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POSSIBLE FORMULAS FOR THE SHARING OF BENEFITS BASED ON DIFFERENT BENEFIT-INDICATORS

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1. Introduction

1. At its Fifth Extraordinary Session, in June 1998, in the context of the ongoing negotiations for the revision of the International Undertaking on Plant Genetic Resources, and

> *"In order to facilitate progress, the Commission requested its Secretariat to carry out an analytical financial study on possible formulas for the sharing of benefits based on different benefit-indicators, establishing the respective total amounts and relative contributions corresponding to each country and region. The study should be simple and objective".*

2. This study accordingly identifies a series of possible indicators for the sharing of benefits resulting from the use of plant genetic resources for food and agriculture, and analyses the information available regarding each indicator, where possible quantifying the relative shares of Governments and Regions, if the indicator were to be used to establish the financial responsibilities of the Parties to the International Undertaking.

3. The major conclusion of this study is that, while constructing appropriate indicators is a challenging task, there is an important correlation between four indicators: Gross National Product (GNP) or Gross Domestic Product (GDP), the FAO scale of contributions, and commercial seed sales, which may be of use to Governments in considering the possible financial responsibilities of Parties.

2. Benefits deriving from the utilization of plant genetic resources for food and agriculture

4. Plant genetic resources for food and agriculture are the essential raw material of the plant breeder, and their use in plant improvement is a source of tremendous benefit to humanity. Countries are very largely dependent for their major food and agricultural crops on germplasm that originated elsewhere[1]. Over the last sixty years, there has been a steady increase in the mean yield of most crops, as farmers and professional breeders have employed these genetic materials in the creation of new and more productive cultivars. Farmers have benefited from increased production associated with the new varieties, industries have benefited from more abundant and lower cost supplies of raw product, and consumers have benefited from the consistent availability of food at attainable prices.

5. The benefits from the use of plant genetic resources for food and agriculture in agricultural development have, however, been unevenly realized. The ability to benefit from access to a resource is a function of the ability to use that resource. Nations with a greater scientific capacity than others have thus had the greater opportunity to benefit from such access[2], especially with the upstream stages of new material invention and implementation. Through its overall level of capacity, a developed nation is in a position to generate benefits of far greater magnitude from access to germplasm than a less developed nation.[3] For historical reasons, nations with the most robust scientific capacities are generally those whose original agricultural genetic endowment was

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1 For dependency, measured in terms of calorie contribution to national budgets, see *Contribution to the estimation of countries' interdependence in the area of plant genetic resources*, by Ximena Flores Palacios, Background Study Paper No. 7 Rev.1.

2 Scientific capacity correlates with a range of other socio-economic features such as the transport and industrial infrastructures, and financial resources.

3 The absolute benefits derived from the use of plant genetic resources for food and agriculture are referred to here. Benefits, considered as a percentage of total economic activity, may be higher for less developed countries, which tend to be more dependent on agriculture than more developed countries.

slimmest and whose dependence on germplasm originating elsewhere, to support the development of their agriculture, has been most acute. Moreover, rather than narrowing, differential national and regional capacities to benefit from genetic resources may at present be widening, with the biotechnological and molecular biological advances being made in major industrial nations.

6. A further form of differential capacity may be considered: the relative roles of the public and private sectors. Before the rise of a global, private seed industry in the last thirty years, plant-breeding capacity was concentrated in public sector institutions, such as universities and governmental experiment stations. With rare exceptions, such plant breeding was a public service function, and not geared to profit and reinvestment. Seed of improved varieties were released at close to the cost of production, and breeding lines were available to other scientists. The benefits of the use of germplasm were thus diffused widely among farmers, industrial processors of agricultural product, and consumers. With the development of a private seed industry in many countries, under intellectual property rights, the private seed trade is able to maximise its capacity to appropriate the benefits – capture the rents, in economic terms – accruing from the application of technology to plant genetic resources for food and agriculture. Intellectual property rights both support innovation, to the benefit of the national and international economies, and provide companies with the means to capture a considerable share of the benefit stream. Moreover, as the International Seed Federation/International Association of Plant Breeders (FIS/ASSINSEL) has recognized, patents (as distinct from plant breeders' rights) may also restrict access to germplasm.[4]

3. Methodology for identifying and quantifying possible indicators

3.1 Identifying the benefits derived from plant genetic resources for food and agriculture

7. It is exceedingly difficult to identify, categorize and quantify the benefits derived from plant genetic resources for food and agriculture, to which the indicators should point. Even establishing what constitutes a "benefit" is conceptually difficult, whether benefits are considered at the level of individual materials, specific crops, or all plant genetic resources for food and agriculture.

8. At the level of individual materials, the benefits resulting from the use of plant genetic resources for food and agriculture might be defined as the increased yield resulting from the inclusion of specific genetic materials in a crop variety, but a single cultivar contains genes from many sources, all of which interact to contribute to yield.[5] Moreover, yield increase cannot be imputed solely to genetic enhancement, but results from a complex interaction of factors, including the environment (weather, pest and disease challenges, soil conditions), inputs (fertilizer, pesticide, cultivation, irrigation), and skills and labour (the work and knowledge of the breeder and the farmer). There is no simple methodology to partition and value each of these components separately.

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4 "In the event of protection through patents, limiting free access to the new genetic resource, ASSINSEL members are prepared to study a system in which the owners of the patents would contribute to a fund established for collecting, maintaining, evaluating and enhancing genetic resources". *ASSINSEL position on access to plant genetic resources for food and agriculture and the equitable sharing of benefits arising from their use*, adopted by the General Assembly in Monte Carlo on June 5, 1998, and made available at the Fifth Extraordinary Session of the Commission.

5 It is also extremely difficult and often impossible to identify the origin of any specific germplasm, within a cultivar. For a review of the technical difficulties involved in such an attempt, see document CPGR-6/95/8 Supp., *Revision of the International Undertaking on Plant Genetic Resources. Analysis of some technical, economic and legal aspects for consideration in Stage II.*

9. At the level of specific crops, there are similar difficulties. Although a few institution-specific and crop-specific studies have attempted to identify genetic contributions to individual crops, and the economic impact, their conclusions have, of necessity, required broad assumptions and *ad hoc* methodologies.[6]

10. However, governments have agreed that the scope of the revised Undertaking will be "plant genetic resources for food and agriculture",[7] within which a multilateral system for facilitated access, and benefit-sharing is proposed, with a list of crops,[8] probably defined by genus, taking into account the genepools used by breeders.[9] This study accordingly investigates benefit-indicators at the level of all plant genetic resources for food and agriculture, not at the levels of individual materials, or individual crops. At this level, too, there are considerable conceptual and technical difficulties.[10]

11. Thus, while authorities agree that plant genetic resources provide enormous benefits to the world's agriculture and economy, and while it appears evident that nations with well-developed and well-funded plant science capabilities benefit most from the use of plant genetic resources, direct estimation and quantification of these benefits, as well as analysis of their distribution, is exceedingly difficult. What is needed is to identify indicators that will be acceptable proxies for actual levels of benefit - however difficult to determine these may be - and patterns of distribution of benefit.

3.2 Criteria for evaluating indicators

12. The Commission requested "different benefit-indicators" to be studied. In this study, it assumed that a main criterion to be used in evaluating indicators is that they may provide negotiating countries with an indication, however rough, of the relative proportions in which countries share the benefits resulting from the use of plant genetic resources for food and agriculture, as the basis for establishing relative assessments under the International Undertaking. Ideally, indicators should be:

- **Equitable**, and appropriately reflect the varying capacities of nations and sectors of society to capture the benefits of plant genetic resources for food and agriculture;
- **Simple**, and based on objective data, which is derived as transparently as possible;

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6 See, for example, Byerlee, D. and Moya, P., *Impacts of international wheat breeding research in the developing world*, (CIMMYT, 1993); Gollin, D., and Evenson, R., "Breeding values for rice genetic resources", in *Agricultural Values of Plant Genetic Resources*, Evenson, R., Gollin, D., and Santaniello, V. (Eds.), (CABI International, Wallingford, UK, 1998); Evenson, R. and Gollin, D., *The economic impact of the International Rice Germplasm Centre (ICRG) and the International Network for the Genetic Evaluation of Rice*, (Unpublished manuscript, 1993); and Fehr, W.R. (Ed.), *Genetic contributions to yield gains of five major crop plants*, (CSSA Special Publication Number 7, Madison, Wisconsin, Crops Science Society of America, 1984).

7 *Consolidated negotiating text*, document CGRFA-Ex5/98/Report, *Appendix C, Article 3*.

8 See the *Tentative list of crops*, annexed to Article 11 of the *Consolidated negotiating text*, document CGRFA-Ex5/98/Report, *Appendix C*.

9 For a discussion of possible methodologies for designating crops, see document CGRFA-Ex5/98/Inf.1, *Technical aspects involved in developing a list of crops for the multilateral system within the revised International Undertaking*, and CGRFA-Ex5/98/Inf. 1/Annex, *Relevant characteristics of the crops and genera in the* Tentative list of crops *annexed to Article 11 of the Consolidated Negotiating Text.*

10 The Commission has received a technical analysis of ways in which the economic value of plant genetic resources for food and agriculture might be estimated, in Background Study Paper No. 1, *The appropriation of the benefits of plant genetic resources for agriculture: an economic analysis of the alternative mechanisms for biodiversity conservation* (1994). On the basis of a review of the literature, and of relevant economic theory on ways in which such a study *might* be accomplished, the study concludes that "this would be a novel study." That such a study has not yet been undertaken testifies to the conceptual complexity, technical difficulty, and logistical costs that are entailed in such a project.

- **Accessible,** derived from data sets that can be obtained without investing extensive new financial or human resources, and ideally based on primary data already collected annually;
- **Legitimate,** in that they derive from data sets compiled by sources that all parties can accept, so that their accuracy is not in question; and
- **Inclusive,** meaning that the data for all Parties is, or would be, available.

3.3 Categories of indicator considered

13. The indicators analysed in this report are grouped into four main categories, containing a total of eleven indicators, as shown below. The utility of each category, and, within it, of each of the eleven indicators, is discussed in terms of the six criteria given above.

Macro-economic indicators

- Gross domestic product
- Gross national product
- FAO scale of contributions

Agricultural indicators

- Agricultural value added
- Value of agricultural production

Scientific capacity indicators

- Scientists and engineers in research and development
- Research and development expenditures
- Patents granted to residents
- Royalty and license fees received

Indicators directly linked to plant genetic resources for food and agriculture

- Plant breeder's rights registration by residents
- Commercial seed market.

3.4 Quantifying of contributions on the basis of indicators

14. The indicators listed above could provide a tool for establishing the *relative* contribution of each Party, as a percentage of the agreed total resulting from the negotiations. Their function is not to suggest the *absolute* financial obligations on which Parties to the revised Undertaking might agree.

15. All the indicators can be expressed numerically, and provide magnitudes of some variable (for example, GNP, the value of agricultural production, or the number of PBR registrations). In the *Tables 1* and *2* at the end of the study, the data available for each of these variables is provided systematically.

- ***Possible benefit-indicators*** (***Table 1),*** tabulates all available figures, for each of the eleven indicators, for the 180 countries covered by the study,[11] expressed as a percentage

[11] Countries are included if data is available for at least one of the indicators. Countries for which no data was available, and which are not included in this report, are Andorra, Brunei, Liechtenstein, Marshall Islands, Micronesia, Monaco, Palau, and San Marino. Not all of these are members of the UN, the FAO, or the Commission on Genetic Resources for Food and Agriculture.

of the total for this set of countries.[12] Such relative percentages for each indicator are also provides at the level of the FAO regional groups: Africa, Asia and the South West Pacific, Europe, Latin America and the Caribbean, the Near East, and North America.

- ***Possible benefit-indicators - summary for the OECD countries (Table 2),*** presents exactly the same data, for each of the eleven indicators, but only for countries that are members of the Organization for Economic Cooperation and Development (OECD).[13]

16. The Commission requested, as well as the examination of various benefit-indicators, that "the respective total amounts and relative contributions corresponding to each country and region" be established. The percentage figures for nations and regions in *Table 1* represent the relative contributions that would be required by the application of each of the eleven indicators.

17. This study eschews any comment as to what the actual amount of contributions may be, as this is a matter for negotiation. However, once governments have agreed on such a sum, the relative contributions corresponding to each country and region may be established by multiplying that sum by the percentages attributed to countries and regions, according to the agreed indicator, or formula.

18. For indicative purposes only, *Table 4* establishes such absolute figures (for the macroeconomic and agricultural indicators, and for the indicators directly related to plant genetic resources for food and agriculture, for the estimated average annual costs, over ten years, of implementing the Global Plan of Action, according to option B (US$248 million)[14].

3.5 Indicators and formulas

19. A "formula" for benefit-sharing might be defined as an algorithmic function of one or more indicators. Given the methodological difficulties described above, this report does not attempt to identify or evaluate any specific formulas for benefit-sharing. Negotiating governments may consider such formulas, and, if they so agree, build them upon some of the indicators described in this document. They may also consider that, for simplicity and transparency's sake, it is preferable to identify a single indicator.

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12 Note that although the percentages in *Table 1* are given to two decimal points, the underlying calculations were to 16 decimal places. This has the effect of producing finely grained differences in *Tables 4*, *5*, and *6* between countries, whose figures in *Table 1* are nominally similar.

13 The OECD nations account for 82.17% of the combined GDP, and 83.34% of the combined GNP, of the 180 nations considered in *Table 1*. In terms of the other indicators, they also account for the bulk of global scientific capacity, formal plant breeding activities, and the commercial seed trade. By the majority of indicators, the OECD countries are the principal beneficiaries of the use of plant genetic resources for food and agriculture.

14 These options are costed in Document CGRFA-7/97/4 Annex, *Revision of cost estimates for the Global Plan of Action*: option A, "a basic or rudimentary approach" (US$150 million); option B, a "moderate approach" (US$248 million); and option C, a "more ideal and comprehensive approach" (US$455 million). Para.4 of the document states: "As recognized by the International Technical Conference, the *Global Plan of Action* includes activities that may be funded by national governments, and other domestic sources of funds, as well as internationally through multilateral organizations, and from bilateral and regional sources. In the costing exercise, only those costs which might be borne by the international community are included, as indicated in the *Global Plan of Action*. This includes a significant share of the costs of implementing activities in developing countries. It also includes activities undertaken largely for the global benefit, regardless of their location.

4. Evaluating the indicators

20. The study now discusses the rationale for the selection, and the construction, of the various indicators, and evaluates their adequacy as indicators of the benefits derived from the use of plant genetic resources for food and agriculture, in the context of benefit-sharing. It also comments on the data presented in the tables.

4.1 Macroeconomic Indicators

21. The macroeconomic indicators considered here include: **Gross Domestic Product (GDP)**, which is the sum of value added by all resident producers of a country; and **Gross National Product (GNP)**, which is GDP plus net receipts from non-resident sources. For most countries, GDP differs only slightly from GNP, but is often used in preference to GNP in matters related to agricultural production. Data on GDP and GNP is widely and easily available, for example, in the World Bank's *World Development Indicators*.[15]

22. It might, at first sight, appear that GDP and GNP are rather simplistic indicators of the benefits derived from plant genetic resources for food and agriculture, because they are not specifically agricultural, but measure the entire range of national economic activities. On the other hand, this may be a strength: as the capacity to benefit from plant genetic resources for food and agriculture is a function of the capacity to use them productively, macroeconomic indicators may be the best measure of a nation's overall capacity to productively use and commercialize plant genetic resources for food and agriculture. Moreover, the very inclusivity of GDP and GNP allows them to reflect – albeit indirectly – the full range of primary, secondary and tertiary benefits flowing from the use of genetic resources, and capture the range of value added associated not just with increased crop yield, but with added benefits resulting from the synergies that accrue to the interaction of higher yields with other factors, such as transportation, food processing and distribution. The use of GDP and GNP as indicators would explicitly acknowledge that food processors and consumers, as well as farmers and seed companies, benefit from plant genetic resources for food and agriculture. The implication is that countries without substantial agricultural production nonetheless benefit substantially from the use of these resources as consumers, which is not clear in the case of indicators such as the Value of Agricultural Production.

23. *Table 1* reports both GDP and GNP. For the purposes of this study, the two indicators may be regarded as virtually interchangeable, since the respective figures for most countries differ in the second decimal figure of one percent. *Table 2* shows the domination by OECD countries of the world economy, with an 82.17% share of GDP and an 83.34% share of GNP.

24. A third macroeconomic indicator, **the FAO Scale of Contributions**, derives from GDP. *Table 1* reports the FAO Scale of Contributions for 1998/99.[16] The FAO scale of contributions is itself derived directly from the United Nations Scale of Assessments, differing only according to the different memberships of the two organizations. The UN scale is based on countries' shares of global GDP, varied according to specific elements and criteria established by the General

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15 Here, as elsewhere, the World Bank's *World Development Indicators, 1998*, has been used by preference, as the primary source of data. (The World Bank does not itself collect data, but tries to ensure the accuracy and consistency of the information it publishes.) The data it gives is generally for the year 1996. (In drawing data from other sources, 1996 statistics are also used, except where otherwise noted.) The figures reported in *Table 1* were derived from its *Tables 1.5* and *4.2*. Note that the World Bank does not report data for countries with populations smaller than one million (for instance, Bahamas, Grenada and Seychelles), and for a few countries where, for various reasons, data is not available (such as Afghanistan, Bosnia, Cuba, Iran, Iraq and Libya).

16 As adopted by Conference Resolution 15/97, and set out in *Appendix M* of document C 97 REP.

Assembly for certain groups of countries, which effectively represent an internationally agreed equity-factor.[17]

25. As *Table 1* shows, this indicator differs little from GDP. Among its advantages is that the framework has been in place for some time, and is familiar to, and accepted by, governments. Like GNP and GDP, it is a simple, straightforward measure, regularly generated, by an established process within the UN system.

4.2 Agricultural Indicators

26. It might be argued that macroeconomic indicators do not relate specifically enough to agriculture. Two indices that do are **Agricultural Value Added**, which is the value that agricultural activities add to GDP, and the **Value of Agricultural Production**, which is the gross value of crop and livestock production. Although similar, these indicators are derived by different organizations (the World Bank and FAO respectively) from different sets of data.[18]

27. Although these indicators are unambiguously from the agricultural sector, their connection with the benefits derived from the use of plant genetic resources for food and agriculture is hardly precise. The World Bank data includes forestry and fisheries as well as crops and livestock. FAO's data is limited to crop and livestock production, but, even in the case of crops, where germplasm is certainly a contributor to agricultural value and value added, so are a wide variety of other inputs, such as machinery, agricultural chemicals, and labour. Nonetheless, *Table 1* shows that the two indicators apparently measure approximately similar things, because for all but three countries (Brazil, China and Japan), the indices do not differ by more than a percentage point.

28. It is striking that the overall pattern of these agricultural indicators differs from that of the macroeconomic indicators. Generally, industrial countries' shares of the agricultural indicators are smaller than those of the macroeconomic indicators. *Table 2* shows that the OECD countries' collective share of Agricultural Value Added is roughly half their share of the world's GDP (43.73% versus 82.17%). *Table 1* shows the converse to be true for virtually all other countries, most of which have slightly larger shares of Agricultural Value Added than of GDP. This presumably reflects the continuing reliance of vast numbers of people in many developing countries on subsistence and relatively small-scale agricultural production, without anything near as great a reliance on improved varieties, as in developed countries, although their aggregate contribution to GDP may be substantial. The large proportions of global Agricultural Value Added accounted for by China (13.2%) and India (7.69%) illustrate this point. On the other hand, Brazil's 8.08% share of Agricultural Value Added reflects its emergence as a major exporter of certain grains, and genetic improvement has certainly played a role in this. Agricultural Value Added is too insensitive an index to distinguish usefully between the situations of these countries in relation to plant genetic resources for food and agriculture. It - and Value of Agricultural Production even more so - may also understate the benefits that the advanced industrial nations receive from plant genetic resources for food and agriculture.

4.3 Scientific Capacity Indicators

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[17] In General Assembly Resolution 52/215, adopted on 22 December 1997, setting the assessments for the years 1998, 1999 and 2000, these include a debt burden adjustment, a low *per capita* income adjustment, a minimum assessment rate of 0.001%, a ceiling rate of 25%, and individual assessments of least developed countries not to exceed 0.01%.

[18] **Agricultural Value Added** was calculated from data in the World Bank's *World Development Indicators, 1998* (*Tables 1.5* and *4.2*), which did not include information for certain agriculturally important nations (including New Zealand, the United Kingdom, the United States, and Canada), in which case 1995 data is taken from *Table 12* of the World Bank's *World Development Report 1997*. The gross **Value of Agricultural Production** is based on the FAO Indices of Agricultural Production, available in the FAO Statistics Database (FAOSTAT), and is the sum of price-weighted quantities of different agricultural crop and livestock commodities produced. The price-weights are derived using the Geary-Khamis formula, which assigns a single "price" to each commodity regardless of its country of origin, thus avoiding the use of exchange rates and facilitating international comparability.

29. Benefit from access to plant genetic resources for food and agriculture is largely a function of the ability to process and use genetic information, for which reason a further approach to developing indicators is to use scientific capacity as a proxy.[19] **Scientists and Engineers in Research and Development** indicates a country's scientific labour resources. **Expenditures for Research and Development** indicates the financial resources for research, rather than the human capacity. It might however be argued that the output of scientific research is a better measure of relative capacity, and so of the benefits associated with the use of plant genetic resources for food and agriculture, than these inputs to the scientific effort. Two output indicators, both related to intellectual property rights over the product, are **Patents Granted to Residents**[20] and **Royalty and License Fees Received**,[21] which may be regarded as measures of the degree to which scientific effort is concretely realized in novel and commercializable products.

30. *Table 1* shows how profoundly uneven the present global distribution of scientific capacity is. As *Table 2* shows, OECD countries account for 55.76% of scientists and engineers and 95.74% of expenditures on research and development. While the overall position is clear, the limitations of the data should be noted.[22]

31. It should be noted that there is the lack of specificity in the data, in regard to agricultural research. The adequacy of these two measures as indicators rests on assumptions about how closely overall human and financial research capacities reflect the abilities to use plant genetic resources for food and agriculture productively. Such assumptions would be more solidly based, if specific data were available on agricultural scientists generally, or on plant breeders, in particular. Such information does not appear to be available, or easily collectable.[23]

32. *Table 1* also shows that only 77 of 180 countries covered had residents who were granted patents in 1996. *Table 2* shows that the OECD nations alone accounted for 88.81% of patents granted, and that the financial benefits accruing to possession of intellectual property rights were even more concentrated: fully 98.85% of the global income from royalty and license fees went to the OECD nations, and more than half to the United States alone.

33. In discussing the two indicators of scientific capacity, problems regarding the reliability or completeness of the data were noted. This is less the case with patents granted and royalty fees received, as WIPO statistics include information for all patent activity. The intellectual property

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19 Data on scientific personnel and expenditures, in the following two indicators, is from UNESCO's 1997 *Statistical Yearbook*, *Table 5.1*. As UNESCO did not report research and development expenditures for the United States, figures for that country were obtained from the United States National Science Foundation's *Science and Engineering Indicators* (National Science Foundation, Washington, DC, 1998)

20 The figures are for 1996 and were taken from the electronic version of *WIPO Industrial Property Statistics*, Publication A-1996, on the World Intellectual Property Organization's (WIPO) internet site, at http://www.ompiorg/eng/general/pcipi/stat-new/ipspub/puba/pdf, in September 1998.

21 From the International Monetary Fund's *Balance of Payments Statistics Yearbook*, summarized in the World Bank's *World Development Indicators, 1998, Table 5.12*.

22 UNESCO was able to provide information on scientific personnel and expenditures for less than half of the 180 countries included in this study. Even when data was available, it was highly uneven in quality, and the years for which the counts of personnel and expenditures were taken ranged from 1981 to 1995.

23 The FAO *Seed Review* provides information on the number of plant breeders working on particular crops, but this is collected only every five or so years, most recently in 1990, when 87 nations responded in some fashion, with information on plant breeders scattered unevenly through individual country reports. No information on plant breeding expenditures is included, nor was it requested. There is reason to believe that no country has such data readily available. The recently concluded United States National Plant Breeding Study (Frey, Kenneth J., *National Plant Breeding Study-III: National Genepool Enrichment of U.S. Crops*. Special Report 101 Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa; Iowa State University (1998)) determined that there was, in 1994, a total of US$551 million devoted to 2,241 scientific person-years of plant breeding activities in the United States. This data is available only because the Study was undertaken in order to collect data that was otherwise not available. It will not be collected annually in the future.

rights indicators, however, fail to disaggregate plant or crop-related patents from other patents, and there is no *a priori* reason to assume that the distribution of plant or crop-related patents closely follows the distribution of all patents. For example, Japan alone accounts for 54.43% of patents granted in 1996, but certainly did not enjoy 54.43% of the benefits flowing from the use of plant genetic resources for food and agriculture.

34. There would be a number of complex methodological questions to be addressed, if it were desired to disaggregate crop- and plant-related patents within overall patent statistics, as a more empirical foundation for a patent-based indicator for benefit-sharing in relation to plant genetic resources for food and agriculture. Patent laws range widely: some countries may exclude patenting of plants, as provided for under Article 27.3(b) of the TRIPS Agreement; in other countries, whole plants, cells, DNA sequences, and other genomic components, are patentable. Defining which patents would be included, and agreeing protocols to select them, would require careful consideration. Even if an appropriate set of crop- or plant-related patents was agreed, application activity, or even the number of patents issued, remains an imperfect index of benefits received, because many patents are never actually used, or never become a source of income for the holder; a relatively small set of patents produces most of the royalty income. Identifying these patents would be difficult, since this would require private firms to provide proprietary information. Furthermore, for royalty and license fees, it is extremely difficult to differentiate the relative contributions to these values of plant genetic resources and research. Finally, it must be noted that most proprietary crop varieties are not protected by patents, but by some form of plant breeder's rights.

4.4 Indicators that relate directly to plant genetic resources for food and agriculture

35. The foregoing indicators have suffered from one or both of two deficiencies: a lack of accurate, inclusive data; and poor goodness of fit between the indicator and the benefits associated with the use of plant genetic resources for food and agriculture. Two further possible indicators were selected for analysis, because they are related directly to the utilization of plant genetic resources for food and agriculture: **Plant Breeder's Rights Registrations by Residents**,[24] and the **Commercial Seed Market**.[25]

36. *Table 1* shows that plant varieties were registered under some form of plant breeders' rights by residents of 29 of the 180 countries included in this study. *Table 2* shows that OECD countries alone accounted for 88.81% of registrations. The Netherlands (as a major breeder of new vegetable and flower varieties) alone accounted for 24.46% of total global Plant Breeder's Rights registrations.

37. This indicator's principal advantage is its clear association with plant genetic resources for food and agriculture. It is also an effective index of the global distribution of capacity to use, and therefore to benefit from, plant genetic resources for food and agriculture. Moreover, the data is easily accessible, collected annually, and of a high degree of reliability.

38. However, since private companies tend to use Plant Breeders' Rights more frequently than do public agencies, this indicator particularly emphasizes the benefits to the seed industry of plant genetic resources for food and agriculture, and, as with Patents Granted to Residents, it reflects the number of varieties registered, rather than those that are actually used in production, or the profits from individual varieties. The indicator could be improved, if data were available on the actual

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[24] While plants and plant varieties may be patented in some countries, more countries provide intellectual property protection over plant varieties through specific "plant breeders' rights" (s). The World Intellectual Property Organization (WIPO) collects global data on PBR, which it publishes in its annual *Industrial Property Statistics*. The data in this study was derived from the 1997 publication.

[25] Comprehensive data on the commercial seed trade is extremely difficult to obtain. For this study, the estimates by ASSINSEL on its web-site (http://www.worldseed.org/~assinsel/stat.htm), on 30 July 1998, have been used.

value of production associated with specific registered varieties, but this information is not available.[26]

39. Perhaps the most accurate, quantitative, globally applicable indicator of the benefits of the use of plant genetic resources for food and agriculture would be the value of the commercial seed market, because the utilization of plant genetic resources for food and agriculture in plant improvement is concretely embodied in new varieties. These are increasingly being developed in the private sector, and released through the market, but it is also not unusual for public agencies to sell new varieties, often at subsidized prices.

40. As was the case with Plant Breeder's Rights Registrations by Residents, the best source of information on the commercial market for seed is private companies, which keep reasonably accurate records of seed of each crop, and each variety sold, where it is sold, and what price it is sold at. However, such market information is not readily shared, and it is not systematically collected by either governments or trade associations.[27]

41. At the international level, FIS/ASSINSEL reportedly does not itself have access to complete or unambiguous information on the extent and magnitude of the global commercial seed market. However, FIS/ASSINSEL has attempted an estimate of both the internal market and export sales of seed and planting material for some countries. It is instructive to note that FIS/ASSINSEL's very useful statistical summary of internal seed markets and export seed and planting material sales for some countries is constructed from a wide variety of disparate sources (the World Trade Organization, GNIS, Rabobank, conferences, and personal communications), which in itself testifies to the absence of relevant centralized or systematized information.

42. FIS/ASSINSEL provided data on 31 countries, whose collective internal market for seed and planting material was estimated at about US$23.5 thousand million. The size of their individual national markets ranged from US$4.5 thousand million for the United States, to US$60 million for Bangladesh. FIS/ASSINSEL also estimated total export sales for those countries at about US$3.5 thousand million. *Tables 1* and *2* derive figures for the commercial seed market, on the basis of the FIS/ASSINSEL data.[28] They show that the OECD countries account for 84.85% of the overall market.

43. The Commercial Seed Market indicator could be improved, if private seed firms, or trade associations on their behalf, were willing to provide more comprehensive data. However, even with such additional information, the broad shape of the figures in *Table 3* suggests that this would probably not lead to very significant changes in the relative national figures.

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26 There is apparently no agency – government or private – in any country that systematically collects national, much less global, information on the area planted to particular varieties. Private seed companies undoubtedly keep records of the sales of registered (and patented) varieties, but this information is proprietary and is not readily shared. Trade organizations such as the American Seed Trade Association (ASTA) or FIS/ASSINSEL have limited amounts of information of this type.

27 For instance, in the United States, ASTA collects market information for only three crops (maize, sorghum, soybeans) from some (not all) companies that provide the data on condition it be reported only in aggregate. Other national trade associations (such as the Groupement national interprofessionnel de semences et plants (GNIS)) probably have similar piecemeal information.

28 For other indicators, this study has treated benefits as accruing to national entities. For the purposes of this indicator, the value of a country's commercial seed exports were summed with its internal seed market, in order to obtain a notional "total sales of commercial seed". Advanced industrial nations were assumed to supply their own internal markets. Eastern European countries with economies in transition were assumed to supply three-quarters of their internal market, and less developed nations were assumed to supply half of their own internal markets. Of course, these assumptions do not entirely hold, but they permit construction of a heuristically useful indicator of the commercial market for seed. (Data was also available collectively for the Commonwealth of Independent States that formerly comprised the Soviet Union. However, because ASSINSEL warns that this data must be considered with "great precaution," and because the relative part of the individual countries was not specified, this data was not included.)

44. While the question of how funds might be raised is not considered in this study, it should be noted that, to a large extent, the sectorial impacts of raising the amounts needed to cover an agreed funding level by a direct "levy" on a particular sector would largely depend on the size of that sector. For instance, a levy at farm level (reflecting the value of agricultural production) is unlikely to have significant market effects, as even a US$300 million levy collected at this level would represent less than 0.02% of total farm gate value. Even if demand is highly price sensitive, the levy would be unlikely to produce significant price effects. However, price effects would be more notable if the same amount was extracted from smaller sectors. For example, assuming for the argument that the commercial seed industry has a value at world level of about US$30 thousand million per year (a figure slightly higher that that in *Tables 1* and *2*), and that industry profits are around 10%, then US$50 million levied on the industry would represent 1.7% of profits, and US$300 million would represent 10% of profits. While the extent to which such an increase in cost would be passed on to upstream stakeholders depends on supply and demand conditions in each stakeholder's market, the relatively large ratio of the levy to total profits (or revenues), relative to a levy at farm level, or consumer level, suggests that a levy on commercial seed production would produce more notable price impacts - at least in the market for seed - than a levy at the farm gate or retail level.

4.5 Consistency of the various indicators

45. In *Table 2*, the total percentage shares, for the OECD countries, show an apparently close consistency of the macroeconomic indicators and the indicators that relate directly to plant genetic resources for food and agriculture, as follows:[29]

Macroeconomic indicators			**PGRFA-related indicators**	
GNP (1996)	GDP (1996)	FAO Scale (1998)	PBR Registration by Residents (1996)	Commercial Seed Market (1998)
83.34%	82.17%	89.46%	88.81%	84.85%

46. *Table 3*, which lists these indicators for thirty of the world's prominent largest economies, shows that this consistency appears to be the case at country level as well: except in a few instances, the scores across those indicators do not diverge for more than a percentage point or two. The major anomalies are the high scores of the Netherlands and France for the indicators that relate directly to plant genetic resources for food and agriculture, and this can be explained in terms of their special role in the seed industry.

47. However, in the absence of better or more complete data, it is not statistically sound to attempt to read too much into this apparent pattern. It is, however, suggestive that the commercial market for seed – and by implication the pattern of benefits associated with the use of plant genetic resources for food and agriculture – appears to be distributed similarly to the relative capacities of national economies, as measured by the macroeconomic indicators. This may recommend the latter indicators for benefit-sharing under the International Undertaking.

4.6 Indicator specificity and data quality

48. The study has noted that a primary problem with any indicator is the difficulty of measuring the contribution of plant genetic resources for food and agriculture to increased crop yield separately from the contribution of other inputs. This is even more difficult in the case of secondary and tertiary benefits to various sectors of society and the economy. This difficulty in

[29] It must be noted that GDP, GNP and the FAO Scale of Contributions are structurally related measures, so that high correlation between them is to be expected.

specifying the character and magnitude of the benefits means that indicators are proxies, not direct measures.

49. The study has also noted the further problem of the paucity of accessible, reliable data for most of the potential indicators. For some indicators, not only is the data poor, but the data-set is not inclusive, and does not cover a large number of countries. While steps could be taken to improve the quality and inclusivity of data, the task may be costly and complicated, and it is unclear which institution or institutions would manage such a project.

5. Conclusions

50. This study has reviewed, in the simple and objective manner the Commission requested, a variety of empirical benefit-indicators that governments Parties to the International Undertaking may wish to consider in apportioning financial responsibilities.

51. The simplest, most inclusive, accessible and legitimate indicators appear to be the **Macroeconomic Indicators** of GDP, GNP, and the FAO Scale of Contributions. Although they may, at first sight, appear to be the indicators least directly related to plant genetic resources for food and agriculture, they may, in fact, be the most equitable, since they reflect overall national capacities to benefit from the use of plant genetic resources for food and agriculture.

52. The **Agricultural Indicators** – Agricultural Value Added, and Value of Agricultural Production – are consistent between themselves, but differ significantly from the distribution of the macroeconomic indicators. They may tend to underestimate the benefits that the industrialized nations derive from the use of plant genetic resources for food and agriculture.

53. The **Indicators of Scientific Capacity** – Scientists and Engineers in Research and Development, Research and Development Expenditures, Patents Granted to Residents, and Royalty and License Fees Received – suffer either from debilitating deficiencies of data availability and accuracy, or are not closely enough linked to the agricultural sector to be useful. None of these indicators is likely to be acceptable as a basis for determining plant genetic resources for food and agriculture benefit-sharing, either singly or as part of a formula.

54. Of the two **Indicators that Relate Directly to Plant Genetic Resources for Food and Agriculture** – PBR Registration by Residents, and Commercial Seed Trade – the latter appears the more promising. Further refinement of the data on commercial seed trade would depend on the willingness of private industry to provide information. A significant finding of this study is that the indicators that related directly to plant genetic resources for food and agriculture appear to correlate quite closely with the macroeconomic indicators.

55. All of the indicators reviewed (with the exception of the uniformly unhelpful scientific capacity indicators) have certain strengths and weaknesses. Given unlimited time and resources, it might be possible to find one or several indicators that are better proxies for the benefits associated with the use of plant genetic resources for food and agriculture. However, there is a very wide range of benefits to many different social groups associated with plant genetic resources for food and agriculture: partitioning the sources and recipients of these benefits is likely to involve so many technical questions and value judgements as to make the result at best uncertain. Moreover, it might be argued that such efforts ran counter to the criterion of simplicity.

56. The apparent isomorphism of macroeconomic indicators and indicators specific for plant genetic resources for food and agriculture suggests that macroeconomic indicators may prove the most broadly acceptable, as meeting the criteria of equity, simplicity, accessibility, legitimacy, and inclusivity.

TABLE 1: Possible Benefit-Indicators - by region

	Macroeconomic Indicators			Agricultural Indicators		Scientific Capacity Indicators				PGRFA-Related Indicators	
	GNP (1996)	GDP (1996)	FAO Scale (1998/99)	Agricultural Value Added (1996)	Value of Agricultural Production (1994-96)	Scientists & Engineers in R&D (1981-95)	Expenditures for R&D (1995)	Patents Granted to Residents (1996)	Royalty and License Fees Received (1996)	PBR Registration by Residents (1996)	Commercial Seed Market (1998)
Country/Region											
Angola	0.01%	0.02%	0.01%	0.04%	0.06%				0.03%		
Algeria	0.15%	0.16%	0.17%	0.46%	0.20%						
Benin	0.01%	0.01%	0.01%	0.06%	0.07%	0.02%	0.00%				
Botswana		0.02%	0.01%	0.02%	0.01%			0.00%			
Burkina Faso	0.01%	0.01%	0.01%	0.07%	0.07%						
Burundi	0.00%	0.00%	0.01%	0.05%	0.05%	0.00%					
Cameroon	0.03%	0.03%	0.01%	0.28%	0.13%						
Cape Verde			0.01%		0.00%						
Central African Republic	0.00%	0.00%	0.01%	0.04%	0.03%	0.00%	0.00%				
Chad	0.00%	0.00%	0.01%	0.04%	0.05%		0.00%				
Comoros			0.01%		0.00%						
Congo, Dem. Rep.	0.02%	0.02%	0.01%	0.34%	0.26%	0.41%		0.00%			
Congo, Rep.	0.01%	0.01%	0.01%	0.02%	0.01%						
Cote D'Ivoire	0.03%	0.04%	0.01%	0.23%	0.25%						
Djibouti			0.01%		0.00%						
Equatorial Guinea			0.01%								
Eritrea			0.01%		0.01%						
Ethiopia	0.02%	0.02%	0.01%	0.25%	0.29%						
Gabon	0.02%	0.02%	0.01%	0.03%	0.01%	0.00%					
Gambia		0.00%	0.01%	0.01%	0.01%						
Ghana	0.02%	0.02%	0.01%	0.21%	0.17%			0.00%			
Guinea	0.01%	0.01%	0.01%	0.08%	0.05%	0.04%					
Guinea-Bissau		0.00%	0.01%	0.01%	0.01%						
Kenya	0.03%	0.03%	0.01%	0.21%	0.22%			0.00%			
Lesotho	0.00%	0.00%	0.01%	0.01%	0.01%			0.00%			
Liberia			0.01%		0.01%						
Madagascar	0.01%	0.01%	0.01%	0.11%	0.15%	0.01%	0.00%	0.00%			
Malawi	0.01%	0.01%	0.01%	0.07%	0.07%						
Mali	0.01%	0.01%	0.01%	0.10%	0.10%						
Mauritania	0.00%	0.00%	0.01%	0.02%	0.02%						
Mauritius	0.01%	0.01%	0.01%	0.03%	0.01%	0.01%	0.00%	0.00%			
Morocco	0.12%	0.13%	0.03%	0.57%	0.30%			0.02%	0.01%		0.40%
Mozambique	0.01%	0.01%	0.01%	0.05%	0.08%						
Namibia	0.01%	0.01%	0.01%	0.03%	0.03%						
Niger	0.01%	0.01%	0.01%	0.06%	0.07%						
Nigeria	0.10%	0.11%	0.12%	1.06%	1.16%	0.03%	0.00%				
Rwanda	0.00%	0.00%	0.01%	0.04%	0.04%	0.00%					
Sao Tome			0.01%		0.00%						
Senegal	0.02%	0.02%	0.01%	0.07%	0.07%	0.06%			0.00%		
Seychelles			0.01%		0.00%		0.00%				
Sierra Leone	0.00%	0.00%	0.01%	0.03%	0.03%						
Somalia			0.01%		0.08%						
South Africa	0.47%	0.45%	0.34%	0.49%	0.54%	0.24%	0.23%		0.12%	1.90%	0.42%
Sudan			0.01%		0.30%						
Swaziland			0.01%		0.01%						
Tanzania	0.02%	0.02%	0.01%	0.21%	0.23%						
Togo	0.00%	0.00%	0.01%	0.04%	0.03%						
Uganda	0.02%	0.02%	0.01%	0.22%	0.22%						
Zambia	0.01%	0.01%	0.01%	0.05%	0.04%						

	Macroeconomic Indicators			Agricultural Indicators		Scientific Capacity Indicators				PGRFA-Related Indicators	
	GNP (1996)	GDP (1996)	FAO Scale (1998/99)	Agricultural Value Added (1996)	Value of Agricultural Production (1994-96)	Scientists & Engineers in R&D (1981-95)	Expenditures for R&D (1995)	Patents Granted to Residents (1996)	Royalty and License Fees Received (1996)	PBR Registration by Residents (1996)	Commercial Seed Market (1998)
Zimbabwe	0.02%	0.03%	0.01%	0.08%	0.10%			0.00%	0.00%		
Africa Totals	**1.25%**	**1.33%**	**1.12%**	**5.76%**	**5.69%**	**0.82%**	**0.24%**	**0.03%**	**0.17%**	**1.90%**	**0.82%**
Australia	1.30%	1.39%	1.58%	1.21%	1.28%	0.87%	0.88%	0.29%	0.47%	3.65%	1.39%
Bangladesh	0.11%	0.11%	0.01%	0.74%	0.70%						0.15%
Bhutan			0.01%								
Cambodia	0.01%	0.01%	0.01%	0.12%	0.09%						
China	3.19%	2.89%	0.79%	13.20%	20.06%	12.74%	0.93%	0.40%			6.20%
Cook Islands			0.01%								
Fiji			0.01%		0.01%						
India	1.26%	1.26%	0.33%	7.69%	8.96%	2.79%	0.49%	0.10%	0.00%		2.23%
Indonesia	0.75%	0.80%	0.15%	2.79%	2.18%	0.70%	0.07%	0.00%			
Japan	18.14%	16.32%	16.73%	7.09%	1.36%	13.97%	26.39%	54.43%	12.47%	13.06%	12.60%
Kazakhstan	0.08%	0.07%	0.20%	0.21%	0.43%			0.26%			
Korea, Dem. Rep.			0.05%		0.22%						
Korea, Rep.	1.70%	1.72%	0.88%	2.24%	0.59%	2.37%	2.31%	2.41%	0.35%	0.03%	
Lao PDR	0.01%	0.01%	0.01%	0.07%	0.04%						
Malaysia	0.32%	0.35%	0.15%	0.99%	0.59%	0.04%	0.06%				
Maldives			0.01%		0.00%						
Mongolia	0.00%	0.00%	0.01%	0.02%	0.04%			0.03%			
Myanmar			0.01%		0.51%						
Nepal	0.02%	0.02%	0.01%	0.14%	0.19%	0.01%					
New Zealand	0.20%	0.23%	0.26%	0.25%	0.44%	0.14%	0.11%	0.07%		2.08%	0.26%
Pakistan	0.22%	0.23%	0.06%	1.30%	1.49%	0.14%	0.10%	0.00%	0.01%		
Papua New Guinea	0.02%	0.02%	0.01%	0.10%	0.06%						
Philippines	0.29%	0.30%	0.06%	1.36%	0.89%	0.13%	0.01%	0.01%	0.00%		
Samoa			0.01%								
Singapore	0.33%	0.33%					0.17%	0.01%			
Solomon Islands			0.01%		0.01%						
Sri Lanka	0.05%	0.05%	0.01%	0.24%	0.14%	0.06%	0.00%	0.02%			
Thailand	0.63%	0.66%	0.14%	1.57%	1.18%	0.20%	0.06%	0.01%	0.05%		
Tonga			0.01%								
Vanuatu			0.01%		0.00%						
Vietnam	0.08%	0.08%	0.01%	0.49%	0.85%	0.49%	0.01%	0.00%			
Asia & SW Pacific Totals	**28.70%**	**26.87%**	**21.55%**	**41.81%**	**42.31%**	**34.63%**	**31.61%**	**58.05%**	**13.34%**	**18.82%**	**22.83%**
Afghanistan			0.01%		0.12%						
Azerbaijan	0.01%	0.01%	0.12%	0.06%	0.08%			0.02%			
Bahrain			0.02%								
Egypt, Arab Rep.	0.23%	0.24%	0.09%	0.89%	0.74%	0.53%	0.11%	0.01%	0.10%		0.35%
Iran			0.48%		0.92%	0.08%	0.00%				
Iraq			0.15%		0.14%			0.01%			
Jordan	0.03%	0.03%	0.01%	0.28%	0.05%	0.01%	0.00%				
Kuwait		0.09%	0.20%	0.00%	0.01%	0.04%	0.00%				
Kyrgyz Rep.	0.01%	0.01%	0.03%	0.07%	0.07%						
Lebanon	0.04%	0.05%	0.01%	0.12%	0.06%	0.01%					
Libya			0.21%		0.04%	0.04%	0.00%				
Oman		0.04%	0.04%								
Qatar			0.04%								
Saudi Arabia		0.45%	0.76%		0.17%						
Syrian Arab Republic	0.06%	0.06%	0.05%	0.22%	0.26%						
Tajikistan	0.01%	0.01%	0.02%		0.05%			0.00%			
Tunisia	0.06%	0.07%	0.03%	0.21%	0.12%	0.07%	0.01%	0.01%	0.00%		

	Macroeconomic Indicators			Agricultural Indicators		Scientific Capacity Indicators				PGRFA-Related Indicators	
	GNP (1996)	GDP (1996)	FAO Scale (1998/99)	Agricultural Value Added (1996)	Value of Agricultural Production (1994-96)	Scientists & Engineers in R&D (1981-95)	Expenditures for R&D (1995)	Patents Granted to Residents (1996)	Royalty and License Fees Received (1996)	PBR Registration by Residents (1996)	Commercial Seed Market (1998)
Turkmenistan	0.02%	0.02%	0.03%		0.10%						
United Arab Emirates		0.14%	0.20%		0.02%						
Uzbekistan	0.08%	0.09%			0.42%	0.79%		0.12%			
Yemen	0.02%	0.02%	0.01%	0.08%	0.05%						
Near East Totals	**0.56%**	**1.32%**	**2.51%**	**1.93%**	**3.42%**	**1.55%**	**0.12%**	**0.18%**	**0.10%**	**0.00%**	**0.35%**
Albania	0.01%	0.01%	0.01%	0.11%	0.05%						
Armenia	0.01%	0.00%	0.05%	0.05%	0.03%			0.04%			
Austria	0.80%	0.80%	0.93%	0.35%	0.28%	0.25%	0.58%	0.39%	0.34%	0.34%	0.84%
Belarus	0.08%	0.07%		0.24%	0.38%	0.64%	0.03%	0.08%			
Belgium	0.95%	0.94%	1.08%	0.20%	0.40%	0.35%	0.78%	0.29%	1.27%	0.34%	1.54%
Bosnia and Herzegovina			0.01%		0.04%						
Bulgaria	0.03%	0.03%	0.09%	0.07%	0.22%	0.66%	0.03%	0.07%			
Croatia	0.06%	0.07%	0.10%	0.18%	0.09%	0.19%		0.01%			
Cyprus			0.03%		0.02%		0.00%				
Czech Republic	0.17%	0.19%	0.27%	0.25%	0.32%	0.25%	0.11%	0.12%	0.08%	1.62%	0.52%
Denmark	0.60%	0.62%	0.77%	0.54%	0.46%	0.26%	0.55%	0.10%		1.59%	0.67%
Estonia	0.02%	0.02%	0.04%	0.02%	0.04%	0.06%	0.00%	0.00%	0.00%		
Finland	0.42%	0.44%	0.66%	0.57%	0.15%	0.36%	0.47%	0.28%	0.12%	0.18%	0.40%
France	5.40%	5.47%	6.86%	2.37%	2.69%	2.87%	6.55%	3.47%	3.47%	13.06%	11.57%
Georgia	0.02%	0.02%	0.12%	0.12%	0.07%			0.05%			
Germany	8.33%	8.35%	9.68%	1.81%	2.17%	4.83%	10.50%	5.73%	6.19%	9.81%	8.50%
Greece	0.42%	0.44%	0.41%	1.99%	0.45%	0.15%	0.10%	0.06%			0.52%
Hungary	0.16%	0.16%	0.15%	0.24%	0.40%	0.23%	0.08%	0.10%	0.08%	0.43%	1.49%
Iceland			0.03%		0.00%			0.00%			
Ireland	0.22%	0.25%	0.23%		0.28%	0.15%	0.15%	0.15%	0.18%	0.09%	
Israel	0.32%	0.33%	0.29%		0.12%	0.57%	0.34%	0.12%	0.26%	1.44%	
Italy	4.02%	4.29%	5.61%	2.79%	1.67%	1.45%	2.53%	2.40%	0.71%		3.98%
Latvia	0.02%	0.02%	0.09%	0.03%	0.06%	0.05%		0.08%			
Lithuania	0.03%	0.03%	0.09%	0.08%	0.12%	0.10%		0.04%			
Luxembourg			0.08%					0.02%			
Macedonia, FYR	0.01%	0.01%	0.01%		0.04%	0.05%		0.01%			
Malta			0.01%		0.00%			0.00%			
Moldova	0.01%	0.01%	0.09%	0.07%	0.11%			0.05%			
Netherlands	1.42%	1.39%	1.70%	0.91%	0.80%	0.83%	1.31%	0.49%	4.40%	24.46%	4.56%
Norway	0.53%	0.56%	0.60%	0.24%	0.09%	0.27%	0.49%	0.07%	1.36%	0.03%	
Poland	0.44%	0.48%	0.35%	0.62%	1.26%	0.82%	0.19%	0.41%	0.04%	1.62%	1.49%
Portugal	0.36%	0.37%	0.30%		0.22%	0.12%	0.10%	0.01%	0.05%	0.09%	
Romania	0.13%	0.13%	0.16%	0.57%	0.62%	0.62%	0.04%	0.51%	0.19%	1.13%	
Russia	1.25%	1.56%		2.38%	3.20%	12.59%	0.49%	4.78%			
Slovakia	0.06%	0.07%	0.09%	0.07%	0.15%	0.19%	0.03%	0.02%	0.03%	2.73%	
Slovenia	0.06%	0.07%	0.08%	0.07%	0.05%	0.12%	0.05%	0.07%	0.01%		
Spain	1.98%	2.06%	2.54%	1.35%	1.35%	0.84%	0.87%	0.23%	0.44%	1.81%	2.73%
Sweden	0.80%	0.89%	1.32%	0.39%	0.22%	0.65%	1.36%	0.48%	1.86%	0.52%	0.40%
Switzerland	1.11%	1.04%	1.29%	0.45%	0.17%		1.39%	0.35%		0.12%	0.40%
Turkey	0.63%	0.64%	0.41%	2.38%	1.55%	0.26%	0.24%	0.01%			
Ukraine	0.21%	0.16%		0.44%	1.46%	6.73%		1.18%			
United Kingdom	4.06%	4.07%	5.69%	1.77%	1.27%	2.78%	4.33%	1.25%	8.81%	4.54%	2.83%
Yugoslavia			0.11%		0.33%	0.32%		0.04%			
Europe Totals	**35.14%**	**36.01%**	**42.43%**	**23.74%**	**23.42%**	**40.61%**	**33.70%**	**23.56%**	**29.92%**	**65.97%**	**42.45%**
Antigua and Barbuda			0.01%		0.00%						
Argentina	1.04%	1.05%	0.51%	1.36%	1.66%	0.24%	0.15%	0.10%	0.01%	1.69%	1.98%

	Macroeconomic Indicators			Agricultural Indicators		Scientific Capacity Indicators				PGRFA-Related Indicators	
	GNP (1996)	GDP (1996)	FAO Scale (1998/99)	Agricultural Value Added (1996)	Value of Agricultural Production (1994-96)	Scientists & Engineers in R&D (1981-95)	Expenditures for R&D (1995)	Patents Granted to Residents (1996)	Royalty and License Fees Received (1996)	PBR Registration by Residents (1996)	Commercial Seed Market (1998)
Bahamas			0.02%		0.00%						
Barbados			0.01%		0.00%						
Belize			0.01%		0.01%						
Bolivia	0.02%	0.02%	0.01%	0.08%	0.12%	0.04%	0.02%				
Brazil	2.50%	2.66%	1.73%	8.08%	4.57%	0.52%	0.48%	0.05%	0.06%		2.98%
Chile	0.25%	0.26%	0.09%	0.29%	0.30%	0.10%	0.10%	0.01%	0.12%	0.21%	0.18%
Colombia	0.28%	0.30%	0.11%	1.05%	0.65%	0.03%	0.01%	0.01%	0.11%		
Costa Rica	0.03%	0.03%	0.01%	0.11%	0.11%	0.03%	0.00%		0.01%		
Cuba			0.05%		0.15%	0.29%	0.00%	0.01%			
Dominica			0.01%		0.00%						
Dominican Republic	0.05%	0.05%	0.01%	0.13%	0.11%						
Ecuador	0.06%	0.07%	0.02%	0.18%	0.25%	0.04%	0.00%	0.00%			
El Salvador	0.03%	0.04%	0.01%	0.10%	0.06%	0.00%					
Grenada			0.01%		0.00%						
Guatemala	0.06%	0.06%	0.02%	0.29%	0.13%	0.02%	0.01%	0.00%			
Guyana			0.01%		0.02%						
Haiti	0.01%	0.01%	0.01%	0.08%	0.04%			0.00%			
Honduras	0.01%	0.01%	0.01%	0.07%	0.08%			0.00%			
Jamaica	0.01%	0.02%	0.01%	0.03%	0.03%				0.01%		
Mexico	1.20%	1.19%	0.84%	1.29%	1.54%	0.17%	0.18%	0.03%	0.23%		0.87%
Nicaragua	0.01%	0.01%	0.01%	0.05%	0.05%	0.02%					
Panama	0.03%	0.03%	0.01%	0.05%	0.04%			0.00%			
Paraguay	0.03%	0.03%	0.01%	0.18%	0.18%						
Peru	0.21%	0.22%	0.06%	0.33%	0.25%	0.13%	0.02%	0.00%	0.00%		
Saint Kitts and Nevis			0.01%		0.00%						
Saint Lucia			0.01%		0.00%						
Saint Vincent and Grenadines			0.01%		0.00%						
Suriname			0.01%		0.01%						
Trinidad and Tobago	0.02%	0.02%	0.03%	0.01%	0.01%	0.00%		0.00%			
Uruguay	0.07%	0.06%	0.04%	0.13%	0.15%			0.00%			
Venezuela	0.24%	0.24%	0.35%	0.21%	0.27%	0.09%	0.06%	0.02%			
Latin Amer & Carib Totals	**6.16%**	**6.36%**	**4.07%**	**14.10%**	**10.80%**	**1.73%**	**1.03%**	**0.26%**	**0.54%**	**1.90%**	**6.01%**
Canada	2.01%	2.06%	3.32%	1.34%	1.63%	1.36%	1.56%	0.21%		0.31%	1.74%
United States	26.19%	26.05%	25%	11.32%	12.73%	19.31%	31.75%	17.72%	55.91%	11.10%	25.80%
North America Totals	**28.20%**	**28.11%**	**28.32%**	**12.66%**	**14.36%**	**20.67%**	**33.30%**	**17.93%**	**55.91%**	**11.40%**	**27.54%**
World Totals	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

TABLE 1a: Summary of Regional Sub-totals

	Macroeconomic Indicators			Agricultural Indicators		Scientific Capacity Indicators				PGRFA-Related Indicators	
	GNP (1996)	GDP (1996)	FAO Scale (1998/99)	Agricultural Value Added (1996)	Value of Agricultural Production (1994-96)	Scientists & Engineers in R&D (1981-95)	Expenditures for R&D (1995)	Patents Granted to Residents (1996)	Royalty and License Fees Received (1996)	PBR Registration by Residents (1996)	Commercial Seed Market (1998)
Africa	1.25%	1.33%	1.12%	5.76%	5.69%	0.82%	0.24%	0.03%	0.17%	1.90%	0.82%
Asia & SW Pacific	28.70%	26.87%	21.55%	41.81%	42.31%	34.63%	31.61%	58.05%	13.34%	18.82%	22.83%
Near East	0.56%	1.32%	2.51%	1.93%	3.42%	1.55%	0.12%	0.18%	0.10%	0.00%	0.35%
Europe	35.14%	36.01%	42.43%	23.74%	23.42%	40.61%	33.70%	23.56%	29.92%	65.97%	42.45%

	Macroeconomic Indicators			Agricultural Indicators		Scientific Capacity Indicators				PGRFA-Related Indicators	
	GNP (1996)	GDP (1996)	FAO Scale (1998/99)	Agricultural Value Added (1996)	Value of Agricultural Production (1994-96)	Scientists & Engineers in R&D (1981-95)	Expenditures for R&D (1995)	Patents Granted to Residents (1996)	Royalty and License Fees Received (1996)	PBR Registration by Residents (1996)	Commercial Seed Market (1998)
Latin America & Caribbean	6.16%	6.36%	4.07%	14.10%	10.80%	1.73%	1.03%	0.26%	0.54%	1.90%	6.01%
North America	28.20%	28.11%	28.32%	12.66%	14.36%	20.67%	33.30%	17.93%	55.91%	11.40%	27.54%
NOTE:	The figures, "0.00%", denote that the data for this country represents less than one hundredth of one per cent. Empty cells indicate either that no data is available for the country, or that the indicator does not apply in the case of that country (countries that have no PBR system).										

TABLE 2: Possible Benefit-Indicators - summary for the OECD countries

	Macroeconomic Indicators			Agricultural Indicators		Scientific Capacity Indicators				PGRFA-Related Indicators	
	GNP (1996)	GDP (1996)	FAO Scale (1998/99)	Agricultural Value Added (1996)	Value of Agricultural Production (1994-96)	Scientists & Engineers in R&D (1981-95)	Expenditures for R&D (1995)	Patents Granted to Residents (1996)	Royalty and License Fees Received (1996)	PBR Registration by Residents (1996)	Commercial Seed Market (1998)
Country/Region											
Australia	1.30%	1.39%	1.58%	1.21%	1.28%	0.87%	0.88%	0.29%	0.47%	3.65%	1.39%
Austria	0.80%	0.80%	0.93%	0.35%	0.28%	0.25%	0.58%	0.39%	0.34%	0.34%	0.84%
Belgium	0.95%	0.94%	1.08%	0.20%	0.40%	0.35%	0.78%	0.29%	1.27%	0.34%	1.54%
Canada	2.01%	2.06%	3.32%	1.34%	1.63%	1.36%	1.56%	0.21%		0.31%	1.74%
Czech Republic	0.17%	0.19%	0.27%	0.25%	0.32%	0.25%	0.11%	0.12%	0.08%	1.62%	0.52%
Denmark	0.60%	0.62%	0.77%	0.54%	0.46%	0.26%	0.55%	0.10%		1.59%	0.67%
Finland	0.42%	0.44%	0.66%	0.57%	0.15%	0.36%	0.47%	0.28%	0.12%	0.18%	0.40%
France	5.40%	5.47%	6.86%	2.37%	2.69%	2.87%	6.55%	3.47%	3.47%	13.06%	11.57%
Germany	8.33%	8.35%	9.68%	1.81%	2.17%	4.83%	10.50%	5.73%	6.19%	9.81%	8.50%
Greece	0.42%	0.44%	0.41%	1.99%	0.45%	0.15%	0.10%	0.06%			0.52%
Hungary	0.16%	0.16%	0.15%	0.24%	0.40%	0.23%	0.08%	0.10%	0.08%	0.43%	1.49%
Ireland	0.22%	0.25%	0.23%		0.28%	0.15%	0.15%	0.15%	0.18%	0.09%	
Italy	4.02%	4.29%	5.61%	2.79%	1.67%	1.45%	2.53%	2.40%	0.71%		3.98%
Japan	18.14%	16.32%	16.73%	7.09%	1.36%	13.97%	26.39%	54.43%	12.47%	13.06%	12.60%
Korea, Rep.	1.70%	1.72%	0.88%	2.24%	0.59%	2.37%	2.31%	2.41%	0.35%	0.03%	
Luxembourg			0.08%					0.02%			
Mexico	1.20%	1.19%	0.84%	1.29%	1.54%	0.17%	0.18%	0.03%	0.23%		0.87%
Netherlands	1.42%	1.39%	1.70%	0.91%	0.80%	0.83%	1.31%	0.49%	4.40%	24.46%	4.56%
Norway	0.53%	0.56%	0.60%	0.24%	0.09%	0.27%	0.49%	0.07%	1.36%	0.03%	
Poland	0.44%	0.48%	0.35%	0.62%	1.26%	0.82%	0.19%	0.41%	0.04%	1.62%	1.49%
Portugal	0.36%	0.37%	0.30%		0.22%	0.12%	0.10%	0.01%	0.05%	0.09%	
Spain	1.98%	2.06%	2.54%	1.35%	1.35%	0.84%	0.87%	0.23%	0.44%	1.81%	2.73%
Sweden	0.80%	0.89%	1.32%	0.39%	0.22%	0.65%	1.36%	0.48%	1.86%	0.52%	0.40%
Switzerland	1.11%	1.04%	1.29%	0.45%	0.17%		1.39%	0.35%		0.12%	0.40%
Turkey	0.63%	0.64%	0.41%	2.38%	1.55%	0.26%	0.24%	0.01%			
United Kingdom	4.06%	4.07%	5.69%	1.77%	1.27%	2.78%	4.33%	1.25%	8.81%	4.54%	2.83%
United States	26.19%	26.05%	25%	11.32%	12.73%	19.31%	31.75%	17.72%	55.91%	11.10%	25.80%
OECD Total	**83.34%**	**82.17%**	**89.28%**	**43.73%**	**35.34%**	**55.76%**	**95.74%**	**91.49%**	**98.85%**	**88.81%**	**84.85%**

NOTE: Empty cells indicate either that no data is available for the country, or that the indicator does not apply in the case of that country (countries that have no PBR system).

TABLE 3: Comparison of Various Indicators for Thirty of the World's Largest Economies

	GNP (1996)	GDP (1996)	UN Scale (1998/99)	PBR Registration by Residents (1996)	Commercial Seed Market (1998)
Country/Region					
Argentina	1.04%	1.05%	0.51%	1.69%	1.98%
Australia	1.30%	1.39%	1.58%	3.65%	1.39%
Austria	0.80%	0.80%	0.93%	0.34%	0.84%
Bangladesh	0.11%	0.11%	0.01%	0.00%	0.15%
Belgium	0.95%	0.94%	1.08%	0.34%	1.54%
Brazil	2.50%	2.66%	1.73%	0.00%	2.98%
Canada	2.01%	2.06%	3.32%	0.31%	1.74%
Chile	0.25%	0.26%	0.09%	0.21%	0.18%
China	3.19%	2.89%	0.79%	0.00%	6.20%
Czech Republic	0.17%	0.19%	0.27%	1.62%	0.52%
Denmark	0.60%	0.62%	0.77%	1.59%	0.67%
Egypt, Arab Rep.	0.23%	0.24%	0.09%	0.00%	0.35%
Finland	0.42%	0.44%	0.66%	0.18%	0.40%
France	5.40%	5.47%	6.86%	13.06%	11.57%
Germany	8.33%	8.35%	9.68%	9.81%	8.50%
Greece	0.42%	0.44%	0.41%	0.00%	0.52%
Hungary	0.16%	0.16%	0.15%	0.43%	1.49%
India	1.26%	1.26%	0.33%		2.23%
Italy	4.02%	4.29%	5.61%		3.98%
Japan	18.14%	16.32%	16.73%	13.06%	12.60%
Mexico	1.20%	1.19%	0.84%		0.87%
Netherlands	1.42%	1.39%	1.70%	24.46%	4.56%
New Zealand	0.20%	0.23%	0.26%	2.08%	0.26%
Poland	0.44%	0.48%	0.35%	1.62%	1.49%
South Africa	0.47%	0.45%	0.34%	1.90%	0.42%
Spain	1.98%	2.06%	2.54%	1.81%	2.73%
Sweden	0.80%	0.89%	1.32%	0.52%	0.40%
Switzerland	1.11%	1.04%	1.29%	0.12%	0.40%
United Kingdom	4.06%	4.07%	5.69%	4.54%	2.83%
United States	26.19%	26.05%	25%	11.10%	25.80%

NOTE: Empty cells indicate that the indicator does not apply in the case of that country (countries that have no PBR system).

TABLE 4: Financial Contributions at $248 million

Country/Region	GNP (1996)	GDP (1996)	FAO Scale (1998/99)	Agricultural Value Added (1996)	Value of Agricultural Production (1994-96)	PBR Registration by Residents (1996)	Commercial Seed Market (1998)
Angola	$26,211	$58,963	$24,800	$89,677	$139,487		
Algeria	$381,809	$401,303	$421,600	$1,133,486	$501,925		
Benin	$17,474	$19,361	$24,800	$159,851	$161,535		
Botswana		$43,122	$24,800	$37,477	$28,163		
Burkina Faso	$20,969	$22,001	$24,800	$167,308	$185,936		
Burundi	$9,611	$9,681	$24,800	$119,888	$126,412		
Cameroon	$73,391	$80,965	$24,800	$703,649	$318,503		
Cape Verde			$24,800		$3,943		
Central African Republic	$8,737	$8,801	$24,800	$107,077	$80,023		
Chad	$8,737	$9,681	$24,800	$96,752	$130,012		
Comoros			$24,800		$6,739		
Congo, Dem. Rep.	$49,801	$60,723	$24,800	$844,378	$644,611		
Congo, Rep.	$15,727	$20,241	$24,800	$43,978	$32,810		
Cote D'Ivoire	$82,128	$93,285	$24,800	$567,508	$622,282		
Djibouti			$24,800		$5,673		
Equatorial Guinea			$24,800				
Eritrea			$24,800		$25,769		
Ethiopia	$52,422	$51,923	$24,800	$620,473	$717,835		
Gabon	$38,443	$50,163	$24,800	$76,292	$20,700		
Gambia		$2,640	$24,800	$16,062	$13,357		
Ghana	$54,170	$55,443	$24,800	$530,031	$428,782		
Guinea	$33,201	$34,322	$24,800	$193,886	$135,866		
Guinea-Bissau		$1,760	$24,800	$20,651	$20,076		
Kenya	$76,012	$80,965	$24,800	$510,145	$550,868		
Lesotho	$11,358	$7,040	$24,800	$16,826	$18,749		
Liberia			$24,800		$26,715		
Madagascar	$29,706	$36,082	$24,800	$274,385	$366,944		
Malawi	$15,727	$19,361	$24,800	$168,264	$181,108		
Mali	$20,969	$22,881	$24,800	$238,629	$252,682		
Mauritania	$9,611	$8,801	$24,800	$47,802	$43,874		
Mauritius	$36,696	$36,962	$24,800	$80,308	$34,842		
Morocco	$304,923	$323,859	$74,400	$1,407,297	$734,350		$984,420
Mozambique	$13,106	$14,961	$24,800	$120,270	$191,810		
Namibia	$31,453	$28,162	$24,800	$85,662	$63,668		
Niger	$16,600	$16,721	$24,800	$141,686	$168,797		
Nigeria	$241,142	$280,736	$297,600	$2,622,812	$2,887,512		
Rwanda	$11,358	$11,441	$24,800	$99,429	$96,458		
Sao Tome			$24,800		$2,816		
Senegal	$42,811	$44,883	$24,800	$175,530	$182,718		
Seychelles			$24,800		$1,267		
Sierra Leone	$7,863	$7,920	$24,800	$75,719	$62,763		
Somalia			$24,800		$189,436		
South Africa	$1,157,658	$1,111,504	$843,200	$1,207,484	$1,333,337	$4,713,673	$1,045,946
Sudan			$24,800		$755,774		
Swaziland			$24,800		$35,083		
Tanzania	$45,433	$51,043	$24,800	$532,325	$582,210		
Togo	$11,358	$12,321	$24,800	$93,692	$80,868		
Uganda	$50,675	$53,683	$24,800	$536,532	$556,038		
Zambia	$29,706	$29,042	$24,800	$113,578	$108,810		
Zimbabwe	$59,412	$66,004	$24,800	$200,769	$256,505		
Africa Totals	**$3,096,407**	**$3,288,749**	**$2,777,600**	**$14,277,566**	**$14,116,442**	**$4,713,673**	**$2,030,366**
Australia	$3,213,483	$3,454,198	$3,918,400	$3,001,979	$3,172,180	$9,047,210	$3,445,470
Bangladesh	$272,596	$279,856	$24,800	$1,824,133	$1,742,525		$369,157
Bhutan			$24,800				
Cambodia	$27,085	$27,282	$24,800	$302,301	$220,878		
China	$7,916,632	$7,175,932	$1,959,200	$32,741,459	$49,739,278		$15,381,562
Cook Islands			$24,800				
Fiji			$24,800		$36,672		
India	$3,126,113	$3,132,980	$818,400	$19,059,700	$22,222,820		$5,537,362
Indonesia	$1,864,484	$1,987,154	$372,000	$6,907,994	$5,396,131		
Japan	$44,988,765	$40,479,684	$41,490,400	$17,590,068	$3,362,743	$32,387,492	$31,255,334

	GNP (1996)	GDP (1996)	FAO Scale (1998/99)	Agricultural Value Added (1996)	Value of Agricultural Production (1994-96)	PBR Registration by Residents (1996)	Commercial Seed Market (1998)
Kazakhstan	$193,962	$183,051	$496,000	$517,029	$1,059,532		
Korea, Dem. Rep.			$124,000		$550,788		
Korea, Rep.	$4,220,864	$4,265,605	$2,182,400	$5,560,736	$1,470,290	$76,027	
Lao PDR	$16,600	$15,841	$24,800	$178,971	$107,703		
Malaysia	$784,586	$873,010	$372,000	$2,465,830	$1,454,941		
Maldives			$24,800		$1,730		
Mongolia	$7,863	$7,920	$24,800	$53,347	$104,324		
Myanmar			$24,800		$1,254,320		
Nepal	$41,064	$38,722	$24,800	$353,354	$471,972		
New Zealand	$498,885	$572,913	$644,800	$622,385	$1,087,011	$5,169,834	$639,873
Pakistan	$555,676	$570,273	$148,800	$3,221,487	$3,691,767		
Papua New Guinea	$43,685	$44,883	$24,800	$253,543	$155,158		
Philippines	$727,795	$737,482	$148,800	$3,364,894	$2,196,352		
Samoa			$24,800				
Singapore	$812,545	$828,128					
Solomon Islands			$24,800		$12,512		
Sri Lanka	$117,950	$122,327	$24,800	$584,717	$342,040		
Thailand	$1,550,825	$1,628,093	$347,200	$3,891,100	$2,937,059		
Tonga			$24,800				
Vanuatu			$24,800		$11,366		
Vietnam	$191,341	$205,052	$24,800	$1,202,895	$2,118,079		
Asia & SW Pacific Totals	**$71,172,800**	**$66,630,386**	**$53,444,000**	**$103,697,921**	**$104,920,171**	**$46,680,564**	**$56,628,759**
Afghanistan			$24,800		$285,734		
Azerbaijan	$31,453	$31,682	$297,600	$158,321	$201,285		
Bahrain			$49,600				
Egypt, Arab Rep.	$561,792	$594,914	$223,200	$2,197,372	$1,847,352		$861,367
Iran			$1,190,400		$2,289,612		
Iraq			$372,000		$356,423		
Jordan	$62,033	$64,244	$24,800	$697,912	$115,951		
Kuwait		$234,093	$496,000		$14,202		
Kyrgyz Rep.	$21,843	$14,961	$74,400	$169,029	$184,045		
Lebanon	$105,718	$113,527	$24,800	$295,991	$139,367		
Libya			$520,800		$95,513		
Oman		$106,486	$99,200				
Qatar			$99,200				
Saudi Arabia		$1,111,504	$1,884,800		$412,206		
Syrian Arab Republic	$146,782	$154,009	$124,000	$535,385	$636,122		
Tajikistan	$17,474	$17,601	$49,600		$133,110		
Tunisia	$153,772	$171,610	$74,400	$522,000	$298,387		
Turkmenistan	$37,569	$37,842	$74,400		$247,110		
United Arab Emirates		$344,100	$496,000		$55,079		
Uzbekistan	$205,320	$221,773			$1,050,520		
Yemen	$52,422	$52,803	$24,800	$206,506	$127,156		
Near East Totals	**$1,396,179**	**$3,271,148**	**$6,224,800**	**$4,782,516**	**$8,489,173**	**$0**	**$861,367**
Albania	$23,590	$23,761	$24,800	$283,945	$130,616		
Armenia	$20,969	$12,321	$124,000	$117,785	$86,380		
Austria	$1,978,940	$1,989,794	$2,306,400	$864,646	$687,740	$836,297	$2,091,892
Belarus	$196,583	$169,850		$590,453	$940,282		
Belgium	$2,346,769	$2,326,854	$2,678,400	$505,556	$1,003,106	$836,297	$3,826,933
Bosnia and Herzegovina			$24,800		$88,130		
Bulgaria	$86,497	$82,725	$223,200	$179,736	$552,357		
Croatia	$158,140	$167,210	$248,000	$435,956	$212,248		
Cyprus			$74,400		$61,657		
Czech Republic	$427,241	$482,268	$669,600	$628,695	$803,329	$4,029,430	$1,292,051
Denmark	$1,475,686	$1,533,048	$1,909,600	$1,332,343	$1,128,914	$3,953,403	$1,673,514
Estonia	$39,317	$37,842	$99,200	$57,554	$89,920		
Finland	$1,040,581	$1,090,383	$1,636,800	$1,421,447	$364,007	$456,162	$984,420
France	$13,399,124	$13,553,658	$17,012,800	$5,889,615	$6,672,096	$32,387,492	$28,695,842
Georgia	$40,190	$37,842	$297,600	$287,769	$164,291		
Germany	$20,659,604	$20,709,349	$24,006,400	$4,499,527	$5,379,495	$24,328,633	$21,078,893
Greece	$1,048,445	$1,081,582	$1,016,800	$4,934,910	$1,104,573		$1,292,051
Hungary	$387,051	$394,263	$372,000	$599,631	$1,003,589	$1,064,378	$3,691,575
Iceland			$74,400		$11,909		
Ireland	$541,696	$612,515	$570,400		$696,632	$228,081	

	GNP (1996)	GDP (1996)	FAO Scale (1998/99)	Agricultural Value Added (1996)	Value of Agricultural Production (1994-96)	PBR Registration by Residents (1996)	Commercial Seed Market (1998)
Israel	$788,955	$808,766	$719,200		$305,488	$3,573,268	
Italy	$9,964,594	$10,628,370	$13,912,800	$6,927,688	$4,136,239		$9,881,115
Latvia	$49,801	$44,003	$223,200	$86,044	$141,881		
Lithuania	$74,265	$67,764	$223,200	$191,400	$289,294		
Luxembourg			$198,400				
Macedonia, FYR	$17,474	$16,721	$24,800		$93,481		
Malta			$24,800		$11,547		
Moldova	$21,843	$15,841	$223,200	$172,088	$279,900		
Netherlands	$3,517,532	$3,453,318	$4,216,000	$2,250,911	$1,986,336	$60,669,528	$11,320,830
Norway	$1,321,040	$1,388,720	$1,488,000	$603,455	$234,739	$76,027	
Poland	$1,089,509	$1,182,788	$868,000	$1,541,908	$3,114,607	$4,029,430	$3,691,575
Portugal	$881,567	$915,253	$744,000		$548,937	$228,081	
Romania	$316,281	$312,418	$396,800	$1,425,462	$1,540,959	$2,812,998	
Russia	$3,110,386	$3,877,503		$5,897,264	$7,947,639		
Slovakia	$159,014	$166,330	$223,200	$180,692	$359,863	$6,766,401	
Slovenia	$160,762	$162,809	$198,400	$176,868	$127,498		
Spain	$4,920,701	$5,118,374	$6,299,200	$3,336,212	$3,350,110	$4,485,592	$6,767,887
Sweden	$1,985,929	$2,201,886	$3,273,600	$956,809	$552,799	$1,292,459	$984,420
Switzerland	$2,740,809	$2,582,068	$3,199,200	$1,122,014	$426,348	$304,108	$984,420
Turkey	$1,550,825	$1,596,412	$1,016,800	$5,896,499	$3,852,558		
Ukraine	$532,086	$388,102		$1,096,200	$3,620,153		
United Kingdom	$10,065,944	$10,083,619	$14,111,200	$4,381,742	$3,158,179	$11,251,993	$7,013,992
Yugoslavia			$272,800		$820,227		
Europe Totals	**$87,139,740**	**$89,316,328**	**$105,226,400**	**$58,872,827**	**$58,080,052**	**$163,610,055**	**$105,271,410**
Antigua and Barbuda			$24,800		$1,127		$0
Argentina	$2,578,300	$2,592,629	$1,264,800	$3,379,808	$4,115,942	$4,181,484	$4,922,100
Bahamas			$49,600		$3,722		
Barbados			$24,800		$7,866		
Belize			$24,800		$17,119		
Bolivia	$55,043	$53,683	$24,800	$209,947	$296,798		
Brazil	$6,199,803	$6,590,698	$4,290,400	$20,047,485	$11,332,268		$7,383,150
Chile	$612,466	$652,997	$223,200	$709,385	$742,638	$532,189	$455,294
Colombia	$700,711	$749,803	$272,800	$2,606,559	$1,608,409		
Costa Rica	$79,507	$79,205	$24,800	$275,341	$262,761		
Cuba			$124,000		$378,149		
Dominica			$24,800		$4,184		
Dominican Republic	$111,834	$115,287	$24,800	$325,629	$267,468		
Ecuador	$152,898	$167,210	$49,600	$435,956	$618,641		
El Salvador	$86,497	$91,525	$24,800	$258,514	$149,244		
Grenada			$24,800		$2,072		
Guatemala	$139,793	$139,048	$49,600	$725,064	$321,943		
Guyana			$24,800		$45,161		
Haiti	$20,095	$22,881	$24,800	$208,800	$108,428		
Honduras	$34,948	$35,202	$24,800	$168,264	$191,569		
Jamaica	$35,822	$38,722	$24,800	$67,306	$73,043		
Mexico	$2,985,446	$2,945,529	$2,083,200	$3,199,880	$3,814,055		$2,153,419
Nicaragua	$14,853	$16,721	$24,800	$123,521	$117,882		
Panama	$71,644	$72,164	$24,800	$125,433	$105,913		
Paraguay	$80,381	$84,485	$24,800	$440,545	$454,430		
Peru	$512,864	$535,951	$148,800	$815,123	$624,696		
Saint Kitts and Nevis			$24,800		$1,207		
Saint Lucia			$24,800		$6,296		
Saint Vincent and Grenadines			$24,800		$3,279		
Suriname			$24,800		$17,360		
Trinidad and Tobago	$43,685	$47,523	$74,400	$20,651	$23,355		
Uruguay	$161,635	$159,289	$99,200	$311,479	$375,433		
Venezuela	$588,003	$592,274	$868,000	$514,734	$681,424		
Latin Amer & Carib Totals	**$15,266,230**	**$15,782,826**	**$10,093,600**	**$34,969,424**	**$26,773,880**	**$4,713,673**	**$14,913,962**
Canada	$4,979,239	$5,098,133	$8,233,600	$3,323,019	$4,045,333	$760,270	$4,306,837
United States	$64,946,785	$64,612,430	$62,000,000	$28,076,727	$31,574,948	$27,521,766	$63,987,298
North America Totals	**$69,926,024**	**$69,710,563**	**$70,233,600**	**$31,399,746**	**$35,620,281**	**$28,282,036**	**$68,294,135**
World Totals	**$248,000,000**	**$248,000,000**	**$248,000,000**	**$248,000,000**	**$248,000,000**	**$248,000,000**	**$248,000,000**

	GNP (1996)	GDP (1996)	FAO Scale (1998/99)	Agricultural Value Added (1996)	Value of Agricultural Production (1994-96)	PBR Registration by Residents (1996)	Commercial Seed Market (1998)
TABLE 4a: Financial Contributions at $248 million							
	GNP (1996)	**GDP (1996)**	**FAO Scale (1998/99)**	**Agricultural Value Added (1996)**	**Value of Agricultural Production (1994-96)**	**PBR Registration by Residents (1996)**	**Commercial Seed Market (1998)**
Africa	$3,096,407	$3,288,749	$2,777,600	$14,277,566	$14,116,442	$4,713,673	$2,030,366
Asia & SW Pacific	$71,172,800	$66,630,386	$53,444,000	$103,697,921	$104,920,171	$46,680,564	$56,628,759
Near East	$1,396,179	$3,271,148	$6,224,800	$4,782,516	$8,489,173	$0	$861,367
Europe	$87,139,740	$89,316,328	$105,226,400	$58,872,827	$58,080,052	$163,610,055	$105,271,410
Latin America & Caribbe	$15,266,230	$15,782,826	$10,093,600	$34,969,424	$26,773,880	$4,713,673	$14,913,962
North America	$69,926,024	$69,710,563	$70,233,600	$31,399,746	$35,620,281	$28,282,036	$68,294,135
NOTE:	Empty cells indicate either that no data is available for the country, or that the indicator does not apply in the case of that country (countries that have no PBR system).						