	-	0.21	19.91
59	CRL	IC/ISC/EARCAL/SADCC	Drought FM	23.7	8.9	26.6	0.56	0.47	65.3	116.7	0.48	3	0.16	0.26	0.29	0.48	0.50	1.45	0.56	20.47
60	GIP	SADCC	Adaptation GN	29.0	33.9	38.4	0.08	0.07	12.0	12.4	0.75	1	0.65	0.05	0.04	0.75	0.00	1.47	0.08	20.55
61	CRL	LASIP	Adapt. to acid soils SG	47.5	8.1	20.1	0.19	0.19	45.0	20.5	0.64	3	0.18	0.20	0.07	0.64	0.50	1.45	0.19	20.74
62	LGM	IC	Peanut stripe virus GN	4.5	4.3	[illegible]	0.18	0.15	[illegible]	42.1	0.54	3	0.09	0.29	0.16	0.54	0.50	1.40	0.18	20.92
63	RMP	SADCC	Drought SG/PM/FM	4.9	[illegible]	25.1	0.14	0.12	[illegible]	12.4	0.85	3	0.16	0.13	0.04	0.85	0.50	1.40	0.14	21.06
64	CRL	IC/ISC/EARCAL/SADCC	Downy mildew PM	75.2	16.8	34.6	1.12	0.85	64.1	114.6	0.23	3	0.34	0.26	0.35	0.23	0.50	1.29	1.12	22.18
65	CRL	IC/WASIP/EARCAL/SADCC	Drought SG	20.3	8.5	28.8	0.85	0.71	21.4	220.7	0.76	4	0.17	0.13	0.77	0.76	1.00	1.38	0.85	23.03
66	CRL	IC/EARCAL/SADCC	Leaf blight SG	9.6	5.0	14.2	0.33	0.28	27.4	52.0	0.85	2	0.10	0.15	0.17	0.85	0.25	1.37	0.33	23.36
67	CRL	EARCAL	Blast disease FM	3.8	13.8	15.0	0.23	0.20	60.0	23.1	0.68	2	0.28	0.24	0.08	0.68	0.25	1.36	0.23	23.60
68	CRL	ISC	Striga PM	10.7	4.8	22.4	0.33	0.28	10.7	31.5	0.66	3	0.10	0.04	0.10	0.66	0.50	1.33	0.33	23.92
69	CRL	IC/ISC	Low grain yld PM	23.4	10.5	40.0	0.87	0.71	55.4	93.6	0.22	3	0.21	0.22	0.21	0.22	0.50	1.30	0.87	[illegible]
70	LGM	IC	Phyto. blight (MGT) PP	9.2	15.0	23.2	0.12	0.05	103.5	147.4	0.01	3	0.22	0.42	0.49	0.01	0.50	1.29	0.12	[illegible]
71	LGM	IC	Helicoverpa PP	[illegible]	0.8	12.0	0.32	0.27	38.2	136.4	0.05	4	0.02	0.20	0.45	0.03	0.75	1.27	0.32	25.33
72	CRL	LASIP	Foliar disease res. SG	5.8	3.3	20.0	0.41	0.41	71.0	23.3	0.50	3	0.07	0.20	0.08	0.50	0.50	1.25	0.41	25.74
73	SMIP	SADCC	Impr. of grain yield FM	4.0	5.6	22.0	0.21	0.14	13.1	6.8	0.55	3	0.11	0.05	0.02	0.55	0.50	1.20	0.21	25.95
74	ECO	SADCC	Res. impact SG/PM/FM	-	-	-	0.12	0.07	13.9	4.6	0.48	1	-	0.05	0.02	0.48	0.00	-	0.12	26.07
75	ECO	SADCC	Policy a'lysis SG/PM/FM	-	-	-	0.12	0.10	[illegible]	24.4	0.76	1	-	0.24	0.11	0.76	0.00	-	0.12	26.19
76	CRL	IC	Shoot fly SG	22.5	12.4	26.2	0.27	0.22	45.6	67.3	0.49	2	0.25	0.18	0.22	0.49	0.25	1.10	0.27	26.46
77	CRL	IC	Lack of adopt. (and) FM	12.5	[illegible]	35.3	0.66	0.25	20.5	68.7	0.23	3	0.20	0.06	0.23	0.23	0.50	1.18	0.66	27.12
78	LGM	IC	Maruca PP	0.7	1.9	5.4	0.06	0.05	12.5	102.4	0.11	4	0.04	0.21	0.34	0.11	0.75	1.17	0.06	27.18
79	LGM	IC	Stunt virus CP	0.8	1.1	14.4	0.10	0.09	85.2	107.0	0.25	3	0.02	0.25	0.36	0.25	0.50	1.13	0.10	27.28
80	LGM	IC/EARCAL	Podfly (MGT) PP	7.5	8.0	23.3	0.14	0.12	70.4	130.0	0.08	3	0.16	0.25	0.43	0.00	0.50	1.10	0.14	27.42
81	LGM	IC	Water logging PP	12.6	7.0	23.4	0.30	0.25	80.4	125.7	0.05	3	0.14	0.36	0.42	0.05	0.50	1.08	0.30	27.72
82	LGM	IC/EARCAL	Podfly PP	0.5	0.5	12.0	0.14	0.12	70.4	130.0	0.20	3	0.01	0.28	0.43	0.20	0.50	1.07	0.14	27.86
83	CRL	IC/ISC	Head caterpillars PM	8.0	4.0	22.3	0.30	0.25	10.3	27.5	0.59	2	0.08	0.04	0.09	0.59	0.25	0.99	0.30	28.16
84	CRL	IC/ISC	High temperature PM	15.5	5.9	25.8	0.50	0.41	58.8	113.6	0.29	2	0.12	0.24	0.38	0.29	0.25	0.96	0.50	28.66
85	LGM	IC	Cold tolerance CP	9.2	7.6	25.1	0.23	0.21	20.2	66.1	0.03	3	0.15	0.08	0.22	0.03	0.50	0.83	0.23	28.89
86	CRL	IC/SADCC	Forage sorghum SG	12.2	9.9	39.2	0.25	0.19	84.2	72.3	0.28	1	0.20	0.34	0.24	0.28	0.00	0.77	0.25	29.14
87	CRL	IC/ISC	Stem borers PM	2.1	1.1	15.1	0.29	0.24	2.5	23.8	0.44	2	0.02	0.01	0.08	0.44	0.25	0.76	0.29	29.43
88	LGM	IC	Botrytis gray mold CP	2.7	2.9	18.3	0.19	0.16	30.1	82.8	0.48	1	0.06	0.12	0.28	0.48	0.00	0.74	0.19	29.62
89	ECO	SADCC	Seed d'bution SG/PM/FM	-	-	-	0.19	0.10	14.8	5.5	0.65	2	-	0.08	0.02	0.65	0.25	-	0.19	29.81
90	ECO	SADCC	Market reform SG/PM/FM	-	-	-	0.17	0.11	20.5	10.5	0.72	1	-	0.08	0.04	0.72	0.00	-	0.17	29.98
91	RMP	IC	Inst'l & human res'ces	-	-	-	0.12	0.10	75.9	114.1	0.00	4	-	0.30	0.38	0.00	0.75	-	0.12	30.10
92	RMP	IC	Input markets	-	-	-	0.08	0.06	75.9	114.1	0.00	2	-	0.30	0.38	0.00	0.25	-	0.08	30.18

Complementary Funding

Rank	Pro-gram	Center(s)/location(s)	Constraint/theme	Efficiency: NPV ($mill)	Efficiency: Net B/C ratio	Efficiency: IRR %	Research cost: First yr ($mill)	Research cost: Av'ge 94-98 ($mill)	Equity: Poverty million poor	Equity: Gender million fem ill	Inter-nation-ality	Sust-aina-bility	Normalized values: Net B/C (1.0)	Normalized values: Poverty (0.5)	Normalized values: Female illiter's (0.5)	Normalized values: Inter-nation'y (1.0)	Normalized values: Sustain-ability (1.0)	Comp-osite Index	First year cost	Cum-ulative cost
93	COU	IC	Quality/Utilization SG	20.0	36.9	36.8	0.13	0.11	105.7	103.2	0.79	3	0.74	0.74	0.56	0.79	0.50	2.88	0.13	30.31
94	RMP	ISC/WASIP	Weeds	14.6	6.5	21.7	0.33	0.20	24.1	42.6	0.76	3	0.13	0.10	0.14	0.76	0.50	1.51	0.33	30.64
95	RMP	SADCC	Weed (MGT)-SG,PM,FM	8.6	10.0	25.7	0.21	0.17	32.1	12.4	0.72	3	0.20	0.13	0.04	0.72	0.50	1.50	0.21	30.85
96	CRL	LASIP	Acid soil adaption SG	11.5	9.1	20.1	0.23	0.19	48.9	20.5	0.69	3	0.18	0.20	0.07	0.69	0.50	1.45	0.23	31.08
97	LGM	ISC	Aphids-GN	0.2	0.1	13.1	0.18	0.15	27.3	37.2	0.77	3	0.00	0.11	0.12	0.77	0.50	1.39	0.18	31.26
98	RMP	SADCC	Nematodes-SG	0.8	2.2	17.5	0.09	0.08	5.8	1.0	0.53	4	0.04	0.02	0.01	0.53	0.75	1.34	0.09	31.35
99	LGM	EARCAL/Malawi	Crop improvement-PP	7.6	2.2	16.7	0.83	0.69	23.0	14.5	0.73	3	0.04	0.09	0.05	0.73	0.50	1.34	0.83	32.17
100	CRL	SADCC/WASIP	Sooty stripe-SG	0.2	0.2	11.1	0.17	0.14	22.9	40.6	0.78	2	0.00	0.09	0.14	0.78	0.25	1.15	0.17	32.34
101	CRL	WASIP/EARCAL	Long smut SG	5.5	4.7	20.5	0.17	0.14	4.4	7.0	0.71	2	0.09	0.02	0.03	0.71	0.25	1.08	0.17	32.51
102	SMIP	SADCC	Storage pests SG,PM	0.0	0.1	9.5	0.12	0.10	17.3	9.7	0.48	3	0.00	0.07	0.03	0.48	0.50	1.03	0.12	32.63
103	CRL	ISC	Low grain yield-PM	6.7	5.5	25.0	0.21	0.16	11.5	20.6	0.32	3	0.11	0.05	0.10	0.32	0.50	1.00	0.21	32.84
104	SMIP	SADCC	Ergot SG	1.9	4.0	25.0	0.18	0.10	13.7	5.5	0.60	1	0.08	0.05	0.02	0.68	0.00	0.80	0.18	33.02
105	GIP	SADCC	Imp. c'vars collec.-GN	7.5	8.2	25.1	0.17	0.14	3.5	3.0	0.55	1	0.16	0.02	0.01	0.55	0.00	0.73	0.17	33.19
106	SMIP	SADCC	Photosensitive-PM	1.0	3.0	17.2	0.08	0.07	2.0	3.8	0.00	3	0.06	0.01	0.01	0.00	0.50	0.57	0.08	33.27
107	SMIP	SADCC	Photosensitive-SG	0.3	3.0	20.0	0.02	0.01	3.6	3.8	0.30	1	0.05	0.01	0.01	0.30	0.00	0.33	0.02	33.29
108	COU	SADCC	Qty. scre'ing-SG/PM/FM	-	-	-	0.17	0.14	17.3	7.1	0.54	1	-	0.07	0.02	0.54	0.00	-	0.17	33.46
109	COU	SADCC	Qty. impr'ment SG/PM/FM	-	-	-	0.05	0.04	17.3	7.1	0.54	3	-	0.07	0.02	0.54	0.50	-	0.05	33.51
110	COU	SADCC	Sweet stem sorghum SG	-	-	-	0.14	0.12	15.9	6.9	0.44	4	-	0.06	0.02	0.44	0.75	-	0.14	33.65

ble 2. Case 1: Efficiency = 0

SMCASE01.WQ1 (Based on CASE1 ranks) Sus.=0.33, Eff.=0, Equ.=0.33, Int.=0.33

lative cost based on benchmark ranks.

ed research 'themes' by composite index - Medium term plan 1994-1998

aints from: AB/C=50; poverty=250; gender=300

Pro-gram	Center(s)/location(s)	Constraint/theme / Weights =>	Effici-ency Net B/C 1.00	Equity Poverty 0.50	Equity Gender 0.50	Inter-nation-ality 1.00	Sust-aina-bili-ty 1.00	Bench mark Ef,Eq, In,Su = 1	Pes. cost/ year (U.S$) (First year	Cumu-lative cost ($mill)	Case 1 Eff=0 Eq=0.33 In=0.33 Su=0.33	Bench mark rank	Ch ca
GRU	IC	Germplasm evaluation	2.04	1.69	1.26	1.00	0.75	5.21	0.13	0.13	1.05		
GRU	IC	Germplasm collection	0.61	1.69	1.26	1.00	1.00	4.24	0.14	0.23	1.13		
LGW	IC	Drought-CP	2.07	0.14	0.40	0.56	1.00	3.64	0.46	0.31	0.46		
GRU	IC	Germplasm maintenance	0.71	1.69	1.26	1.00	0.50	3.65	0.10	0.81	0.96	4	
LGW	IC	Aschochyta blight-CP	2.69	0.13	0.31	0.37	0.00	3.49	0.14	1.25	0.16	5	
LGW	IC/ISC/SACCC	Rust-GN	0.96	1.05	1.13	0.70	0.50	3.35	0.03	1.38	0.79	6	
LGW	IC	Aflatoxin-GN	1.46	0.99	1.00	0.82	1.00	5.28	0.15	1.43	0.93	7	
LGW	IC/ISC/SACCC	Late leaf spot-GN	0.15	1.33	1.01	0.84	0.75	3.09	0.43	1.86	0.91	8	
LGW	IC/ISC	Aflatoxin (MGT)-GN	0.13	1.44	1.03	0.60	1.00	2.95	0.56	2.42	0.94	9	
LGW	IC	Insect damage-CP	1.67	0.35	0.36	0.36	0.75	2.94	0.25	2.67	0.45	10	
LGW	IC	Wilt-CP	2.28	0.35	0.36	0.36	0.00	2.80	0.14	2.81	0.20	11	
RWP	IC	Accpt. assess./imp. eval.	0.09	1.44	1.10	1.00	0.50	3.65	0.62	3.43	0.91	12	
RWP	IC	Res. resource. allocate	0.31	1.69	1.26	1.00	0.75	3.96	0.31	3.74	1.05	13	
RWP	IC	Soil nutrients	0.72	0.67	0.54	0.49	1.00	2.81	0.34	4.15	0.69	14	
LGW	IC/ISC/SACCC	Early leaf spot-GN	0.09	1.38	1.04	0.72	0.75	2.75	0.45	4.63	0.86	15	
LGW	IC/EARCAL	Genetic potential-PP	1.27	0.50	0.55	0.23	0.50	2.53	0.13	4.76	0.42	16	
LGW	IC/ISC/SACCC	Yield potential-GN	0.25	0.84	1.21	0.71	0.50	3.53	0.44	5.20	0.75	17	
CRL	IC/WASIP/EARCAL/SACCC	Striga-SG	0.63	0.13	0.15	0.50	0.75	2.51	0.28	5.48	0.56	18	
LGW	IC/ISC/SACCC	Drought-GN	0.10	1.33	1.09	0.69	0.50	2.43	0.50	5.98	0.77	19	
LGW	IC	Root rots-CP	1.41	0.35	0.36	0.33	0.25	2.34	0.14	6.12	0.81	20	
LGW	IC	Bud necrosis virus-GN	0.02	1.33	1.09	0.66	0.50	3.33	0.13	6.25	0.75	21	
CRL	IC/WASIP/SACCC	Grain & stover yld.-SG	0.33	0.72	0.55	0.65	0.50	2.33	0.58	6.83	0.66	22	
RWP	ISC/WASIP(N)	Soil fertility	0.43	0.07	0.13	0.76	1.00	2.28	0.58	7.41	0.61	23	
LGW	IC	St. rosa b/fl. wilt-PP	0.61	0.50	0.55	0.12	0.75	2.21	0.31	7.72	0.46	24	
RWP	IC	Soil structure	0.13	0.67	0.54	0.46	1.00	2.16	0.74	8.46	0.68	25	
LGW	IC	Leaf miner-GN	0.12	0.76	0.60	0.46	0.75	2.17	0.13	8.65	0.66	26	
LGW	IC	Biolog. N fixation-CP	0.69	0.35	0.45	0.43	1.00	2.16	0.10	8.75	0.60	27	
LGW	IC	Leaf miner (MGT)-GN	0.09	0.76	0.60	0.46	0.75	2.14	0.23	8.98	0.66	28	
RWP	IC	Water deficit	0.38	0.62	0.50	0.54	0.75	2.03	0.85	9.83	0.64	29	
LGW	IC	Spodoptera-GN	0.02	0.70	0.63	0.40	0.75	1.93	0.14	10.27	0.69	30	
LGW	IC	Peanut clump virus-GN	0.10	0.45	0.41	0.64	0.50	1.87	0.23	10.80	0.69	31	
LGW	IC/ISC/SACCC	Rosette virus-GN	0.17	0.29	0.24	0.69	0.50	1.82	0.63	10.63	0.55	32	
LGW	IC	Helicoverpa (MGT)-PP	0.48	0.39	0.45	0.17	0.75	1.82	0.17	11.00	0.44	33	
CRL	IC/WASIP/EARCAL/SACCC	Ster borer-SG	0.03	0.93	0.64	0.75	0.25	1.82	0.76	11.76	0.59	34	
CRL	IC/WASIP/EARCAL	Grain mold-SG	0.43	0.20	0.19	0.68	0.50	1.81	0.45	12.21	0.45	35	
LGW	ISC	Millipedes-GN	0.16	0.11	0.12	0.77	0.75	1.80	0.04	12.25	0.64	36	
RWP	ISC/WASIP(N)	Water deficit-PM,SG,GN	0.06	0.10	0.14	0.76	0.75	1.71	0.83	13.08	0.64	37	
RWP	ISC/WASIP(M,N)	Tech. adopt./imp. eval.	0.51	0.10	0.14	0.63	0.65	1.71	0.29	13.37	0.40	38	
RWP	ISC/WASIP	Agro-forestry	0.07	0.10	0.14	0.76	0.75	1.70	0.80	13.97	0.64	39	
RWP	ISC/WASIP(N)	Char'n of prod'n envt'l	0.33	0.10	0.14	0.76	0.50	1.70	0.72	14.69	0.46	40	
LGW	IC	Nematodes-GN,PP,CP	0.12	0.72	0.68	0.27	0.50	1.69	0.41	15.10	0.52	41	
LGW	IC	Termites-GN	0.05	0.11	0.12	0.77	0.75	1.68	0.11	15.21	0.64	42	
LGW	IC	Sub-optimal yield-CP	0.01	0.35	0.45	0.52	0.75	1.68	0.25	15.46	0.55	43	

2. contd. ..

Pro-gram	Constraint/Problem (Centers) / (Location)	Weights =>	Efficiency (Net B/C) 1.00	Equity: Poverty 0.50	Equity: Gender 0.50	Interna-tionality 1.00	Sustain-ability 1.00	Benchmark (sf,Eq,Su) (n,S) = 1	Res. cost/ year (m.$) First year	Cumu-lative cost ($mill)	Case 1 Ef=0 Eq=0.33 Su=0.33 CI	Benchmark rank	Ran pos on Eff
CRL	EARCAL	Low temperature-SS	0.19	0.13	0.04	0.60	0.75	1.63	0.19	15.65	0.47	44	
LGM	ISC	White grubs-SW	0.03	0.11	0.12	0.72	0.75	1.62	0.11	15.75	0.52	45	
CRL	IC/WASIP	Head bug-SS	0.14	0.17	0.25	0.76	0.50	1.61	0.27	16.03	0.43	46	
LGM	IC/EARCAL	Drought-PP	0.15	0.39	0.45	0.28	0.75	1.61	0.41	15.44	0.48	47	
CRL	IC/WASIP/EARCAL/SAICC	Anthracnose-SS	0.09	0.61	0.07	0.82	0.25	1.60	0.43	15.87	0.50	48	
CRL	IC/WASIP/EARCAL	Midge-SS	0.08	0.23	0.16	0.82	0.50	1.59	0.52	17.39	0.50	49	
PWP	IC	Characterization of environ.	(0.73)	0.30	0.38	0.00	0.50	1.57	0.25	17.64	0.26	50	
PWP	IC/EARCAL	Micro-econ studies	(0.27)	0.24	0.08	0.64	0.50	1.57	0.41	16.05	0.43	51	
PWP	IC	Natural resources	(0.23)	0.20	0.38	0.00	1.00	1.57	0.50	18.65	0.44	52	
PWP	IC	Supply & demand	(0.49)	0.30	0.08	0.70	0.75	1.57	0.21	18.85	0.39	53	
PWP	IC	Farmers' preferences	(0.73)	0.30	0.08	0.00	0.50	1.57	0.14	19.00	0.28	54	
PWP	IC	Beneficial organisms	0.23	0.25	0.35	0.27	0.75	1.55	0.41	12.41	0.44	55	
PWP	SAICC	Plant nutrie-SS/PW,FW	0.05	0.13	0.04	0.70	0.50	1.54	0.08	18.48	0.42	56	
LGM	IC	Peanut mottle virus-SW	0.07	0.59	0.46	0.81	0.00	1.51	0.21	19.70	0.47	57	
PWP	IC/WASIP/W	Cons./demand studies	(0.05)	0.10	0.14	0.78	0.25	1.50	0.21	19.91	0.38	58	
CRL	IC/IDC/EARCAL/SAICC	Drought-PW	0.18	0.06	0.39	0.48	0.50	1.43	0.56	20.47	0.43	59	
SIP	SAICC	Adaptability-SW	0.06	0.05	0.04	0.75	0.00	1.47	0.08	20.55	0.26	60	
CRL	WASIP	Adapt. to acid soils-SS	0.18	0.20	0.07	0.64	0.50	1.40	0.19	20.74	0.42	61	
LGM	IC	Peanut stipe virus-SW	0.03	0.39	0.16	1.54	0.50	1.40	0.18	20.92	0.43	62	
PWP	SAICC	Drought-SS/PW,FW	0.05	0.13	0.04	0.55	0.50	1.40	0.14	21.06	0.41	63	
CRL	IC/IDC/EARCAL/SAICC	Downy mildew-PW	0.04	0.26	0.08	0.02	0.50	1.39	1.12	22.18	0.35	64	
CRL	IC/WASIP/EARCAL/SAICC	Drought-SS	0.17	0.13	0.07	0.75	0.00	1.38	0.85	23.03	0.42	65	
CRL	IC/EARCAL/SAICC	Leaf blight-SS	0.10	0.15	0.17	0.86	0.25	1.37	0.33	23.36	0.42	66	
CRL	EARCAL	Rhizo disease-PW	0.03	0.24	0.08	0.63	0.25	1.36	0.33	23.69	0.38	67	
CRL	IDC	Striga-PW	0.02	0.04	0.10	0.66	0.50	1.33	0.30	24.00	0.41	68	
CRL	IC/IDC	Low grain yield-PW	0.07	0.02	0.01	0.32	0.50	1.32	0.37	24.38	0.36	69	
LGM	IC	Phyto blight (WET)-PP	0.02	0.42	0.49	0.01	0.50	1.28	0.12	25.01	0.32	70	
LGM	IC	Helicoverpa-PP	0.02	0.39	0.45	0.03	0.75	1.27	0.02	25.33	0.41	71	
CRL	WASIP	Foliar disease res.-SS	0.07	0.29	0.08	0.53	0.50	1.25	0.41	25.74	0.39	72	
SWIP	SAICC	Impr. of grain yield-PW	0.11	0.05	0.02	0.55	0.50	1.20	0.21	25.95	0.38	73	
PIC	SAICC	Res. impact-SS/PW,FW	(0.69)	0.05	0.02	0.48	0.00	1.20	0.12	26.07	0.17	74	
PIC	SAICC	Policy analysis-SS/PW,FW	(0.31)	0.04	0.01	0.76	0.00	1.20	0.12	26.19	0.33	75	
CRL	IC	Shoot fly-SS	0.25	0.19	0.02	0.49	0.25	1.19	0.27	26.46	0.21	76	
CRL	IC	Lack of adapt. varie.-PW	0.10	0.08	0.08	0.03	0.50	1.18	0.66	27.12	0.33	77	
LGM	IC	Maruca-PP	0.04	0.21	0.04	0.11	0.75	1.17	0.06	27.18	0.37	78	
SM	IC	Stunt virus-SP	0.02	0.35	0.16	0.25	0.50	1.13	0.10	27.28	0.37	79	
LGM	IC/EARCAL	Poofly (WET)-PP	0.16	0.28	0.43	0.08	0.50	1.10	0.14	27.42	0.31	80	
LGM	IC	Water logging-PP	0.14	0.35	0.42	0.05	0.50	1.08	0.30	27.72	0.31	81	
LGM	IC/EARCAL	Poofly-PP	0.01	0.28	0.43	0.20	0.50	1.07	0.14	27.86	0.35	82	
CRL	IC/ISC	Head caterpillars-PW	0.08	0.04	0.09	0.59	0.25	0.99	0.30	28.16	0.30	83	
CRL	IC/ISC	High temperature-PW	0.12	0.24	0.28	.29	0.25	0.96	0.50	28.66	0.28	84	
LGM	IC	Cold tolerance-SP	0.15	0.08	0.22	0.03	0.50	0.83	0.23	28.89	0.22	85	
CRL	IC/SAICC	Forage sorghum-SS	0.09	0.34	0.24	0.26	0.00	0.77	0.25	29.14	0.19	86	
CRL	IC/ISC	Stem borers-PW	0.02	0.01	0.04	0.44	0.25	0.76	0.29	29.43	0.24	87	
LGM	IC	Botrytis gray mold-SP	0.06	0.12	0.29	0.48	0.00	0.74	0.19	29.62	0.22	88	
ECO	SAICC	Seed distribution-SS/PW,FW	(-0.22)	0.06	0.02	0.65	0.25	0.72	0.19	29.81	0.31	89	
ECO	SAICC	Market reform-SS/PW,FW	(-0.06)	0.08	0.04	0.72	0.00	0.72	0.17	29.98	0.26	90	
PWP	IC	Inst'l & human res'rces	(-0.37)	0.30	0.38	0.00	0.75	0.72	0.12	30.10	0.35	91	
PWP	IC	Input markets	(0.13)	0.30	0.28	0.00	0.25	0.72	0.08	30.18	0.20	92	

3. Case2: Sustainability = 0

SVCASE02.WQ1 (Based on CASE 2 ranks) Sus.=0, Eff.=0.33, Equ.=0.33, Int.=0.33
ative cost based on benchmark ranks.
d research "theres" by composite index - Medium term plan 1994-1998
ize from: NB/C=50; poverty=250; gender=200

Program	Center(s)/Location(s)	Constraint/theme	Efficiency: Net B/C	Equity: Poverty	Equity: Gender	Interna-tionality	Sustain-ability	Benchmark Ef,Eq,In,Su = 1	Res. cost/year (Im.$) First year	Cumulative cost ($mill)	Case 2 Ef=0.33 Eq=0.33 In=0.33 Su=0 CI	Benchmark CI	Case 2 CI
		Weights =>	1.00	0.50	0.50	1.00	1.00	CI					
GRU	IC	Germplasm evaluation	2.04	1.69	1.26	1.00	0.75	5.21	0.19	0.19	1.47	1	
GRU	IC	Germplasm collection	0.81	1.69	1.26	1.00	1.00	4.24	0.14	0.33	1.07	2	
LGM	IC	Drought-CP	2.27	0.24	0.40	0.55	0.50	3.64	0.48	0.81	1.04	3	
GRU	IC	Germplasm maintenance	0.71	1.69	1.26	1.00	0.50	3.63	0.10	0.91	1.03	4	
LGM	IC	Ascochyta blight-CP	2.69	0.13	0.31	0.67	0.00	3.48	0.14	1.05	1.15	5	
LGM	IC/ISC/SADCC	Rust-GN	0.36	1.35	1.03	0.70	0.50	3.35	0.33	1.38	0.84	6	
LGM	IC	Aflatoxin-GN	0.46	0.83	1.00	0.82	1.00	3.28	0.05	1.43	0.75	7	
LGM	IC/ISC/SADCC	Late leaf spot-GN	0.25	1.32	1.01	0.84	0.75	3.09	0.43	1.86	0.74	8	
LGM	IC/ISC	Aflatoxin (MGT)-GN	0.13	1.44	1.03	0.80	1.00	2.95	0.56	2.42	0.66	9	
LGM	IC	Insect damage-CP	1.67	0.85	0.86	0.06	0.75	2.34	0.05	2.47	0.72	10	
LGM	IC	Wilt-CP	2.08	0.05	0.06	0.06	0.00	2.30	0.14	2.81	0.36	11	
RMP	IC	Adopt. asses./imp. evl.	(0.09)	1.44	1.10	1.00	0.50	2.86	0.62	3.43	0.60	12	
RMP	IC	Res. resource. alloc'n	(-0.31)	1.69	1.26	1.00	0.75	2.86	0.21	3.64	0.60	13	
RMP	IC	Soil nutrients	0.72	0.67	0.54	0.49	1.00	2.81	0.54	4.18	0.89	14	
LGM	IC/ISC/SADCC	Early leaf spot-GN	0.09	1.38	1.04	0.70	0.75	2.75	0.45	4.63	0.66	15	
LGM	IC EARCAL	Genetic potential yld-PP	1.27	0.55	0.86	0.83	0.50	2.63	0.13	4.76	0.87	16	
LGM	IC/ISC/SADCC	Yield potential-GN	0.25	0.94	1.01	0.71	0.50	2.53	0.44	5.20	0.67	17	
CRL	IC WASIP/EARCAL/SADCC	Striga-SG	0.83	0.13	0.16	0.80	0.75	2.51	0.28	5.48	0.58	18	
LGM	IC/ISC/SADCC	Drought-GN	0.10	1.33	1.03	0.62	0.50	2.43	0.50	5.98	0.84	19	
LGM	IC	Root rots-CP	1.41	0.05	0.06	0.03	0.05	0.24	0.14	6.12	0.69	20	
LGM	IC	Sub neprosis / rus-GN	0.02	1.23	1.09	0.66	0.50	0.33	0.13	6.25	0.60	21	
CRL	IC WASIP SADCC	Grain & stover yld.-SG	0.30	0.12	0.06	0.65	0.50	0.33	0.68	6.93	0.69	22	
RMP	ISC WASIP N	Soil fertility	0.42	0.07	0.13	0.76	1.00	0.28	0.58	7.51	0.42	23	
LGM	IC	St. necrosis/Fu. wilt-PP	0.61	0.50	0.06	0.12	0.75	0.21	0.21	7.72	0.48	24	
RMP	IC	Soil structure	0.12	0.67	0.64	0.46	1.00	0.18	0.74	8.46	0.39	25	
LGM	IC	Leaf miner-GN	0.12	0.78	0.80	0.46	0.75	0.17	0.19	8.65	0.47	26	
LGM	IC	Biolog. N fixation-CP	0.33	0.35	0.45	0.43	1.00	0.16	0.10	8.75	0.38	27	
LGM	IC	Leaf miner (MGT)-GN	0.09	0.77	0.80	0.45	0.75	0.14	0.23	8.98	0.45	28	
RMP	IC	Water deficit	0.38	0.62	0.50	0.34	0.75	0.03	0.35	9.33	0.42	29	
LGM	IC	Spodoptera-GN	0.02	0.70	0.83	0.40	0.75	0.03	0.14	10.07	0.09	30	
LGM	IC	Peanut clump virus-GN	0.10	0.46	0.41	0.34	0.50	0.07	0.03	10.30	0.45	31	
LGM	IC/ISC/SADCC	Rosette virus-GN	0.17	0.29	0.24	0.39	0.50	0.02	0.53	10.83	0.44	32	
LGM	IC	Helicoverpa (MGT)-PP	0.48	0.39	0.45	0.17	0.75	0.02	0.17	11.00	0.05	33	
CRL	IC/WASIP/EARCAL/SADCC	Stem borer-SG	0.03	0.93	0.64	0.75	0.25	0.02	0.76	11.76	0.52	34	
CRL	IC/WASIP/EARCAL	Grain mold-SG	0.43	0.20	0.19	0.68	0.50	0.01	0.46	12.21	0.43	35	
LGM	ISC	Millipedes-GN	0.16	0.11	0.12	0.77	0.75	0.00	0.04	12.25	0.35	36	
RMP	ISC/WASIP(N)	Water deficit-PM,SG,GN	0.08	0.10	0.14	0.76	0.75	0.71	0.83	13.08	0.32	37	
RMP	ISC/WASIP(M,N)	Tech. adopt./imp. eval.	(0.51)	0.10	0.14	0.83	0.25	0.71	0.29	13.37	0.31	38	
RMP	ISC/WASIP	Agro-forestry	0.07	0.10	0.14	0.76	0.75	0.70	0.50	13.87	0.31	39	
RMP	ISC/WASIP(N)	Char'n of prod'n envi't	(0.32)	0.10	0.14	0.76	0.50	0.70	0.72	14.59	0.31	40	
LGM	IC	Nematodes-GN,PP,CP	0.12	0.72	0.86	0.27	0.50	0.69	0.41	15.10	0.39	41	
LGM	ISC	Termites-GN	0.05	0.11	0.12	0.77	0.75	0.68	0.11	15.21	0.31	42	
LGM	IC	Sub-optimal yield-CP	0.01	0.35	0.45	0.52	0.75	0.68	0.25	15.46	0.31	43	

3. contd. ..

Prog	Constraint/theme / Weights =>	Efficiency (Net B/C) 1.00	Equity: Poverty 0.50	Equity: Gender 0.50	Interrationality 1.00	Sustainability 1.00	Benchmark (Ef.Eq, In,Su = 1) 01	Res. cost/year (m.$) First year	Cumulative cost ($mill)	Case 2 (Ef=..33 Eq=0.33 In=.33 Su=0) 01	Benchmark rank	Ran bas (in Cas (Su
CRL	EARCAL	Low temperature-SG	0.19	0.13	0.24	0.60	0.75	1.68	0.19	15.65	0.29	44	
LSM	ISC	White grubs-SM	0.00	0.11	0.12	0.72	0.75	1.62	0.11	15.76	0.29	45	
CRL	IC/KARIP	Head bug-SG	0.14	0.17	0.25	0.76	0.50	1.61	0.27	16.03	0.37	46	
LSM	IC/EARCAL	Drought-PP	0.15	0.09	0.45	0.28	0.75	1.61	0.41	16.44	0.28	47	
CRL	IC/KARIP/EARCAL/SACCO	Anthracnose-SG	0.03	0.51	0.27	0.62	0.25	1.68	0 48	16.87	0.45	48	
CRL	IC/KARIP/EARCAL	Midge-SG	0.03	0.23	0.16	0.82	0 50	1.69	0.52	17 39	0.35	49	
SWP	IC	Char'zation of environ.	(0.28)	0.30	0.38	0.00	0.50	1.57	0.25	17.64	0.25	50	
SWP	IC/EARCAL	Micro-econ studies	(0.27)	0.24	0.08	0.54	0.50	1.57	0.41	18.05	0.25	51	
SWP	IC	Natural resources	(0.03)	0.33	0.08	0.00	1.00	1.57	0.61	18.65	0.25	52	
SWP	IC	Supply & demand	(0.48)	0.30	0.08	0.00	0.75	1.57	0.91	19.56	0.26	53	
SWP	IC	Farmers' preferences	(0.10)	0.00	0.08	0.00	0.50	1.57	0.14	19.00	0.25	54	
SWP	IC	Beneficial organisms	0.23	0.25	0.35	0.27	0.75	1.55	0.41	19.41	0.25	55	
SWP	SACCO	Plant nutr'n-SG PM/FM	0.25	0.13	0.24	0.70	0.50	1.54	0.08	19.49	0.34	56	
LSM	IC	Peanut mottle virus-SM	0.07	0.59	0.46	0.81	0.00	1.51	0.21	19 70	0.50	57	
SWP	ISC/KARIP/M	Cons./demand studies	(0.35)	0.12	0.14	0.78	0.25	1.50	0.21	19.91	0.33	58	
CRL	IC/ISC/EARCAL/SACCO	Drought-PM	0.15	0.26	0.23	0.48	0.00	1.48	0.56	20 47	0.32	59	
SIP	SACCO	Adaptability-SM	0.68	0.05	0.24	0.75	0.00	1.47	0.08	20.55	0.49	60	
CRL	KARIP	Adapt. to acid soils-SG	0.19	0.20	0.07	0.64	0.50	1.45	0.19	20.74	0.31	61	
LSM	IC	Peanut stripe virus-SM	0.09	0.39	0.16	0.84	0.50	1.40	0.18	20.92	0.33	62	
SWP	SACCO	Drought-SG/PM-FM	0.15	0.13	0.24	0.65	0.50	1.40	0.14	21.06	0.30	63	
CRL	IC/ISC/EARCAL/SACCO	Downy mildew-PM	0.34	0.26	0.18	0.23	0.50	1.38	1.12	22.18	0.29	64	
CRL	IC/KARIP/EARCAL/SACCO	Drought-SG	0.11	0.13	0.27	0.76	0.00	1.35	0.85	23.03	0.45	65	
CRL	IC/EARCAL/SACCO	Leaf blight-SG	0.10	0.15	0.11	0.85	0.25	1.37	0.03	23.06	0.37	66	
CRL	EARCAL	Blast disease-PM	0.03	0.24	0.18	1.88	0.25	1.28	0.03	23.09	0.37	67	
CRL	ISC	Striga-PM	0.10	0.04	0.10	0.86	0.50	1.10	0.03	24.12	0.27	68	
CRL	IC/ISC	Low grain yld-PM	0.21	0.23	0.21	0.32	0.50	1.00	0.57	24.69	0.26	69	
LSM	IC	Phyto. blight (MGT)-PP	0.32	0.40	0.49	0.01	0.50	1.28	0.12	25.01	0.25	70	
LSM	IC	Helicoverpa-PP	0.02	0.39	0.45	0.08	0.75	1.27	0.00	25.33	0.17	71	
CRL	KARIP	Foliar disease res.-SG	0.07	0.23	0.08	0.50	0.50	1.25	0.41	25.74	0.25	72	
SWP	SACCO	Impr. of grain yield-PM	0.11	0.05	0.12	0.55	0.50	1.22	0.21	25.95	0.23	73	
ECO	SACCO	Res. impact-SG PM/FM	(0.69)	0.05	0.02	0.48	0.00	1.20	0.12	26.07	0.23	74	
ECO	SACCO	Policy analysis-SG/PM-FM	(0.21)	0.04	0.11	0.76	0.00	1.20	0.12	26.19	0.23	75	
CRL	IC	Shoot fly-SG	0.25	0.18	0.22	0.49	0.25	1.19	0.27	26.46	0.31	76	
CRL	IC	Lack of adapt.(arid)-PM	0.20	0.08	0.23	0.33	0.50	1.18	0.66	27.12	0.23	77	
LSM	IC	Maruca-PP	0.04	0.21	0.34	0.11	0.75	1.17	0.06	27.18	0.14	78	
LSM	IC	Stunt virus-SP	0.02	0.35	0.16	0.25	0.50	1.13	0.10	27.28	0.21	79	
LSM	IC/EARCAL	Podfly (MGT)-PP	0.16	0.28	0.43	0.08	0.50	1.10	0.14	27.42	0.20	80	
LSM	IC	Water logging-PP	0.14	0.36	0.42	0.05	0.50	1.08	0.10	27.72	0.19	81	
LSM	IC/EARCAL	Podfly-PP	0.01	0.28	0.43	0.20	0.50	1.07	0.14	27.85	0.19	82	
CRL	IC/ISC	Head caterpillars-PM	0.08	0 34	0.09	0.59	0.25	0.99	0.30	28. 6	0.24	83	
CRL	IC/ISC	High temperature-PM	0.12	0.24	0.39	0.29	0.25	0.96	0.50	28 56	0.24	84	
LSM	IC	Cold tolerance-SP	0.15	0.08	0.22	0.03	0.50	0.83	0.23	28.69	0.11	85	
CRL	IC/SACCO	Forage sorghum-SG	0.20	0.34	0.24	0.08	0.00	0.77	0.25	29.14	0.25	86	
CRL	IC/ISC	Stem borers-PM	0.02	0.01	0.08	0.44	0.25	0.76	0.29	29.43	0.17	87	
LSM	IC	Botrytis gray mold-SP	0.05	0.12	0.28	0.48	0.00	0.74	0.19	29.62	0.24	88	
ECO	SACCO	Seed d'bution-SG/PM/FM	(-0.22)	0.06	0.02	0.65	0.25	0.72	0.19	29.81	0.11	89	
ECO	SACCO	Market reform-SG/PM/FM	(-0.06)	0.08	0.04	0.72	0.00	0.72	0.17	29.98	0.11	90	
RMP	IC	Inst'l & human res'rces	(-0.37)	0.30	0.08	0.00	0.75	0.72	0.12	30.10	0.11	91	
RMP	IC	Input markets	(0.13)	0.30	0.08	0.00	0.25	0.72	0. 8	30.18	0.11	92	

4. Case 3: Internationality = 0

CASE03.WQ1 (Based on CASE 3 ranks) Sus.=0.33, Eff.=0.33, Equ.=0.33, Int.=0
ve cost based on benchmark ranks
esearch "themes" by composite index - Medium term plan 1994-1998
e from: NB/C=50; poverty=250; gender=300

Center(s)/location(s)	Constraint/theme	Efficiency Net B/C	Equity: Poverty	Equity: Gender	Internationality	Sustainability	Benchmark (Ef,Eq,In,Su = 1)	Res. cost/year (m.$) First year	Cumulative cost ($million)	Case 3 (Ef=0.3, Eq=.33, In=0, Su=.33)	Benchmark rank	Rank based on case 3 (In=0)
	Weights =>	1.00	0.50	0.50	1.00	1.00	01			01		
IC	Germplasm evaluation	2.04	1.59	1.26	1.00	0.75	5.21	0.19	0.19	1.39	1	1
IC	Germplasm collection	0.81	1.59	1.26	1.00	1.00	4.24	0.14	0.33	1.07	2	2
IC	Drought-CP	2.27	0.24	0.40	0.55	0.50	3.64	0.48	0.81	1.02	3	3
IC	Germplasm maintenance	0.71	1.59	1.26	1.00	0.50	3.63	0.10	0.91	0.87	4	5
IC	Ascochyta blight-CP	2.59	0.12	0.31	0.67	0.00	3.48	0.14	1.05	0.95	5	4
IC/ISC/SADCC	Rust-GN	0.96	1.35	1.03	0.70	0.50	3.35	0.33	1.38	0.87	6	6
IC	Aflatoxin-GN	0.45	0.93	1.00	0.82	1.00	3.23	0.05	1.43	0.81	7	8
IC/ISC/SADCC	Late leaf spot-GN	0.25	1.32	1.01	0.84	0.75	3.00	0.43	1.86	0.71	8	15
IC/ISC	Aflatoxin (MGT)-GN	0.13	1.44	1.03	0.60	1.00	2.96	0.56	2.42	0.79	9	10
IC	Insect damage-CP	1.57	0.35	0.39	0.25	0.75	2.94	0.25	2.67	0.88	10	5
IC	Wilt-CP	2.28	0.35	0.39	0.25	0.00	2.90	0.14	2.81	0.87	11	7
IC	Adopt. assess./imp. eval.	(0.03)	1.44	1.10	1.00	0.50	2.88	0.62	3.43	0.78	12	11
IC	Res. resource. alloc'n	(-0.31)	1.59	1.26	1.00	0.75	2.86	0.21	3.64	0.77	13	12
IC	Soil nutrients	0.70	0.67	0.54	0.43	1.00	2.81	0.54	4.18	0.77	14	13
IC/ISC/SADCC	Early leaf spot-GN	0.33	1.38	1.04	0.70	0.75	2.75	0.45	4.63	0.68	15	17
IC/EARCAL	Genetic potent'l yld-PP	1.27	0.50	0.56	0.33	0.50	2.53	0.13	4.76	0.75	16	14
IC/ISC/SADCC	Yield potential-GN	0.25	0.94	1.21	0.71	0.50	2.53	0.44	5.20	0.50	17	19
IC/WASIP/EARCAL/SADCC	Striga-SG	0.83	0.13	0.15	0.80	0.75	2.51	0.28	5.48	0.57	18	23
IC/ISC/SADCC	Drought-GN	0.10	1.33	1.09	0.62	0.50	2.43	0.50	5.98	0.50	19	20
IC	Root rots-CP	1.41	0.35	0.38	0.33	0.25	2.34	0.14	6.12	0.66	20	18
IC	Bud necrosis virus-GN	0.00	1.20	1.09	0.66	0.50	2.33	0.13	6.25	0.55	21	27
IC/WASIP/SADCC	Grain & stover yld.-SG	0.33	0.72	0.88	0.65	0.50	2.33	0.68	6.93	0.43	22	31
ISC/WASIP(N)	Soil fertility	0.40	0.07	0.13	0.75	1.00	2.28	0.58	7.51	0.50	23	30
IC	St. mosaic/Fu. wilt-PP	0.81	0.50	0.55	0.13	0.75	2.21	0.21	7.72	0.69	24	16
IC	Soil structure	0.12	0.67	0.54	0.46	1.00	2.18	0.74	8.46	0.57	25	22
IC	Leaf miner-GN	0.12	0.78	0.80	0.46	0.75	2.17	0.10	8.55	0.55	26	24
IC	Biolog. N fixation-CP	0.23	0.35	0.45	0.43	1.00	2.16	0.20	8.75	0.57	27	21
IC	Leaf miner (MGT)-GN	0.03	0.78	0.80	0.46	0.75	2.14	0.23	8.98	0.55	28	26
IC	Water deficit	0.38	0.62	0.50	0.34	0.75	2.03	0.95	9.93	0.56	29	25
IC	Spodoptera-GN	0.02	0.70	0.83	0.40	0.75	1.93	0.14	10.07	0.50	30	29
IC	Peanut clump virus-GN	0.10	0.46	0.41	0.84	0.50	1.87	0.23	10.30	0.24	31	47
IC/ISC/SADCC	Rosette virus-GN	0.17	0.29	0.24	0.89	0.50	1.84	0.53	10.83	0.21	32	53
IC	Helicoverpa (MGT)-PP	0.43	0.39	0.45	0.17	0.75	1.82	0.17	11.00	0.54	33	28
IC/WASIP/EARCAL/SADCC	Stem borer-SG	0.03	0.93	0.54	0.75	0.25	1.82	0.76	11.76	0.35	34	45
IC/WASIP/EARCAL	Grain mold-SG	0.43	0.20	0.13	0.63	0.50	1.81	0.45	12.21	0.37	35	44
ISC	Millipedes-GN	0.16	0.11	0.12	0.77	0.75	1.80	0.04	12.25	0.34	36	50
ISC/WASIP(N)	Water deficit-PM,SG,GN	0.08	0.10	0.14	0.76	0.75	1.71	0.83	13.08	0.31	37	55
ISC/WASIP(M,N)	Tech. adopt./imp. eval.	(0.51)	0.10	0.14	0.83	0.25	1.71	0.29	13.37	0.31	38	56
ISC/WASIP	Agro-forestry	0.07	0.10	0.14	0.76	0.75	1.70	0.60	13.97	0.31	39	57
ISC/WASIP(N)	Char'n of prod'n envi't	(0.32)	0.10	0.14	0.76	0.50	1.70	0.72	14.69	0.31	40	58
IC	Nematodes GN,PP,CP	0.12	0.72	0.88	0.27	0.50	1.69	0.41	15.10	0.47	41	32
ISC	Termites-GN	0.05	0.11	0.12	0.77	0.75	1.68	0.11	15.21	0.30	42	60
IC	Sub-optimal yield-CP	0.01	0.35	0.45	0.52	0.75	1.58	0.25	15.46	0.38	43	42

1. cont'd ..

Pro-gram	Center(s)/location(s)	Constraint/theme Weights ⇒	Efficiency Net B.C. 1.00	Equity Poverty 0.50	Equity Gender 0.50	Internationality 1.00	Sustainability 1.00	Benchmark (Ef.Eq.In.Su) = C1	Res. cost/year (in $m) first year	Cumulative cost ($mill)	Case 3 (Ef=0.3, Eq=.33, In=0, Su=.33) C1	Benchmark rank	Rank based on case 3 (Case
L	[illegible]-RCAL	Low temperature-SG	0.13	0.03	0.04	0.60	0.75	1.63	0.19	15.85	0.34	44	4
M	ICC	White grubs-GN	0.03	0.31	0.12	0.72	0.75	1.62	0.11	15.76	0.30	45	6
L	IC/WASIP	Head bug-SG	0.14	0.17	0.25	0.78	0.50	1.61	0.27	16.03	0.28	46	6
M	IC EARCAL	Drought-PP	0.15	0.33	0.45	0.63	0.75	1.61	0.41	16.44	0.44	47	3
L	IC/WASIP/EARCAL/SADCC	Anthracnose-SG	0.09	0.51	0.27	0.82	0.25	1.60	0.43	16.87	0.26	48	7
L	IC/WASIP/EARCAL	Striga-SG	0.06	0.23	0.15	0.82	0.50	1.59	0.62	[illegible]	0.26	49	7
P	IC	Char'zation of environ.	(0.73)	[illegible]	0.38	0.00	0.50	1.57	0.05	17.54	0.43	50	3
P	IC/EARCAL	Micro-econ studies	(0.27)	0.24	0.08	0.54	0.50	1.57	0.41	18.25	0.43	51	3
P	IC	Natural resources	(0.03)	0.30	0.38	0.00	1.00	1.57	0.60	18.85	0.43	52	3
P	IC	Supply & demand	(0.48)	0.30	0.38	0.00	0.75	1.57	0.21	18.85	0.43	53	3
P	IC	Farmers' preferences	(0.70)	0.30	0.38	0.00	0.50	1.57	0.14	19.00	0.43	54	3
P	IC	Beneficial organisms	0.23	0.25	0.25	0.27	0.75	1.56	0.41	19.41	0.42	55	3
P	SADCC	Plant nutr'n-SG/PM/FM	0.26	0.13	0.04	0.70	0.50	1.54	0.03	19.43	0.28	56	6
P	ISC/WASIP W	Cons. demand studies	(0.05)	0.10	0.14	0.78	0.25	1.50	0.27	19.70	0.33	58	5
L	IC/ISC/EARCAL SADCC	*Drought-PM	0.16	0.26	0.39	0.45	0.50	1.48	0.56	20.26	0.33	59	5
P	SADCC	Adaptability-GN	0.03	0.26	0.04	0.75	0.00	1.47	0.08	20.34	0.24	60	7
L	WASIP	Adapt. to acid soils-SG	0.18	0.20	0.07	0.64	0.50	1.45	0.19	20.53	0.27	61	6
M	IC	Peanut stripe virus-GN	0.09	0.39	[illegible]	0.64	0.50	1.40	[illegible]	20.71	0.28	62	6
P	SADCC	Drought-SG/PM/FM	0.16	0.13	0.04	0.66	0.50	1.40	0.14	20.85	0.25	63	7
L	IC/ISC/EARCAL SADCC	Downy mildew-PM	0.34	0.26	0.38	0.33	0.50	1.39	[illegible]	21.37	0.38	64	4
L	EARCAL	Blast disease-FM	0.28	0.24	0.28	0.68	0.25	1.36	[illegible]	[illegible]	0.23	67	7
L	ISC	*Striga-PM	0.10	0.04	0.10	0.85	0.50	1.30	[illegible]	[illegible]	0.22	68	7
L	IC/ISC	Low grain yld-PM	0.01	[illegible]	[illegible]	[illegible]	0.50	[illegible]	[illegible]	[illegible]	[illegible]	69	5
M	IC	Photo. [illegible]	[illegible]	0.42	0.43	0.01	0.50	[illegible]	[illegible]	[illegible]	0.43	70	4
M	IC	Helicoverpa-PP	[illegible]	0.33	0.43	0.08	0.75	[illegible]	[illegible]	[illegible]	[illegible]	71	4
L	WASIP	Foliar disease res.-SG	0.07	0.33	0.28	0.50	0.50	1.25	0.41	[illegible]	0.28	72	7
P	SADCC	Impr. of grain yield-FM	[illegible]	0.05	0.02	0.65	0.50	[illegible]	[illegible]	24.58	0.21	73	7
P	SADCC	Res. [illegible]-SG/PM/FM	(0.09)	0.05	0.02	0.48	0.00	1.20	[illegible]	24.65	0.21	74	8
P	SADCC	Policy [illegible]	(0.01)	0.04	[illegible]	0.75	0.00	1.20	[illegible]	24.80	0.22	75	9
L	IC	Shoot fly-SG	[illegible]	0.13	0.02	0.49	0.25	1.19	0.27	25.07	0.23	76	7
L	IC	Lack of adapt. [illegible]	[illegible]	[illegible]	0.23	0.33	[illegible]	1.16	0.66	25.73	0.23	77	6
M	IC	Maruca-PP	0.04	0.21	0.34	[illegible]	0.75	[illegible]	0.06	25.79	0.26	78	4
M	IC	Stunt virus-CP	0.02	0.35	0.26	0.26	0.50	1.13	[illegible]	25.89	0.23	79	6
M	IC EARCAL	Podfly (WGT)-PP	0.16	0.28	0.43	0.08	0.50	1.10	0.14	26.03	0.34	80	5
M	IC	Water logging-PP	0.14	0.36	0.42	0.05	0.50	1.08	0.00	26.03	0.34	81	4
M	IC/EARCAL	Podfly-PP	0.01	0.28	0.43	0.20	0.50	1.07	0.14	26.47	0.29	82	6
L	IC/ISC	*High temperature-PM	0.12	0.24	0.38	0.29	0.25	0.95	0.50	26.97	0.22	84	7
M	IC	Cold tolerance-CP	0.15	0.06	0.22	0.03	0.50	0.93	0.03	27.20	0.26	85	6
L	IC/WASIP/EARCAL/SADCC	*Drought-SG	0.17	0.13	0.17	0.76	0.00	1.38	0.55	28.05	0.20	65	7
M	IC	Peanut bottle virus-GN	0.07	0.59	0.46	0.91	0.00	1.51	0.21	28.26	0.20	57	8
L	IC/EARCAL/SADCC	Leaf blight-SG	0.10	0.15	0.17	0.86	0.25	1.37	0.33	28.59	0.17	66	8
L	IC/SADCC	Forage sorghum-SG	0.20	0.34	0.24	0.28	0.00	0.77	0.25	28.84	0.16	86	8
L	IC/ISC	*Head caterpillars-PM	0.08	0.24	0.09	0.59	0.25	0.99	0.30	29.14	0.13	83	8
L	IC/ISC	*Stem borers-PM	0.02	0.01	0.08	0.44	0.25	0.75	0.29	29.43	0.10	87	8
M	IC	Botrytis gray mold-CP	0.06	0.12	0.28	0.48	0.00	0.74	0.19	29.62	0.08	88	8
P	IC	Input markets	(0.10)	0.30	0.38	0.00	0.25	0.72	0.08	29.70	0.08	92	8
P	IC	Inst'l & human res'rces	(-0.37)	0.30	0.38	0.00	0.75	0.72	0.12	29.82	0.08	91	9
P	SADCC	Market reform-SG/PM/FM	(-0.06)	0.08	0.04	0.72	0.00	0.72	0.17	29.99	0.08	90	9
P	SADCC	Seed d'bution-SG/PM/FM	(-0.22)	0.06	0.02	0.65	0.25	0.72	0.19	30.18	0.07	89	9

6. Case 4: Equity = 0

WPCASE4.WQ1 (Based on CASE4 ranks: Sus.=0.33, Eff.=0.33, Equ.=0, Int.=0.33
ive cost based on benchmark ranks
research "themes" by composite index - Medium term plan 1994-1998
ta from: NB/DrSD, poverty=ASD; gender=SD

Program Center(s)/location(s)	Constraint theme	Efficiency (Net BIC)	Equity: Poverty	Equity: Gender	Internationality	Sustainability	Benchmark (Ef.50, In.20, S.1)	Res. cost (m $/year) First year	Cumulative cost ($m/yr)	Case 4 (Ef.0.33)	Benchmark rank	Rank (based on case ...)
Weights =>		1.00	0.50	0.50	1.00	1.00	33			33		
ICC	Germplasm evaluation	0.04	1.83	1.26	1.00	0.75	5.21	0.12	[illegible]	1.25	1	[illegible]
ICC	Germplasm collection	0.31	1.39	1.35	1.00	1.00	4.24	0.14	0.56	0.83	2	4
ICC	Drought-CP	2.21	0.34	0.40	0.55	0.50	3.84	0.48	0.81	1.10	3	[illegible]
ICC	Germplasm maintenance	0.11	1.83	1.25	1.00	0.50	3.63	0.10	0.91	0.73	4	[illegible]
ICC	Ascochyta blight-CP	0.53	1.12	0.91	0.97	0.50	3.48	0.14	1.05	1.03	5	[illegible]
ICC/ISC/SADCC	Rust-GN	0.86	1.35	1.03	0.70	0.85	3.35	0.02	1.08	[illegible]	6	[illegible]
ICC	Aflatoxin-GN	0.48	0.83	1.00	0.82	1.00	3.33	0.35	1.43	0.75	7	[illegible]
ICC/ISC/SADCC	Late leaf spot-GN	0.25	1.12	1.01	0.34	0.75	3.30	0.43	1.86	0.81	8	17
ICC/ISC	Aflatoxin (WCA)-GN	[illegible]	1.44	1.39	0.60	1.00	3.11	0.55	2.42	0.87	9	14
ICC	Insect damage-CP	1.17	0.31	0.38	0.26	0.75	2.94	0.25	2.87	0.55	10	8
ICC	Wilt-CP	2.13	1.31	0.38	0.35	0.00	2.90	0.14	2.81	0.84	11	8
ICC	Adopt. assess./imp. ev.	0.23	1.44	1.10	1.00	0.50	2.85	0.62	3.43	0.72	12	10
ICC	Res. resource. allocation	-0.07	1.53	1.35	1.00	0.75	2.86	0.21	3.64	0.73	13	11
ICC	Soil nutrients	0.72	0.87	0.54	1.49	1.00	2.87	0.54	4.18	0.73	14	12
ICC/ISC/SADCC	Early leaf spot-GN	0.03	1.33	1.24	0.70	0.75	2.75	0.45	4.63	0.31	15	32
ICC/EARCAL	Genetic potential yield-PP	1.17	0.50	0.55	0.23	0.50	2.63	0.11	4.75	0.88	16	15
ICC/ISC/SADCC	Yield potential-GN	0.25	0.84	[illegible]	0.71	0.50	2.53	0.44	5.20	0.48	17	28
ICC/WASIP/EARCAL/SADCC	Striga-SG	[illegible]	[illegible]	0.16	0.60	0.75	2.51	0.18	5.43	0.78	18	[illegible]
ICC/ISC/SADCC	Drought-GN	[illegible]	1.23	1.19	0.22	0.50	2.40	0.51	5.88	0.40	19	34
ICC	Root rots-CP	1.47	0.35	0.16	0.33	0.25	2.34	0.14	6.12	0.85	20	13
ICC	Bud necrosis virus-GN	0.17	1.33	[illegible]	0.86	0.60	[illegible]	[illegible]	6.35	0.39	21	[illegible]
ICC/WASIP/SADCC	Grain & stover ...-SG	0.10	[illegible]	0.55	0.88	0.50	2.28	0.34	6.62	0.58	22	[illegible]
ICC/WASIP	Soil fertility	[illegible]	[illegible]	[illegible]	0.79	1.00	2.29	0.33	7.01	[illegible]	23	[illegible]
ICC	St. moist. util. & ...-PP	0.81	0.50	0.35	[illegible]	0.75	2.24	0.27	7.73	0.55	24	23
ICC	Soil structure	0.13	0.87	0.54	0.48	1.00	2.18	0.74	8.49	0.52	25	26
ICC	Leaf miner-GN	[illegible]	0.73	0.80	0.46	0.75	2.17	0.19	8.85	0.44	26	43
ICC	Biological N fixation-CP	0.33	0.38	0.45	0.43	1.00	2.16	0.12	8.75	0.58	27	13
ICC	Leaf miner (WCA)-GN	0.19	0.78	0.80	0.46	0.75	2.14	0.03	8.88	0.45	28	45
ICC	Water deficit	0.38	0.45	0.50	0.34	0.75	2.13	0.35	9.93	0.43	29	34
ICC	Spodoptera-GN	0.02	0.70	0.85	1.40	0.75	1.93	0.74	10.07	0.39	30	59
ICC	Peanut clump virus-GN	0.10	1.46	0.41	0.24	0.50	1.87	0.23	10.30	0.47	31	37
ICC/ISC/SADCC	Rosette virus-GN	0.17	1.23	0.24	0.58	0.50	1.82	0.35	10.60	0.52	32	33
ICC	Helicoverpa (WCA)-PP	0.46	0.13	0.43	0.17	0.75	1.82	0.17	11.00	0.45	33	41
ICC/WASIP/EARCAL/SADCC	Stem borer-SG	0.03	1.30	0.64	0.75	0.25	1.82	0.75	11.76	0.34	34	53
ICC/WASIP/EARCAL	Grain mold-SG	0.40	0.20	0.19	0.63	0.50	1.81	0.45	12.21	0.53	35	23
ISC	Millipedes-GN	0.16	0.11	0.12	0.77	0.75	1.80	0.04	12.25	0.55	36	21
ISC/WASIP(N)	Water deficit-PM,SG,GN	0.06	0.10	0.14	0.77	0.75	1.71	0.83	13.08	0.52	37	24
ISC/WASIP(M,N)	Tech. accpt./imp. eval.	(0.51)	0.10	0.14	0.83	0.25	1.71	0.29	13.37	0.52	38	25
ISC/WASIP	Agro-forestry	0.37	0.10	0.14	0.75	0.75	1.70	0.60	13.97	0.52	39	26
ISC/WASIP(N)	Chara'n of prod'n envir'n	(0.32)	0.10	0.14	0.75	0.50	1.70	0.72	14.69	0.52	40	27
ICC	Nematodes-GN,PP,CP	0.12	0.72	0.85	0.27	0.50	1.69	0.41	15.10	0.29	41	77
ISC	Termites-GN	0.05	0.11	0.12	0.77	0.75	1.68	0.11	15.21	0.52	42	29
ICC	Sub-optimal yield-CP	0.01	0.35	0.45	0.52	0.75	1.68	0.25	15.46	0.42	43	45

... contd. ..

Center(s)/location(s)	Constraint/theme	Efficiency (Net B/C)	Equity: Poverty	Equity: Gender	Internationality	Sustainability	Benchmark (Ef,Eq,In,Su)	Res. cost/year (m.$) First year	Cumulative cost (m.$)	Case 4	Benchmark rank
	Weights →	1.00	0.50	0.50	1.00	1.00					
EARCAL	Low temperature-SG	0.19	0.13	0.14	0.50	0.75	1.83	0.19	15.55	0.51	44
ISC	White grubs-GN	0.03	0.11	0.12	0.70	0.75	1.82	0.18	15.73	0.33	45
IC/WASIP	Head bug-SG	0.14	0.17	0.23	0.75	0.50	1.81	0.27	16.00	0.46	46
IC/EARCAL	Drought-PP	0.15	0.33	0.45	0.23	0.75	1.61	0.41	16.44	0.33	47
IC/WASIP/EARCAL/SACCD	Anthracnose-SG	0.03	0.51	0.27	0.82	0.25	1.60	0.43	16.87	0.38	48
IC/WASIP/EARCAL	Midge-SG	0.08	0.23	0.15	0.82	0.50	1.59	0.52	17.39	0.46	49
IC	Characterization of environ.	(0.33)	0.30	0.33	0.00	0.50	1.57	0.25	17.64	0.41	50
IC/EARCAL	Micro-econ studies	(0.27)	0.24	0.08	0.64	0.50	1.57	0.41	18.05	0.41	51
IC	Natural resources	(0.23)	0.30	0.08	0.00	1.00	1.57	0.60	18.65	0.41	52
IC	Supply & demand	(0.48)	0.30	0.33	0.00	0.75	1.57	0.21	18.86	0.41	53
IC	Farmers' preferences	(0.72)	0.30	0.33	0.00	0.50	1.57	0.14	19.00	0.41	54
IC	Beneficial organisms	0.23	0.25	0.33	0.27	0.13	1.55	0.41	19.41	0.41	55
SACCD	Plant nutrition-SG,PM,FM	0.26	0.13	0.04	0.70	0.50	1.54	0.08	19.49	0.43	56
IC	Peanut mottle virus-GN	0.27	0.59	0.45	0.31	0.00	1.51	0.21	19.70	0.32	57
ISC/WASIP/WA	Cons. demand studies	(0.05)	0.10	0.14	0.78	0.25	1.50	0.21	[illegible]	0.33	58
IC/ISC/EARCAL/SACCD	*Drought-PM	0.13	0.26	0.33	0.48	0.50	1.48	0.56	20.47	0.33	59
SACCD	Acceptability-GN	0.88	0.05	0.04	0.75	0.00	1.47	0.08	20.55	0.47	60
WASIP	Adapt. to acid soils-SG	0.13	0.20	0.07	0.64	0.50	1.45	0.19	20.74	0.44	61
IC	Peanut stripe virus-GN	0.23	0.39	0.15	0.34	0.50	1.40	0.18	20.92	0.37	62
SACCD	Drought-SG/FM/PM	0.15	0.13	0.04	0.65	0.50	1.40	0.14	21.06	0.43	63
IC/ISC/EARCAL/SACCD	Downy mildew-PM	0.24	0.28	0.33	0.31	0.50	1.38	0.12	21.18	0.35	64
IC/WASIP/EARCAL/SACCD	*Drought-SG	0.17	0.13	0.17	0.75	0.00	1.38	0.55	[illegible]	0.31	65
IC/EARCAL/SACCD	Leaf blight-SG	0.12	0.15	0.17	0.66	0.25	1.37	0.32	[illegible]	0.40	66
EARCAL	Blast disease-FM	0.08	0.24	0.09	0.88	0.25	1.35	0.33	[illegible]	0.40	67
IC	*Striga-PM	0.12	0.24	0.17	0.38	0.50	1.33	[illegible]	[illegible]	0.41	68
IC/ISC	Low grain yield-PM	0.01	0.20	0.01	0.32	0.50	1.30	0.87	[illegible]	0.34	69
IC	Phyto. blight (MGT)-PP	0.32	0.42	0.43	0.01	0.50	1.28	0.12	[illegible]	0.27	70
IC	Helicoverpa-PP	0.02	0.39	0.45	0.08	0.75	1.27	0.32	[illegible]	0.28	71
WASIP	Foliar disease res.-SG	0.07	0.29	0.08	0.50	0.50	1.25	0.41	25.74	0.35	72
SACCD	Impr. of grain yield-FM	0.11	0.05	0.12	0.55	0.50	1.22	0.21	25.95	0.38	73
SACCD	Res. impact-SG,PM,FM	(0.05)	0.05	0.02	0.48	0.50	1.20	0.12	26.07	0.33	74
SACCD	Policy alters-SG,PM,FM	(0.01)	0.34	0.11	0.75	0.00	1.20	0.12	26.19	0.33	75
IC	Shoot fly-SG	0.26	0.18	0.22	0.49	0.25	1.19	0.27	26.46	0.30	76
IC	Lack of adapt. (arid)-PM	0.20	0.08	0.23	0.33	0.50	1.18	0.66	27.12	0.24	77
IC	Maruca-PP	0.04	0.21	0.34	0.11	0.75	1.17	0.05	27.17	0.20	78
IC	Stunt virus-CP	0.02	0.35	0.35	0.25	0.50	1.13	0.10	27.28	0.25	79
IC/EARCAL	Podfly (MGT)-PP	0.16	0.28	0.43	0.03	0.50	1.10	0.14	27.42	0.24	80
IC	Water logging-PP	0.14	0.35	0.42	0.05	0.50	1.08	0.30	27.72	0.23	81
IC/EARCAL	Podfly-PP	0.11	0.28	0.43	0.20	0.50	1.07	0.14	27.86	0.23	82
IC/ISC	*Head caterpillars-PM	0.08	0.04	0.09	0.59	0.25	0.99	0.30	28.16	0.20	83
IC/ISC	*High temperature-PM	0.12	0.24	0.38	0.23	0.25	0.86	0.50	28.66	0.22	84
IC	Cold tolerance-CP	0.15	0.08	0.22	0.33	[illegible]	0.83	0.23	28.89	0.23	85
IC/SACCD	Forage sorghum-SG	0.20	0.24	0.24	0.28	[illegible]	0.77	0.25	29.14	0.16	86
IC/ISC	*Stem borers-PM	0.02	0.01	0.08	0.44	[illegible]	0.76	0.29	29.43	0.23	87
IC	Botrytis gray mold-CP	0.06	0.12	0.28	0.43	0.00	0.74	0.19	29.62	0.19	88
SACCD	Seed distribution-SG/PM/FM	(-0.22)	0.1[illegible]	0.02	0.55	0.25	0.72	0.19	29.81	0.16	89
SACCD	Market reform-SG/PM/FM	(-0.05)	0.06	0.04	0.72	0.00	0.72	0.17	29.98	0.15	90
IC	Inst'l & human res'rces	(-0.37)	0.30	0.36	0.00	0.75	0.72	0.12	30.10	0.16	91
IC	Input markets	(0.13)	0.30	0.33	0.00	0.25	0.72	0.08	30.18	0.16	92

6. Case 5: Internationality given three times the weight of o hers.

SWCASE05.WQ1 (Based on CASE5 ranks) S.s.=1/6, Eff.=1/6, Equ.=1/6, Int.=1/2
tive cost based on benchmark ranks
research "themes" by composite index - Medium term plan 1994-1998
ata from: NB,C=50; poverty=050, gender=000

Pro-gram	Centers(s)	Locations(s)	Constraint/theme / Weights =>	Effici-ency Net B/C (1.0)	Equity Poverty (0.5)	Equity Gender (0.5)	Inter-nat'l-ity (1.0)	Sust-aina-bility (1.0)	Res. cost Year (m.$) First year	Cumu-lative cost ($m))	Compo-site index	Case % CI	Bench-mark Rank	Rank based on Case 5 CI**
RG	IIO		Germplasm evaluation	2.24	1.59	1.26	1.00	0.75	0.19	0.19	5.24	1.02	1	1
RG	IIO		Germplasm collection	0.81	1.59	1.26	1.00	1.00	0.14	0.33	4.24	1.04	2	2
GM	IIO		Drought-CP	2.07	0.24	0.40	0.85	0.50	0.48	0.81	3.64	0.79	3	6
RG	IIO		Germplasm maintenance	0.71	1.59	1.26	1.00	0.50	0.10	0.91	3.63	0.84	4	3
GM	IIO		Ascochyta blight-CP	2.69	0.12	0.31	0.57	0.00	0.14	1.05	3.48	0.77	5	4
GM	IIO/ISC/SACCO		Rust-CN	0.35	1.05	1.00	0.70	0.50	0.00	1.33	3.05	0.78	6	5
GM	IIO		Aflatoxin-CN	0.46	0.93	1.00	0.82	1.00	0.05	1.43	3.28	0.82	7	4
GM	IIO/ISC/SACCO		Late leaf spot-CN	0.05	1.02	1.01	0.84	0.75	0.43	1.26	3.00	0.76	8	7
GM	IIO/ISC		Aflatoxin (WCT)-CN	0.10	1.44	1.03	0.60	1.00	0.66	2.40	2.36	0.69	9	9
GM	IIO		Insect damage-CP	1.57	0.35	0.05	0.26	0.75	0.25	1.87	2.94	0.68	10	22
GM	IIO		Wilt-CP	2.28	0.35	0.38	0.15	0.00	0.14	1.87	2.93	0.67	11	23
WP	IIO		Adopt. assess./trp. eval.	0.09	1.44	1.10	1.00	0.50	0.50	3.43	2.85	0.68	12	15
WP	IIO		Res. resource. alloc'n	-0.34	1.59	1.26	1.00	0.75	0.21	3.84	2.66	0.63	13	15
WP	IIO		Soil nutrients	0.72	0.67	0.54	0.49	1.00	0.54	4.16	2.81	0.63	14	17
GM	IIO/ISC/SACCO		Early leaf spot-CN	0.09	1.08	1.04	0.70	0.75	0.45	4.63	2.75	0.69	15	10
GM	IIO/FARCAL		Genetic potential y d-PP	1.27	0.50	0.56	0.03	0.50	0.10	4.76	2.53	0.52	16	48
PM	IIO/ISC/SACCO		Yield potential-CN	0.05	0.94	1.21	0.71	0.50	0.44	5.00	2.33	0.66	17	13
PL	IIO/WASIP/FARCAL/SACCO		Strigs-SG	0.60	0.13	0.15	0.60	0.75	0.28	5.48	2.51	0.62	18	11
GM	IIO/ISC/SACCO		Drought-CN	0.10	1.03	1.03	0.62	0.50	0.50	5.98	2.43	0.61	19	19
GM	IIO		Root rots-CP	1.41	0.05	0.06	0.03	0.25	0.14	6.12	2.04	0.50	20	42
GM	IIO		Bud necrosis virus-CN	0.10	1.02	1.02	0.66	0.50	0.13	6.25	2.33	0.57	21	29
PL	IIO/WASIP/SACCO		Strain & stalk fly-SG	0.33	0.72	0.55	0.65	0.50	0.58	6.83	2.33	0.57	22	31
WP	IIO/WASIP/		Soil fertility	0.42	0.67	0.13	0.76	1.00	0.58	7.41	2.29	0.53	23	34
GM	IIO		St. necrosis/Fus. wilt-PP	0.81	0.50	0.56	0.12	0.75	0.21	7.62	2.21	0.41	24	55
WP	IIO		Soil structure	0.12	0.67	0.54	0.45	1.00	0.74	8.45	2.18	0.52	25	39
GM	IIO		Leaf miner-CN	0.10	0.78	0.80	0.45	0.75	0.13	8.65	2.17	0.51	26	38
GM	IIO		Biological N fixation-CP	0.33	0.05	0.46	0.43	1.00	0.10	8.75	2.16	0.50	27	47
GM	IIO		Leaf miner (WCT)-CN	0.09	0.78	0.80	0.46	0.75	0.33	8.98	2.14	0.51	28	38
WP	IIO		Water deficit	0.38	0.62	0.50	0.34	0.75	0.35	9.33	2.03	0.45	29	52
GM	IIO		Sporocteria-CN	0.02	0.70	0.83	0.40	0.75	0.14	10.07	1.93	0.46	30	49
GM	IIO		Peanut clump virus-CN	0.10	0.46	0.47	0.84	0.50	0.23	10.30	1.87	0.53	31	31
GM	IIO/ISC/SACCO		Rosette virus-CN	0.17	0.29	0.24	0.89	0.50	0.53	10.83	1.82	0.50	32	53
GM	IIO		Helicoverpa (WCT)-PP	0.48	0.39	0.45	0.17	0.75	0.17	11.00	1.82	0.36	33	57
RL	IIO/WASIP/FARCAL/SACCO		Stem borer-SG	0.03	0.93	0.54	0.75	0.25	0.75	11.76	1.82	0.55	34	26
RL	IIO/WASIP/FARCAL		Grain moth-SG	0.43	0.20	0.19	0.68	0.50	0.45	12.21	1.81	0.53	35	34
GM	IISC		Millipedes-GN	0.16	0.11	0.12	0.77	0.75	0.04	12.25	1.80	0.56	36	24
WP	IISC/WASIP(N)		Water deficit-PM,SG,GN	0.09	0.10	0.14	0.76	0.75	0.83	13.08	1.71	0.54	37	29
WP	IISC/WASIP(M,N)		Tech. adopt./trp. eval.	0.01	0.10	0.14	0.83	0.25	0.29	13.37	1.71	0.54	38	30
WP	IISC/WASIP		Agro-forestry	0.01	0.10	0.14	0.76	0.75	0.60	13.97	1.70	0.54	39	32
WP	IISC/WASIP(N)		Char'n of prod'n envi't	0.02	0.10	0.14	0.76	0.50	0.[illegible]	14.69	1.70	0.53	40	33
GM	IIO		Nematodes-GN,PP,CP	0.12	0.12	0.86	0.27	0.50	0.41	15.10	1.69	0.37	41	63
GM	IISC		Termites-GN	0.05	0.11	0.12	0.77	0.75	0.11	15.21	1.68	0.54	42	35
GM	IIO		Sub-optimal yield-CP	0.01	0.35	0.46	0.62	0.75	0.25	15.46	1.68	0.45	43	51

6. contd. ..

Pro-gram	Center(s)/location(s)	Constraint/theme Weights =>	Effic-iency Net B/C (1.0)	Equity Poverty (0.5)	Equity Gender (0.5)	Inter-natio-nality (1.0)	Sust-aina-bili-ty (1.0)	Res. cost/ year (m.$) First year	Cumu-lative cost ($mil)	Compo-site index	Case 5 CI	Bench-mark Rank	Rank based on Case In.-3*CI
RL	EARCAL	Low temperature-SG	0.19	0.13	0.04	0.60	0.75	0.19	15.65	1.63	0.47	44	41
SM	ISC	White grubs-SM	0.03	0.11	0.12	0.72	0.75	0.11	15.76	1.52	0.51	45	42
RL	IC/WASIP	Head bug-SG	0.14	0.17	0.25	0.75	0.50	0.27	16.03	1.51	0.52	46	39
SM	IC/EARCAL	Drought PP	0.15	0.33	0.46	0.23	0.75	0.41	16.44	1.51	0.35	47	51
RL	IC/WASIP/EARCAL/SADCC	Anthracnose-SG	0.09	0.51	0.37	0.82	0.25	0.40	16.87	1.50	0.34	48	21
RL	IC/WASIP/EARCAL	Midge-SG	0.08	0.23	0.16	0.62	0.50	0.52	17.39	1.53	0.54	49	23
MP	IC	Char'zation of environ.	0.78	0.50	0.38	0.00	0.50	0.25	17.64	1.57	0.36	50	69
MP	IC/EARCAL	Micro-econ studies	0.27					0.41	18.05	1.57	0.36	51	61
MP	IC	Natural resources	0.23	0.30	0.38	0.00	1.00	0.60	18.65	1.57	0.35	52	70
MP	IC	Supply & demand	0.48	0.50	0.38	0.00	0.75	0.21	18.85	1.57	0.35	53	71
MP	IC	Farmers' preferences	0.73	0.00	0.00	0.00	0.50	0.14	19.00	1.57	0.35	54	72
MP	IC	Beneficial organisms	0.23	0.25	0.35	0.27	0.75	0.41	19.41	1.55	0.35	55	73
MP	SADCC	Plant nutr'n-SG/PM/FM	0.26	0.13	0.14	0.00	0.50	0.28	19.69	1.54	0.43	56	47
SM	IC	Peanut bottle virus-SM	0.07	0.59	0.48	0.81	0.00	0.21	19.70	1.51	0.55	57	43
MP	ISC/WASIP(M)	Cons./demand studies	0.35	0.10	0.14	0.75	0.25	0.21	19.91	1.50	0.41	58	57
RL	IC/ISC/EARCAL/SADCC	*Drought-PM	0.18	0.26	0.33	0.48	0.50	0.56	20.47	1.48	0.41	59	53
IP	SADCC	Acceptability-SM	0.68	0.05	0.34	0.75	0.00	0.08	20.55	1.47	0.50	60	44
RL	EASIP	Adapt. to acid soils-SG	0.18	0.20	0.07	0.64	0.50	0.19	20.74	1.46	0.46	61	42
SM	IC	Peanut stripe virus-SM	0.09	0.39	0.16	0.84	0.50	0.15	20.92	1.40	1.41	62	58
MP	SADCC	Drought-SG,PM/FM	0.16	0.13	0.24	0.85	0.50	0.14	21.26	1.43	0.46	63	50
RL	IC/ISC/EARCAL/SADCC	Downy mildew-PM	0.34	0.26	0.38	0.33	0.50	1.12	22.18	1.39	0.31	64	75
RL	IC WASIP/EARCAL/SADCC	*Drought-SG	0.17	0.13	0.17	0.76	0.00	0.65	22.83	1.38	0.48	65	49
RL	IC/EARCAL SADCC	Leaf blight-SG	0.10	0.15	0.17	0.86	0.25	1.38	23.38	1.37	0.52	66	67
RL	EARCAL	Blast disease-PM	0.23	0.24	0.38	0.88	0.25	0.33	23.69	1.36	0.45	67	63
RL	ISC	*Striga-PM	0.10	0.24	0.10	0.88	0.50	0.38	24.12	1.33	0.44	68	64
RL	IC/ISC	Low grain yld-PM	0.21	0.22	0.31	0.82	0.50	0.27	24.69	1.30	0.32	69	74
SM	IC	Phyto. blight (WGT)-PP	0.32	0.42	0.49	0.01	0.50	0.12	25.01	1.28	0.22	70	85
SM	IC	Helicoverpa-PP	0.02	0.39	0.45	0.28	0.75	0.32	25.33	1.27	0.24	71	82
RL	EASIP	Foliar disease res.-SG	0.07	0.29	0.08	0.60	0.50	0.41	25.74	1.25	0.37	72	62
MIP	SADCC	Impr. of grain yield-FM	0.11	0.05	0.12	0.55	0.50	0.21	25.95	1.20	0.33	73	59
CO	SADCC	Res. impact-SG/PM/FM	0.69	0.05	0.02	0.45	0.00	0.12	26.07	1.20	0.38	74	60
CO	SADCC	Policy analysis-SG/PM/FM	0.21	0.34	0.11	0.76	0.00	0.12	26.19	1.20	0.37	75	61
RL	IC	Shoot fly-SG	0.25	0.18	0.22	0.49	0.25	0.27	26.46	1.19	0.36	76	54
RL	IC	Lack of accept.(aroid)-PM	0.23	0.08	0.23	0.33	0.50	0.66	27.12	1.18	0.31	77	76
SM	IC	Maruca-PP	0.04	0.21	0.34	0.11	0.75	0.06	27.18	1.17	0.28	78	83
SM	IC	Stunt virus-SP	0.02	0.35	0.26	0.25	0.50	0.10	27.28	1.13	0.27	79	78
SM	IC/EARCAL	Podfly (WGT)-PP	0.16	0.28	0.43	0.08	0.50	0.14	27.42	1.10	0.21	80	86
SM	IC	Keter logging-PP	0.14	0.36	0.42	0.05	0.50	0.30	27.72	1.09	0.20	81	87
SM	IC, EARCAL	Podfly-PP	0.01	0.28	0.43	0.20	0.50	0.14	27.86	1.07	0.24	82	81
RL	IC/ISC	*Head caterpillars-PM	0.08	0.04	0.09	0.59	0.25	0.30	28.16	0.99	0.36	83	65
RL	IC/ISC	*High temperature-PM	0.12	0.24	0.33	0.29	0.25	0.50	28.65	0.96	0.26	84	80
SM	IC	Cold tolerance-SP	0.15	0.08	0.22	0.03	0.50	0.23	28.89	0.83	0.15	85	88
RL	IC/SADCC	Forage sorghum-SG	0.20	0.34	0.24	0.28	0.00	0.25	29.14	0.77	0.22	86	84
RL	IC/ISC	*Stem borers-PM	0.02	0.01	0.08	0.44	0.25	0.29	29.43	0.76	0.27	87	79
CM	IC	Botrytis gray mold-CP	0.05	0.12	0.28	0.48	0.00	0.19	29.62	0.74	0.28	88	77
CO	SADCC	Seed d'but'on-SG/PM/FM	-0.22	0.05	0.02	0.65	0.25	0.19	29.81	0.72	0.15	89	89
CO	SADCC	Market reform-SG/PM/FM	-0.05	0.08	0.04	0.72	0.00	0.17	29.98	0.72	0.15	90	92
MP	IC	Inst'l & human res'rces	-0.37	0.30	0.28	0.30	0.75	0.12	30.10	0.72	0.15	91	90
MP	IC	Input markets	0.13	0.30	0.38	0.00	0.25	0.08	30.18	0.72	0.15	92	91

e 7.1a. Drop out themes at mean resource envelope (27.5 m.S) for various simulations

odity	List of themes	Rank	Benchmark	Ef.=0 (Case 01)	In.=3 (Case 05)
hum	*Drought-SG	65			
	Leaf blight-SG	66			
	Forage sorghum-SG	86	Forage sorghum-SG	Forage sorghum-SG	Forage sorghum-SG
llet	Impr. of grain yield-FM	73			
	Lack of adapt.(arid)-PM	77			
	*Head caterpillars-PM	83	*Head caterpillars-PM		
	*High temperature-PM	84	*High temperature-PM	*High temperature-PM	*High temperature-PM
	*Stem borers-PM	87	*Stem borers-PM	*Stem borers-PM	
ndnut	Peanut mottle virus-GN	57			
	Adaptability-GN	60		Adaptability-GN	
kpea	Ascochyta blight-CP	5		Ascochyta blight-CP	
	Wilt-CP	11		Wilt-CP	
	Stunt virus-CP	79			
	Cold tolerance-CP	85	Cold tolerance-CP	Cold tolerance-CP	Cold tolerance-CP
	Botrytis gray mold-CP	88	Botrytis gray mold-CP	Botrytis gray mold-CP	
onpea	Phyto. blight (MGT)-PP	70			Phyto. blight (MGT)-PP
	Helicoverpa-PP	71			Helicoverpa-PP
	Maruca-PP	78			Maruca-PP
	Podfly (MGT)-PP	80			Podfly (MGT)-PP
	Water logging-PP	81	Water logging-PP		Water logging-PP
	Podfly-PP	82	Podfly-PP		Podfly-PP
	Char'zation of environ.	50		Char'zation of environ.	
	Farmers' preferences	54		Farmers' preferences	
	Cons /demand studies	58			
	Res. impact-SG/PM/FM	74		Res. impact-SG/PM/FM	
	Policy analysis-SG/PM/FM	75			
	Seed d'bution-SG/PM/FM	89	Seed d'bution-SG/PM/FM		Seed d'bution-SG/PM/FM
	Market reform-SG/PM/FM	90	Market reform-SG/PM/FM	Market reform-SG/PM/FM	Market reform-SG/PM/FM
	Inst'l & human res'rces	91	Inst'l & human res'rces		Inst'l & human res'rces
	Input markets	92	Input markets	Input markets	Input markets

Table 7.2a Themes below cut-off at the mean resource envelope

Commodity	List of themes	Benchmark		Efficiency, Weight =			Sustainability, Weight =			Internationality, Weight =				Equity, Weight =		
		Rank	dropped themes	0 Case 1	0.5 Case 13	2.0 Case 8	0 Case 2	0.5 Case 11	2.0 Case 7	0 Case 3	0.5 Case 10	2.0 Case 6	3.0 Case 5	0 Case 4	0.5 Case 12	2.0 Case 9
Sorghum	*Drought-SG	65							•	•						
	Leaf blight-SG	66								•						
	Forage sorghum-SG	68	•	•	•	•	•	•	•	•	•	•	•	•	•	•
P.millet	Impr. of grain yield-PM	73									•					•
	Lack of adapt (arid) PM	77					•									
	*Head caterpillars-PM	83	•		•	•			•	•	•					•
	*High temperature-PM	84	•	•	•	•		•	•		•	•	•	•	•	•
	*Stem borers-PM	87	•	•	•	•	•	•	•	•	•	•		•	•	•
Groundnut	Peanut mottle virus GN	57								•						
	Adaptability-GN	60		•												
Chickpea	Ascochyta blight-CP	5		•												
	Wilt-CP	11		•												
	Stunt virus-CP	79				•	•									
	Cold tolerance-CP	85	•	•	•	•	•	•	•		•	•	•	•	•	•
	Botrytis gray mold-CP	88	•	•	•	•	•	•	•	•	•	•		•	•	•
Pigeonpea	Phyto. blight (MGT)-PP	70											•			
	Helicoverpa-PP	71					•						•			
	Maruca-PP	78				•	•	•				•	•			
	Podfly (MGT)-PP	80					•	•				•	•	•	•	
	Water logging-PP	81	•		•		•	•				•	•	•	•	
	Podfly-PP	82	•			•	•	•				•	•	•	•	
RMP	Char'zation of environ	53		•												
	Farmers' preferences	54		•												
	Cons.demand studies	58			•										•	
	Res. impact-SG PM FM	74		•							•					•
	Policy a'lysis-SG PM FM	75					•				•					•
	Seed d'bution-SG PM FM	89	•		•	•	•	•	•	•	•	•	•	•	•	•
	Market reform-SG PM FM	90	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Inst'l & human res'rces	91	•		•		•	•	•	•	•	•	•	•	•	•
	Input markets	92	•	•	•	•	•	•	•	•	•	•	•	•	•	•

• Indicates that this theme would be dropped at the mean resource envelope level of funding if the weighting were as indicated at the column head

Table 7.2b Themes below cut-off at the mean resource envelope - 10%

Commodity	List of themes	Benchmark		Efficiency, Weight =			Sustainability, Weight =			Internationality, Weight =				Equity, Weight =		
		Rank	dropped themes	0 Case 1	0.5 Case 13	2.0 Case 8	0 Case 2	0.5 Case 11	2.0 Case 7	0 Case 3	0.5 Case 10	2.0 Case	3.0 Case 5	0 Case 4	0.5 Case 12	2.0 Case 9
Sorghum	*Drought SG	65							•	•	•			•		
	Leaf blight SG	66							•	•	•					
	Foliar disease res -SG	72	•			•	•	•		•	•					•
	Shoot fly SG	76	•	•	•	•			•	•	•			•	•	•
	Forage sorghum-SG	86	•	•	•	•	•	•	•	•	•	•	•	•	•	•
P. millet	Downy mildew PM	64		•								•	•			
	Blast disease-PM	67							•	•						
	*Striga-PM	68			•					•	•					•
	Low grain yld-PM	69	•		•		•						•			
	Impr. of grain yield-PM	73	•		•	•	•	•		•	•					•
	Lack of adapt (arid)-PM	77	•	•	•	•	•	•	•		•	•	•		•	•
	*Head caterpillars-PM	83	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	*High temperature-PM	84	•	•			•	•	•	•	•	•	•	•	•	•
	*Stem borers-PM	87	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Groundnut	Nematodes-GN,PP,CP	41												•		
	Peanut mottle virus GN	57							•	•				•		
	Adaptability-GN	60		•	•				•	•						
Chickpea	Ascochyta blight-CP	5		•												
	Wilt CP	11		•												
	Root rots-CP	20		•												
	Stunt virus-CP	79	•		•	•	•	•	•		•	•	•	•	•	•
	Cold tolerance-CP	85	•	•	•	•	•	•	•		•	•	•	•	•	•
	Botrytis gray mold-CP	88	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Pigeonpea	Phyto. Blight (MGT)-PP	70	•	•	•		•	•				•	•	•	•	
	Helicoverpa-PP	71	•		•	•	•	•				•	•	•	•	
	Maruca-PP	78	•		•	•	•	•				•	•	•	•	•
	Podfly (MGT)-PP	80	•	•	•	•	•	•				•	•	•	•	•
	Water logging-PP	81	•	•	•	•	•	•	•			•	•	•	•	
	Podfly-PP	82	•		•	•	•	•	•		•	•	•	•	•	
RMP	Char'zation of environ.	50		•												
	Farmers' preferences	54		•												
	Beneficial organisms	55					•									
	Cons./demand studies	58			•											
	Drought-SG,PM,FM	63								•						•
	Res. Impact SG PM FM	74	•	•	•	•	•	•		•	•					•
	Policy analysis-SG PM FM	75	•	•	•		•	•		•	•					•
	Seed distribution-SG PM FM	89	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Market reform-SG,PM FM	90	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Inst'l & human res recs	91	•		•	•	•	•	•	•	•	•	•	•	•	•
	Input markets	92	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Table 8a Number of research themes dropped at the mean resource envelope

Commodity	Bench-mark	Efficiency, Weight =			Sustainability, Weight =			Internationality, Weight =				Equity, Weight =		
		0 Case 1	0.5 Case 13	2.0 Case 8	0 Case 2	0.5 Case 11	2.0 Case 7	0 Case 3	0.5 Case 10	2.0 Case 6	3.0 Case 5	0 Case 4	0.5 Case 12	2.0 Case 9
Sorghum	1	1	1	1	0	1	2	3	1	1	1	1	1	1
Millet	3	2	3	3	2	2	3	2	4	2	1	2	2	4
Groundnut	0	1	0	0	0	0	0	1	0	0	0	0	0	0
Chickpea	2	4	2	3	2	2	2	1	2	2	1	2	2	2
Pigeonpea	2	0	1	2	5	4	0	0	0	4	6	3	2	0
RMP	4	5	5	4	5	4	4	4	6	4	4	4	5	6
Total	12	13	12	13	14	13	11	11	13	13	13	12	12	13

Table 8b Number of research themes dropped at the mean resource envelope - 10%

Commodity	Bench-mark	Efficiency, Weight =			Sustainability, Weight =			Internationality, Weight =				Equity, Weight =		
		0 Case 1	0.5 Case 13	2.0 Case 8	0 Case 2	0.5 Case 11	2.0 Case 7	0 Case 3	0.5 Case 10	2.0 Case 6	3.0 Case 5	0 Case 4	0.5 Case 12	2.0 Case 9
Sorghum	3	2	2	3	2	2	4	5	5	1	1	3	3	3
Millet	6	5	6	6	5	6	5	6	6	5	5	3	4	6
Groundnut	0	1	1	0	0	0	2	2	0	0	0	2	0	0
Chickpea	3	5	3	3	3	3	3	1	3	3	3	3	3	3
Pigeonpea	6	3	5	5	6	6	3	0	1	6	6	6	6	4
RMP	6	7	7	6	7	6	4	7	6	4	4	4	5	7
Total	24	23	24	23	23	23	21	21	21	19	19	21	21	23

Table 9a. Research cost (m.$) of themes that move up the priority list under the mean resource envelope (benchmark vs. different cases)

Commodity	Ef.=0 case 1	Ef.*.5 case 13	Ef.*2 case 8	Su.=0 case 2	Su.*.5 case 11	Su.*2 case 7	In.=0 case 3	In*.5 case 10	In.*2 case 6	In.*3 case 5	Eq.= case 4	Eq*.5 case 12	Eq.*2 case 9
Sorghum				0.25									
P. Millet	0.30			0.80	0.30		0.50		0.30	0.59	0.30	0.30	
Pigeonpea	0.44	0.14	0.30			0.44	0.44	0.44					0.44
Chickpea				0.19			0.23			0.19			
RMP	0.31												
Groundnut													
Total	1.05	0.14	0.30	1.24	0.30	0.44	1.17	0.44	0.30	0.78	0.30	0.30	0.44

Table 9b. Research cost (m.$) of themes that are dropped the priority list under the mean resource envelope (benchmark vs. different cases)

Commodity	Ef.=0 case 1	Ef.*.5 case 13	Ef.*2 case 8	Su.=0 case 2	Su.*.5 case 11	Su.*2 case 7	In.=0 case 3	In*.5 case 10	In.*2 case 6	In.*3 case 5	Eq.= case 4	Eq*.5 case 12	Eq.*2 case 9
Sorghum						0.85	1.18						
P. Millet				0.66				0.21					0.21
Pigeonpea			0.06	0.52	0.20				0.20	0.64	0.14		
Chickpea	0.28		0.10	0.10									
RMP	0.51	0.21		0.12				0.24				0.21	0.24
Groundnut	0.08						0.21						
Total	0.87	0.21	0.16	1.40	0.20	0.85	1.39	0.45	0.20	0.64	0.14	0.21	0.45

Table 10a. Research cost (m.$) of themes that move up the priority list under the -10% of mean resource envelope (benchmark vs. different cases)

Commodity	Ef.=0 case 1	Ef.*.5 case 13	Ef.*2 case 8	Su.=0 case 2	Su.*.5 case 11	Su.*2 case 7	In.=0 case 3	In*.5 case 10	In.*2 case 6	In.*3 case 5	Eq.= case 4	Eq*.5 case 12	Eq.*2 case 9
Sorghum	0.41	0.41		0.27	0.27	0.41			0.68	0.68	0.41	0.41	
P. Millet	1.08		0.87	0.87		1.08	1.53	0.87	1.08	0.51	1.74	1.08	0.87
Pigeonpea	0.52	0.32	0.12			0.50	1.08	0.94					0.44
Chickpea	0.10						0.33						
RMP	0.12					0.24			0.24	0.24	0.24	0.24	
Groundnut													
Total	2.23	0.73	0.99	1.14	0.27	2.23	2.94	1.81	2.00	1.43	2.39	1.73	1.31

Table 10b. Research cost (m.$) of themes that are dropped the priority list under the -10% of mean resource envelope (benchmark vs. different cases)

Commodity	Ef.=0 case 1	Ef.*.5 case 13	Ef.*2 case 8	Su.=0 case 2	Su.*.5 case 11	Su.*2 case 7	In.=0 case 3	In*.5 case 10	In.*2 case 6	In.*3 case 5	Eq.= case 4	Eq*.5 case 12	Eq.*2 case 9
Sorghum						1.18	1.18	1.18			0.85	0.85	
P. Millet	1.12		0.33			0.33	0.66	0.33	1.12	1.12			0.33
Pigeonpea													
Chickpea	0.42												
RMP	0.39	0.21		0.41			0.14					0.21	0.14
Groundnut	0.08	0.08				0.29	0.29				0.62		
Total	2.01	0.29	0.33	0.41	0.00	1.80	2.27	1.51	1.12	1.12	1.47	1.06	0.47

Table 11. Correlation matrix of benchmark indices with simulation indices and benchmark ranks with simulation ranks

Case	Indices			Ranks		
	all 92 themes	bottom 33% > rank 62	sensitive region ranks 62>.<83	all 92 themes	bottom 33% ranks >62	sensitive region ranks 62>.<83
1 (Ef.=0)	0.77	0.70	0.47	0.77	0.69	0.48
2 (Su.=0)	0.95	0.72	0.74	0.91	0.75	0.75
3 (In.=0)	0.96	0.66	-0.20	0.88	0.43	-0.24
4 (Eq.=0)	0.92	0.88	0.68	0.90	0.83	0.68
5 (In.*3)	0.92	0.75	0.70	0.88	0.74	0.65
6 (In.*2)	0.97	0.85	0.76	0.96	0.85	0.77
7 (Su.*2)	0.97	0.90	0.27	0.97	0.79	0.32
8 (Ef.*2)	0.95	0.96	0.86	0.97	0.94	0.84
9 (Eq.*2)	0.97	0.90	0.50	0.97	0.82	0.53
10 (In.*.5)	0.99	0.89	0.29	0.97	0.73	0.26
11 (Su.*.5)	0.99	0.92	0.28	0.97	0.87	0.78
12 (Eq.*.5)	0.98	0.96	0.85	0.97	0.93	0.81
13 (Ef.*.5)	0.96	0.98	0.89	0.98	0.96	0.88

APPENDIX 1

Chickpea constraint themes with well-above average efficiency: How to explain the NTP data set.

1. Drought

Query on high efficiency for CP Drought in NP.

High returns on research investment in CP-Drought are expected because of:

- large yield losses of currently used varieties (landraces) attributable to drought over a large global area.
- low on-farm average yields, especially in drought environments, in relation to yield potential of chickpea.
- an expectation that a considerable proportion of this yield loss may be recovered through:
  - Drought escape, i.e. use of varieties of shorter duration than currently used ones that can complete their life cycles before soil moisture is exhausted (e.g. extra-short-duration varieties such as ICCV 2 for use in peninsular India). Development of such varieties is at an advanced stage for a range of environments. It may be noted that development of winter sowing technology in WANA (Iran) on genetic incorporation of frost and Ascochyta blight resistance) and incorporation of low temperature tolerance of reproductive growth in subtropical South Asia (which allows earlier maturity) are also forms of drought escape.
  - Drought resistance, i.e. specific traits increasing water use or water use efficiency, such as:
    - large root systems - in advanced stages of testing and promising 10-20% yield advantage in drought environments within an appropriate

duration group.

- other promising traits such as reduced leaf area, large seed size and double pods at lower nodes, high leaf reflectance, higher water use efficiency,etc. are under test for their usefulness in drought environments.

2. Ascochyta blight

Over 15 years of research and development have been spent already in the genetic improvement of chickpea for resistance to ascochyta blight. Effective screening nurseries have been developed (Syria, Pakistan, India, USA). As a result winter sowing has become possible in the WANA Region (Turkey and other countries) and Europe and the adoption process is in progress. Pakistan, India and the USA also benefit from crop improvement for ascochyta blight. Indirectly, 'chilling resistance' can enable plants to escape the disease epidemic. All these efforts and options allow, with relatively low inputs of scientific man-years, sustained progress, and this explains the effect on ranking if this efficiency weighting is set at zero.

3. Insect damage

For a long time the linkage of pod borer resistance and fusarium wilt susceptibility has formed an obstacle to progress in the use of the former trait. Breaking the linkage solved the problem, and opens the way to adoption of two-way resistant materials. Especially a combination of these resistances with shorter-duration is powerful and feasible.

"Chilling tolerance" has the effect of reducing the crop season length, but also of escaping the insect attack when it is about to reach a peak. These different avenues to progress will enable relatively efficient progress, which explains the considerable weighting effect for efficiency.

4. Wilt

Nearly 20 years of research have gone in the understanding of this disease. Our knowledge about the epidemiology of the fungus (*Fusarium oxysporum*, its races, and genetic nature of inheritance of resistance

are well understood. As a result, inexpensive and efficient screening techniques have been developed and a large number of germplasms and breeding lines showing stable resistance across locations have been identified. Since wilt is a major biotic constraint to production in almost all the chickpea domains, all advanced chickpea breeding materials sent out to NARS by ICRISAT now carry resistance to wilt. An excellent progress has been made in combining resistance to wilt with other desirable traits such as short- and extra-short-duration, kabuli seed type, and resistance to root rots, ascochyta blight, stunt, *Helicoverpa* pod borer, and drought. Some of these materials have moved to NARS and to farmers' fields and feedbacks indicate we are on the verge of reaping the benefits of this research.

5. Root rots

Same as wilt.

Appendix II. Averages for different parameters by commodity

Rank	Commodity	Program	Constraint/theme	Area affected ('000 ha)	Avg. yield 86-90 kg/ha	Yield losses (%)	Expec. yield improvement (%)	Number of years required a	b	c	Prob. success (%) P	S	Adop. ceiling (%) P	S	Extra capital ('000 US $)	EVS (m.$)	Scientist # First year	Total period	Efficiency NPV ($mill)	Net B/C ratio	Res. cost First year ($mill)	Equity Poverty million poor	Gender million fem ill	Internationality	Sustainability	Benchmark Composite index	Food aid (m.t)	Stability
12	AL	RNP	Adopt. asses./imp. evl.	N.E.	N.E.	N.E.	N.E.	5	11	20	70	-	-	-	5		1.50	7.5	N.E.	4.5	0.62	360.0	329.0	1.00	3.0	2.06	0.3	2
13	AL	RNP	Res. resource. alloc'n	N.E.	N.E.	N.E.	N.E.	3	-	-	70	-	-	-	Nil		0.50	1.5	N.E.	-15.7	0.21	397.0	370.0	1.00	4.0	2.06	73.8	2
14	AL	RNP	Soil nutrients	20921	723	N.E.	12.5	5	11	21	30	-	30	-	Nil	490.0	1.30	13.0	130.3	35.9	0.54	167.9	162.2	0.43	5.0	2.61	8.6	2
23	AL	RNP	Soil fertility	N.E	N.E	N.E	N.E	[illegible]	15	25	30	-	30	-	100	1051.0	1.40	14.0	86.4	21.1	0.50	16.0	37.9	0.26	5.0	2.50	8.2	4
25	AL	RNP	Soil structure	20921	723	N.E.	3.4	10	15	25	25	-	30	-	Nil	214.0	1.00	10.0	29.4	5.9	0.74	167.9	162.2	0.46	5.0	2.10	8.6	3
29	AL	RNP	Water deficit	20386	208	N.E.	8.5	6	14	24	25	-	30	-	Nil	769.0	2.30	23.0	122.8	19.1	0.95	154.4	151.4	0.34	4.0	2.03	8.6	3
37	AL	RNP	Water deficit-PM,SG,GN	N.E	N.E	N.E	N.E	10	15	25	15	-	30	-	40	641.6	2.00	20.0	22.0	3.9	0.83	24.1	42.6	0.76	4.0	1.71	9.6	4
38	AL	RNP	Tech. adopt./imp. eval.	N.E	N.E	N.E	N.E	10	16	-	50	-	-	-	20		0.70	7.0	N.E.	25.5	0.29	24.1	42.6	0.03	2.0	1.71	9.6	2
39	AL	RNP	Agro-forestry	N.E	N.E	N.E	N.E	10	18	30	30	-	40	-	150	560.0	1.60	16.0	16.7	3.5	0.60	24.1	42.6	0.76	4.0	1.70	9.6	4
40	AL	RNP	Char'n of prod'n envi't	N.E	N.E	N.E	N.E	5	10	-	40	-	-	-	80		1.75	8.8	N.E.	16.0	0.72	24.1	42.6	0.76	3.0	1.70	9.6	2
50	AL	RNP	Char'zation of environ.	N.E.	N.E.	N.E.	N.E.	5	10	-	75	-	-	-	20		0.60	3.0	N.E.	36.4	0.25	75.9	114.1	0.00	3.0	1.57	0.3	3
51	AL	RNP	Micro-econ studies	N.E.	N.E.	N.E.	N.E.			-		-	-	-			1.00	5.0		13.6	0.41	60.0	23.1	0.64	3.0	1.57	0.3	3
52	AL	RNP	Natural resources	N.E.	N.E.	N.E.	N.E.	5	11	17	50	-	30	-	5		1.45	7.3	N.E.	11.4	0.60	75.9	114.1	0.00	5.0	1.57	0.3	3
53	AL	RNP	Supply & demand	N.E.	N.E.	N.E.	N.E.	3	12	-	70	-	-	-	5		0.50	2.5	N.E.	23.9	0.21	75.9	114.1	0.00	4.0	1.57	0.3	2
54	AL	RNP	Farmers' preferences	N.E.	N.E.	N.E.	N.E.	5	6	10	60	-		-	15		0.35	1.8	N.E.	36.4	0.14	75.9	114.1	0.00	3.0	1.57	0.3	1
55	AL	RNP	Beneficial organisms	25547	723	N.E.	1.8	8	13	23	30	-	30	-	Nil	170.0	1.00	8.0	27.3	11.3	0.41	62.4	104.9	0.27	4.0	1.55	2.7	1
56	SG	RNP	Plant nutr'n-SG/PM/FM	1465	671	N.E	30.0	5	8	23	30		60		-	48.1	0.20	1.0	4.5	13.0	0.08	32.1	12.4	0.70	3.0	1.54	9.3	1
58	AL	RNP	Cons./demand studies	N.E	N.E	N.E	N.E	10	15	-	50	-	-	-			0.50	5.0	N.E.	17.5	0.21	24.1	42.6	0.78	2.0	1.50	9.6	2
63	SG	RNP	Drought-SG/PM/FM	2368	724	N.E	20.0	5	8	23	25		30		-	44.7	0.35	1.0	4.9	8.1	0.14	32.1	12.4	0.65	3.0	1.40	9.3	3
74	SG	ECO	Res. impact-SG/PM/FM	1375	N.E	N.E	N.E	3	4	5	30		-		-		0.30	0.4	N.E.	34.4	0.12	11.9	4.6	0.48	1.0	1.20	2.3	1
75	SG	ECO	Policy a'lysis-SG/PM/FM	2050	N.E	N.E	N.E	5			70		-		-		0.30	1.5	N.E.	10.6	0.12	65.7	34.4	0.76	1.0	1.20	26.0	1
83	SG	ECO	Seed d'bution-SG/PM.FM	1565	635	N.E	N.E	3	5	25	70		-		-		0.45	1.4	N.E.	-10.9	0.19	14.0	5.5	0.65	2.0	0.72	4.2	2
90	SG	ECO	Market reform-SG/PM/FM	1750	N.E	N.E	N.E	4	5	10	60		-		-		0.40	1.6	N.E.	-2.9	0.17	20.5	10.5	0.72	1.0	0.72	7.4	3
91	AL	RNP	Inst'l & human res'rces	N.E.	N.E.	N.E.	N.E.	3	-	-	60	-	-	-	Nil		0.30	1.5	N.E.	-10.6	0.12	75.9	114.1	0.00	4.0	0.72	0.3	2
92	AL	RNP	Input markets	N.E.	N.E.	N.E.	N.E.	4	-	-	60	-	-	-	Nil		0.20	0.8	N.E.	6.4	0.00	75.9	114.1	0.00	2.0	0.72	0.3	2
51	AL	RNP	Average (13:6 themes)	12295	701		12.8	6	11	20	47		30		23	438.3	0.51	6.9	49.4	12.4	0.37	86.4	93.0	0.51	3.2	1.64	8.8	2.3
18	SG	CRL	Striga-SG	7710	711	6.5	5.0	2	8	17	70	60	50	30	Nil	138.8	0.60	6.0	70.7	41.4	0.20	31.5	43.0	0.80	4.0	2.51	6.4	2
22	SG	CRL	*Grain & stover yld.-SG	46929	758	-	3.0	3	9	17	50	40	20	10	Nil	225.3	1.65	8.3	47.1	16.6	0.68	100.8	169.2	0.65	3.0	2.35	20.0	3
34	SG	CRL	Stem borer-SG	30739	757	8.9	6.6	8	13	22	35	20	15	10	15	247.3	1.83	18.3	8.4	1.6	0.76	232.7	191.2	0.75	2.0	1.82	19.4	2
35	SG	CRL	Grain mold-SG	6321	816	15.4	15.0	2	12	20	60	60	50	30	Nil	121.4	1.10	11.0	66.0	21.5	0.45	51.2	57.2	0.68	3.0	1.81	0.3	3
44	SG	CRL	Low temperature-SG	800	885	N.E.	2.0	7	12	22	70	50	50	30	50	2.8	0.45	3.3	1.6	9.6	0.19	32.7	11.8	0.60	4.0	1.63	2.8	3
46	SG	CRL	Head bug-SG	9320	782	9.7	6.1	5	11	19	60	50	30	20	Nil	75.1	0.65	6.5	12.8	7.1	0.27	43.2	74.8	0.76	3.0	1.61	8.9	3
48	SG	CRL	Anthracnose SG	14765	774	3.6	2.3	1	7	15	70	70	15	5	Nil	66.5	1.05	10.5	13.5	4.6	0.43	126.7	110.8	0.82	2.0	1.60	19.3	2
49	SG	CRL	Midge-SG	15948	748	13.3	10.0	5	15	23	75	60	15	10	Nil	218.8	1.25	12.5	14.4	4.1	0.52	56.6	47.1	0.82	3.0	1.59	9.2	3
61	SG	CRL	Adapt. to acid soils-SG	811	2110	N.E.	N.E.	4	7	17	70	-	50	-	-	57.6	0.45	4.5	11.5	9.1	0.19	40.9	20.5	0.64	3.0	1.45	8.4	3
65	SG	CRL	*Drought-SG	7663	652	34.2	5.3	1	7	15	70	70	15	10	Nil	143.2	2.05	10.3	30.3	8.6	0.05	31.4	229.7	0.76	1.0	1.30	4.5	3
66	SG	CRL	Leaf blight-SG	9373	748	3.6	2.0	3	7	15	70	60	15	10	Nil	43.3	0.81	5.7	9.6	5.0	0.33	37.4	52.0	0.86	2.0	1.37	15.7	2
72	SG	CRL	Foliar disease res.-SG	2690	1756	17.0	11.8	3	8	17	80	40	30	50	-	89.0	1.00	5.0	5.8	3.3	0.41	71.9	23.3	0.50	3.0	1.25	10.7	3
76	SG	CRL	Shoot fly-SG	6895	730	9.1	6.7	8	14	22	70	60	50	15	Nil	203.8	0.65	6.5	22.5	12.4	0.27	45.6	67.3	0.43	2.0	1.19	0.3	2
86	SG	CRL	Forage sorghum-SG	1200	50000	N.E	2.0	1	4	12	70	50	40	10	Nil	12.0	0.60	4.0	12.2	9.9	0.25	84.2	72.3	0.20	1.0	0.77	0.3	2
52	SG	CRL	Average (14 themes)	11512	941	12.1	6.0	4	10	18	67	55	32	18	5	117.5	1.02	8.1	23.9	11.1	0.42	76.8	83.6	0.69	2.6	1.59	9.0	2.6

Appendix II. Averages for different parameters by commodity

Rank	Commodity	Program	Constraint/theme	Area affected (000 ha)	Avg. yield 80-90 (kg/ha)	Yield losses (%)	Expec. yield improvement (%)	Number of years required a	b	c	Prob. success (%) P	S	Adop. ceiling (%) P	S	Extra Capital (000 US $)	EVS (m.$)	Scientist time First year	Total period	Res. cost First year ($mill)	Efficiency NPV ($mill)	Net B/C ratio	Equity Poverty million poor	Gender $million few ill	Internationality	Sustainability	Benchmark Competitive Index	Food aid (m.t)	Stability
1	ML	GRU	Germplasm evaluation	N.E.	N.E.	N.E.	N.E.	6	-	-	60	-	-	-	100	99.8	0.45	2.5	79.1	101.9	0.19	397.0	378.0	1.00	4.0	5.21	73.8	3
2	ML	GRU	Germplasm collection	N.E.	N.E.	N.E.	N.E.	6	-	-	60	-	-	-	100	41.9	0.35	1.8	24.5	40.7	0.14	397.0	378.0	1.00	5.0	4.24	3.8	3
3	ML	GRU	Germplasm maintenance	N.E.	N.E.	N.E.	N.E.	6	-	-	75	-	-	-	-	21.0	0.25	1.5	15.3	35.5	0.10	397.0	378.0	1.00	3.0	3.63	[illegible]	2
3	ML	GRU	Average (3 themes)					6			72				67	54.2	0.35	1.8	39.8	59.4	0.14	397.0	378.0	1.00	4.0	4.36	26.6	2.7
6	GN	LGN	Rust-GN	14414	1067	10.1	6.0	5	15	25	70	-	60	-	-	241.8	0.80	6.9	88.8	47.9	0.33	337.0	310.0	0.70	3.0	3.35	10.1	2
7	GN	LGN	Aflatoxin-GN	10409	869	5.7	2.9	6	16	24	60	-	25	-	15	62.4	0.12	7.9	7.6	23.1	0.05	240.2	230.6	0.82	5.0	3.28	6.9	3
8	GN	LGN	Late leaf spot-GN	14157	1077	15.0	7.5	6	15	27	45	-	40	-	-	300.0	1.05	10.9	32.7	12.4	0.43	329.0	302.0	0.84	4.0	3.00	8.3	3
9	GN	LGN	Aflatoxin (MGT)-GN	11646	826	5.7	5.0	6	12	20	60	-	20	-	-	126.0	1.35	10.7	19.7	6.4	0.56	360.0	309.0	0.60	5.0	2.96	13.9	3
15	GN	LGN	Early leaf spot-GN	14817	1049	8.0	2.0	5	10	20	30	-	25	-	-	81.5	1.00	6.6	9.1	4.4	0.45	345.0	313.0	0.70	4.0	2.75	15.5	3
17	GN	LGN	Yield potential-GN	13516	913	N.E.	12.0	6	16	31	50	-	40	-	-	308.0	1.06	9.9	29.6	12.3	0.44	234.2	363.4	0.71	3.0	2.53	21.4	2
19	GN	LGN	Drought-GN	12111	820	20.0	8.0	6	16	26	50	-	20	-	-	374.0	1.21	10.1	14.5	5.2	0.50	331.8	326.0	0.62	3.0	2.43	15.2	3
21	GN	LGN	Bud necrosis virus-GN	10786	1151	3.0	1.5	7	17	29	60	-	15	-	-	45.0	0.32	4.0	1.0	1.2	0.13	298.9	328.1	0.66	3.0	2.33	3.1	1
26	GN	LGN	Leaf miner-GN	7915	872	10.0	5.0	5	15	25	50	-	20	-	-	82.1	0.45	3.5	5.7	6.0	0.19	195.7	268.6	0.46	4.0	2.17	0.3	3
28	GN	LGN	Leaf miner (MGT)-GN	7915	872	10.0	4.0	5	0	23	40	-	15	-	-	65.7	0.55	3.5	4.8	4.5	0.23	195.7	268.6	0.46	4.0	2.14	0.3	3
30	GN	LGN	Spodoptera-GN	6393	878	6.0	2.0	6	16	26	40	-	15	-	-	32.2	0.34	3.2	0.7	0.9	0.14	174.7	247.6	0.40	4.0	1.93	0.3	2
31	GN	LGN	Peanut clump virus-GN	8093	778	2.5	1.5	5	12	22	50	-	40	-	-	22.4	0.55	4.2	5.7	4.9	0.23	114.3	124.0	0.84	3.0	1.87	16	1
32	GN	LGN	Rosette virus-GN	4863	668	18.5	14.2	4	14	24	50	-	40	-	-	120.4	1.28	8.5	20.8	8.6	0.53	71.9	71.4	0.89	3.0	1.62	26.4	1
36	GN	LGN	Millipedes-GN	2977	914	15.0	10.3	9	14	24	15	-	30	-	30	77.6	0.10	1.9	3.0	8.0	0.84	27.3	37.2	0.77	4.0	1.68	7.8	3
41	GN	LGN	Nematodes-CH,PP,CP	2328	610	12.0	4.0	5	15	27	50	-	30	-	-	132.3	1.00	12.1	15.1	5.9	0.41	179.7	263.9	0.27	3.0	1.69	12.9	1
42	GN	LGN	Termites-GN	2977	914	15.0	10.7	9	14	24	15	-	30	-	230	76.0	0.26	3.2	2.3	2.4	0.11	27.3	37.2	0.77	4.0	1.68	7.8	3
45	GN	LGN	White grubs-GN	2977	914	15.0	6.9	9	14	24	15	-	30	-	-	49.1	0.26	3.6	1.3	1.6	0.11	27.3	37.2	0.72	4.0	1.62	7.8	3
57	GN	LGN	Peanut mottle virus-GN	7345	867	3.9	2.3	4	11	20	30	-	25	-	-	34.8	0.61	3.8	3.9	3.5	0.21	147.3	138.7	0.91	1.0	1.51	21.9	1
60	GN	GIP	Adaptability-GN	824	584	N.E.	35.0	5	10	25	90	-	40	-	-	44.2	0.20	2.5	20.0	33.3	0.08	12.9	12.4	0.25	1.0	1.47	9.3	2
62	GN	LGN	Peanut stripe virus-GN	2998	818	6.1	3.0	5	12	22	50	-	40	-	-	17.5	0.44	4.0	4.5	4.3	0.18	97.1	97.1	0.54	3.0	1.40	1.7	1
30	GN	LGN	Average (19+1 themes)	8003	873	10.0	7.2	6	14	24	46		30		14	118.7	0.65	6.0	14.1	9.9	0.27	187.8	205.2	0.67	3.4	2.19	10.24	2.2
3	CP	LGN	Drought-CP	7682	695	50.4	25.0	5	10	20	60	50	50	-	110	525.0	1.16	7.1	265.2	115.7	0.40	60.6	119.5	0.55	3.0	3.64	10.7	3
5	CP	LGN	Ascochyta blight-CP	5796	761	14.3	7.4	3	7	15	50	-	40	-	-	120.9	0.33	1.8	73.2	134.7	0.14	31.1	94.4	0.57	1.0	3.48	10.8	1
10	CP	LGN	Insect damage-CP	8022	691	15.0	7.5	3	8	20	50	50	50	-	25	164.0	0.60	3.2	76.1	78.5	0.25	88.2	107.9	0.26	4.0	2.94	8.2	1
11	CP	LGN	Wilt-CP	8022	691	10.0	5.0	3	7	17	80	80	50	-	-	109.0	0.35	2.0	63.9	114.2	0.14	88.2	107.9	0.26	1.0	2.90	1.6	1
20	CP	LGN	Root rots-CP	8022	691	4.5	2.0	3	8	17	80	80	50	-	-	44.1	0.35	2.0	41.3	70.3	0.14	88.2	107.9	0.33	2.0	2.34	1.6	1
27	CP	LGN	Biolog. N fixation-CP	8814	717	10.2	7.0	5	10	25	30	-	15	-	-	171.0	0.25	2.6	9.6	16.6	0.10	88.2	133.7	0.43	3.0	2.16	0.3	2
41	CP	LGN	Nematodes-GH,PP,CP	2328	610	12.0	4.0	5	15	27	50	-	30	-	-	132.3	1.00	12.1	15.1	5.9	0.41	179.7	263.9	0.27	3.0	1.69	12.9	1
43	CP	LGN	Sub-optimal yield-CP	8814	717	-	0.5	6	12	23	60	-	30	-	-	12.0	0.60	6.5	0.9	0.5	0.25	88.2	133.7	0.52	4.0	1.60	10.7	3
73	CP	LGN	Stunt virus-CP	7784	692	2.0	0.5	10	15	23	30	20	20	-	-	23.5	0.25	3.4	0.8	1.1	0.10	88.2	107.9	0.25	3.0	1.13	8.2	1
85	CP	LGN	Cold tolerance-CP	1351	841	10.3	5.0	5	10	18	50	50	40	-	110	20.0	0.55	3.7	9.2	7.6	0.23	20.2	66.1	0.03	3.0	0.03	10.8	1
88	CP	LGN	Botrytis grey mold-CP	1772	649	7.4	3.0	5	12	22	50	-	40	-	-	13.2	0.45	3.5	2.7	2.9	0.19	30.1	82.8	0.48	1.0	0.74	8.3	1
37	CP	LGN	Average (10+1 themes)	6219	706	13.6	6.1	5	10	21	54	55	36		24	122.4	0.54	4.3	50.7	49.6	0.22	77.4	120.5	0.36	2.7	2.14	9.1	1.7

Averages for different parameters by commodity

Rank	Commodity	Program	Constraint/theme	Area affected (000 ha)	Avg. yield 80-90 kg/ha	Yield losses (%)	Expec. yield improvement (%)	Number of years required a	b	c	Prob. success (%) P	S	Adop. ceiling (%) P	S	Extra capital (000 US $)	EVS (m.$)	Scientist R First year	Scientist R Total period	Efficiency NPV ($mill)	Efficiency Net B/C ratio	Res. cost First year ($mill)	Equity Poverty: million poor	Equity Gender: million fem ill	Inter-nationality	Sustainability	Benchmark Composite index	Food aid (m.t)	Stability
2	AL	GRU	Average (3 themes)					6			72				67	54.2	0.35	1.0	39.6	59.4	0.14	397.0	378.0	1.09	4.0	4.36	73.8	2.7
30	GH	LGH	Average (19+1 themes)	8003	873	10.0	7.2	6	11	24	46		30		14	118.7	0.65	6.0	14.1	9.9	0.47	182.8	205.2	0.67	3.4	2.79	10.5	2.2
37	CP	LGH	Average (10+1 themes)	6219	706	13.6	6.1	5	10	21	54	55	36		24	122.4	0.54	4.5	50.7	49.6	0.22	77.4	120.5	0.35	2.7	2.14	9.1	1.7
51	AL	RMP	Average (19+6 themes)	12295	701		12.0	6	11	20	47		30		23	438.3	0.91	6.9	49.4	12.4	0.37	86.4	93.0	0.51	3.2	1.64	8.8	2.3
52	SO	CRL	Average (14 themes)	11512	941	-2.1	6.0	4	10	18	67	53	52	18	5	117.5	1.02	8.1	23.9	11.1	0.42	76.8	83.6	0.63	2.6	1.59	9.0	2.6
57	PP	LGH	Average (10+1 themes)	2553	689	24.2	9.3	7	14	26	50		36		5	116.6	0.53	6.1	19.6	15.9	0.22	101.0	149.5	0.15	3.5	1.53	6.3	2.8
73	PH	CRL	Average (10 themes)	6900	649	11.7	10.0	5	8	14	51	33	42	25	15	57.8	1.19	8.8	22.5	8.1	0.52	36.1	62.0	0.46	2.6	1.19	5.3	2.8
46	ALL	Average (92 themes)		8177			8.2	6	12	21	53		34			146.5				17.7	0.33	111.1	129.0	0.53	3.1	1.84	10.1	2.4

Appendix II. Averages for different parameters by commodity

Rank	Commodity	Program	Constraint/theme	Area affected (000 ha)	Avg. yield 80-90 kg/ha	Yield losses (%)	Expec. yield improvement (%)	Number of years required a	b	c	Prob. success (%) P	S	Adop. ceiling (%) P	S	Extra capital (000 US $)	EVS (m.$)	Scientist R First year	Scientist R Total period	Efficiency NPV ($mill)	Efficiency Net B/C ratio	Res. cost First year ($mill)	Equity Poverty: million poor	Equity Gender: million fem ill	Inter-nationality	Sustainability	Benchmark Composite index	Food aid (m.t)	Stability
16	PP	LGH	Genetic poten'l yld-PP	3818	737	-	14.0	7	12	22	60	-	40	-	3	207.0	0.31	4.5	64.0	63.5	0.13	125.2	168.2	0.23	3.0	2.53	11.0	3
24	PP	LGH	SL. mosaic/Fu. wilt-PP	3506	693	37.5	23.2	6	14	29	70	-	50	-	-	293.0	0.50	7.6	58.5	40.4	0.21	125.2	168.2	0.12	4.0	2.21	11.0	3
33	PP	LGH	Helicoverpa (HGT)-PP	2835	615	34.6	15.0	6	14	26	50	-	50	-	-	137.5	0.42	4.4	26.0	23.8	0.17	98.2	136.4	0.17	4.0	1.82	11.0	4
41	GH	LGH	Nematodes-GH,PP,CP	2328	610	12.0	4.0	5	15	27	50	-	30	-	-	132.3	1.00	12.1	15.1	5.9	0.41	179.7	263.9	0.27	3.0	1.69	11.0	4
47	PP	LGH	Drought-PP	2935	615	62.2	10.0	7	12	22	60	-	30	-	24	91.9	1.00	9.3	19.7	7.7	0.41	98.2	136.4	0.28	4.0	1.61	0.3	3
70	PP	LGH	Phyto. blight (HGT)-PP	2849	691	8.9	3.0	4	8	18	70	-	20	-	-	31.4	0.29	2.1	9.2	15.9	0.12	103.9	147.4	0.01	3.0	1.20	12.9	1
71	PP	LGH	Helicoverpa-PP	2835	615	34.6	15.0	10	20	32	30	-	50	-	25	137.5	0.78	9.9	1.8	0.8	0.32	98.2	136.4	0.08	4.0	1.27	11.0	4
78	PP	LGH	Maruca-PP	1073	551	9.5	5.0	10	18	30	25	-	50	-	-	85.4	0.35	2.1	0.7	1.9	0.06	52.5	102.4	0.11	4.0	1.17	0.3	2
80	PP	LGH	Podfly (HGT)-PP	2064	787	15.0	10.0	7	14	24	50	-	20	-	-	85.4	0.35	3.7	7.5	8.0	0.14	70.4	130.0	0.08	3.0	1.10	0.3	2
81	PP	LGH	Water logging-PP	1877	864	12.9	10.0	7	12	22	30	-	40	-	-	84.8	0.73	6.4	12.6	7.0	0.30	89.4	125.7	0.05	3.0	1.08	0.3	3
82	PP	LGH	Podfly-PP	2064	787	15.0	7.0	12	20	30	50	-	20	-	-	60.0	0.35	4.8	0.5	0.5	0.14	70.4	130.0	0.20	3.0	1.07	0.3	2
57	PP	LGH	Average (10+1 themes)	2553	689	24.2	9.3	7	14	26	50		36		5	116.6	0.53	6.1	19.6	15.9	0.22	101.0	149.5	0.15	3.5	1.53	6.3	2.8
59	PH	CRL	*Drought-PH	10870	531	24.5	9.7	9	15	16	50	30	40	20	10	141.8	1.35	13.5	33.7	8.9	0.56	65.3	116.7	0.40	3.1	1.48	5.7	3
64	PH	CRL	Downy mildew-PH	10451	527	10.9	9.9	4	9	13	80	25	50	20	30	110.3	2.60	12.9	75.2	16.8	1.12	64.1	114.6	0.23	3.0	4.39	2.2	4
67	PH	CRL	Blast disease-PH	795	912	N.E.	10.0	7	12	22	70	60	50	30	50	8.3	0.30	5.5	3.8	13.8	0.33	60.0	23.1	0.68	2.0	1.36	10.7	3
68	PH	CRL	*Striga-PH	10903	731	10.3	10.3	7	11	19	20	20	30	15	-	120.6	0.80	8.0	10.7	4.8	0.33	10.7	31.1	2.66	3.0	1.33	3.1	3
69	PH	CRL	Low grain yld-PH	4676	670	-	1.0	3	4	7	50	40	50	50	-	7.7	2.10	20.2	59.4	10.5	0.07	55.4	93.6	0.32	3.0	1.30	1.4	3
73	PH	SHIP	Impr. of grain yield-PH	322	487	N.E	40.0	4	9	24	70	-	50	-	-	9.0	0.50	2.0	4.0	5.6	0.24	13.1	6.6	0.55	3.0	1.20	5.4	2
77	PH	CRL	Lack of adapt.Carid)-PH	6941	412	-	2.0	3	4	7	50	50	50	20	5	10.5	1.60	3.2	12.5	9.9	0.66	20.5	68.7	0.33	3.0	1.18	1.4	3
83	PH	CRL	*Head caterpillars-PH	9254	760	14.4	9.0	6	9	12	30	30	30	20	-	72.5	0.73	7.9	1.0	4.0	0.30	10.3	27.5	0.53	2.0	0.99	2.5	2
84	PH	CRL	*High temperature-PH	9624	496	10.4	2.9	4	9	13	70	20	40	20	30	43.6	1.20	8.5	15.5	5.9	0.50	58.8	113.6	0.29	2.0	0.96	0.3	3
87	PH	CRL	*Stem borers-PH	5160	954	10.0	5.0	6	10	19	20	20	30	20	-	45.4	0.70	7.0	2.1	1.1	0.29	2.5	23.8	0.44	2.0	0.76	7.7	2