South-North Trade, Intellectual Property Jurisdictions, and *Freedom to Operate* in Agricultural Research on Staple Crops

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Abstract

A biotechnology revolution is proceeding in tandem with international proliferation of intellectual property. Does the intellectual property impede agricultural research conducted in, or of consequence for, developing countries? This question has important spatial dimensions that link the location of production, the pattern of international trade, and the jurisdiction of intellectual property. Our main conclusion is that the current concerns about the *freedom to operate* in agricultural research oriented towards food crops for the developing world are overblown. Rights to intellectual property are confined to the jurisdictions where they are granted, and, presently, many of the intellectual property (IP) rights for biotechnologies potentially useful to developing-country agricultural producers are valid only in developed countries.

IP problems might arise in technologies destined for crops grown in developing countries unencumbered by IP restrictions, if those crops are subsequently exported in a form in which infringement is detectable to countries in which IP is likely to prevail. Thus freedom to trade is also part of the IP story. However, using international production and trade data in the 15 crops critical to food security throughout the developing world, we show that exports from developing to developed countries are generally dwarfed by production and consumption in the developing world, the value of these exports is concentrated in a few crops and a few exporting countries, and the bulk of these exports go to Western Europe. Thus LDC researchers can focus on domestic IPR in determining their freedom to operate with respect to food staples.

Undue concern with current freedom to operate is diverting attention from the lack of financial and technical support necessary for the effective generation, evaluation, adaptation, and regulation of newly available technologies by public and international nonprofit breeders, given the continued inability of private-sector research to fill the gap.

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1. Introduction

A landmark in the 10,000-year history of agriculture was the Green Revolution—a revolution in agricultural production that took hold in the 1960s giving rise to unprecedented increases in the yields and production of basic food grains worldwide and a commensurate decline in the price of food despite continued population increase. The technologies of improved wheat and rice and other cereals that led to these global gains came from a whole host of sources, including the international agricultural research centers collectively known as the Consultative Group for International Agricultural R&D (CGIAR, or CG for short) and national research agencies in developed and developing countries alike. Improved varieties or breeding lines developed in one location spilled over to researchers and farmers working in other locations. Most of the relevant research was paid for and conducted by public agencies, and the technologies and the seeds that embodied them were largely unencumbered by intellectual property (IP) concerns.

The science of agriculture, like the biological and medical sciences more generally, has undergone a sea change in the past few decades. The private sector has become the leader in application of modern methods of genetic transformation which combined with new information (or bioinformatics) technologies, have opened up entirely new prospects for advances in the function, form, and performance of crops and livestock.

Though the recent achievements in biotechnology of the private sector are widely recognized, many are now concerned about farmers and consumers in the developing world. In agricultural biotechnology, the most visible and controversial field of agricultural research, the portion of the key technology that is protected as intellectual property is highly concentrated in the hands of a small number of large, multinational corporations based in North America and Western Europe.[1] A similar pattern characterizes global technological innovation in general. A preponderance of the world's

[1] See http://www.cambia.org/

technology innovations take place in developed countries of the North, which is inhabited by about 15 percent of the world's population.[2] Many worry that a lack of capacity to adopt modern technology will isolate a significant portion of the world's population from the benefits of important innovations. According to Sachs (2000, p.81), about "one third of the world's population is technologically disconnected, neither innovating at home nor adopting foreign technologies."

Whatever the merits of Sach's argument for other sectors, it is negated by the history of agricultural development. Over the past four decades, large parts of the putative "technologically isolated" developing world have adopted improved crop varieties and other complementary technologies, often via adaptive innovation complementary to the work of developed-country researchers and the breeding efforts of international agricultural research centers. Moreover, the new technologies are eminently adaptable. Indeed, basic agricultural biotechnology is itself largely generated from research directed at human health, which itself is heavily subsidized in leading developed countries. Although absorptive capacity in LDCs is (and has been) a serious issue, a system of international and national agricultural research centers has bought about benefits from genetic improvements for the vast majority of poor consumers.

Within the worldwide agricultural research community, attention is focusing on another challenge to the continued effectiveness of technology adoption via public agricultural research. The very intellectual property rights that have been associated with the surge of private research in biotechnology now threaten to block access to new developments to public and nonprofit researchers. This problem, a manifestation of the "tragedy of the anticommons" (Heller and Eisenberg 1998), plagues not just agriculture, but the much larger health sciences sector (see, for example, NIH 1998).

In agriculture, a major difficulty is that even in developed countries, the now-dominant private-sector research efforts are concentrated on a small number of crops with high commercial value. In the foreseeable future, the vast number of other crops must rely on public and nonprofit institutions as the principal source of genetic innovations. These institutions in developed countries increasingly find their access to essential

[2] This area includes Japan, Korea, Taiwan, Australia, and Israel, in addition to Western and Northern

innovative inputs uncertain, unduly expensive, or, in some reported cases, blocked altogether (Wright 1998, Lindner 1999, Erbisch 2000).

Given the minor role of the crops involved, this problem in the North is a source of aggravation and inefficiency, but is no way a serious threat to the well being of consumers. But there is understandable concern in the international research and donor communities that the problems with access to intellectual property experienced in the North constitute a serious threat to the supply of food and fiber to the poor in the South. Much of the world's poor rely for sustenance on crops such as rice, beans, and cassava, which are large in caloric output but largely beyond the focus of the private research sector, and low income elasticities mean that future commercial prospects are modest. The fact that there have been some well-publicized "donations" of "intellectual property" by major multinational corporations to less-developed countries for certain non-commercial crops has not only highlighted the usefulness of these technologies, but reinforced the impression of a general lack of access to modern technological opportunities for these crops.

The CGIAR and other international and local agricultural research organizations are still supporting and conducting agricultural R&D geared towards poor farmers and consumers, as they did during the Green Revolution. However, the research budgets of many of these agencies are now dwarfed by those of the major corporations in the field. Major donors have expressed the need for the CGIAR and other international and local agricultural research organizations to negotiate with major corporations to gain access to the toolbox of enabling technologies for use in agricultural research conducted in or for less-developed economies. A survey (Cohen et al. 1998) shows fairly widespread use by CGIAR Centers of "protected" intellectual property, in many cases without formal authorization from the patentees. While confirming the extent of international researchers' involvement in the use of biotechnologies, this study also created a sense of urgency regarding the regularization of licensing or other IPR transfer arrangements, at least partly due to confusion regarding the relevant intellectual property rights at the Centers.

Europe, the United States, and Canada. This information is based on data from 1997 (Sachs 2000).

In this paper, we argue the concerns in LDCs about current access to essential intellectual property are overblown and misdirected. International and national agricultural research centers have far greater freedom to operate in agricultural research oriented towards food crops for the developing world than commonly perceived. They are generally able to operate in regions where most modern technologies are unprotected by intellectual property rights. Production in the South of a crop protected only in the North is both legal and moral per se. This point is broached by Barton and Strauss (2000) and is the main force of RAFI (2000). IP is primarily based on national laws. However, if there is significant international trade in agricultural commodities and/or international transfer of the technologies used in their production, identification of valid intellectual property concerns becomes more complex. Thus, the spatial aspects of IP are pivotal to the freedom to operate in agricultural research, and in this paper, we focus on these spatial aspects.[3]

2. Intellectual Property and Agricultural Biotechnologies

Economists, policymakers and even many biotechnologists are largely unfamiliar with the legal aspects and practice of seeking and using rights over IP. To set the stage for analysis of policy concerns noted above, we lay out below the basics of IP rights from a legal cum economic perspective, highlighting the primary forms used to protect agricultural biotechnologies.

Introduction to Intellectual Property

Intellectual property rights are rights to products of the mind—ideas and the way they are represented—be they artistic, scientific, technological, or economic products, that may be afforded legal protection. Such things as inventions, computer programs, publications, videotapes, and music are intellectual properties. Intellectual properties can be protected by means of copyrights, trademarks, utility patents, plant patents, plant breeder's rights, and trade secrets.[4]

[3] The trade-related spatial issues discussed here were addressed in a pilot study with less comprehensive data by Binenbaum and Wright (1998).
[4] Other forms of intellectual property protection, such as design patents, are not dealt with here.

A utility patent, often referred to simply as a "patent," is awarded for inventions of machines, compositions, and processes.[5] In agricultural biotechnology, patents may cover, for example, plant transformation methods, vectors, genes, transgenic plants, and the like. For plant breeding materials, protection may be obtained under two significantly different regimes: plant breeders' rights, and, in some jurisdictions, the regular patent system. Plant variety protection is an example of so-called *sui generis* rights: that is, rights designed for a specific field of technology. Plant breeders' rights are harmonized internationally through the UPOV Convention (the International Union for the Protection of New Plant Varieties—which is signed by 46 countries, most recently China, Brazil, Bolivia, Estonia, Kenya, Kyrgyz Republic, Panama, and Slovenia).

IP rights have a number of dimensions that are relevant here, including the requirements for obtaining the rights, the scope of what is protected, the geographical limits to the rights, and the duration of the rights. These dimensions vary according to the type of IP, and the legal and administrative system of each country.

Rationales for granting IP rights include stimulation of new innovations, the provision of incentives for disclosure of new knowledge, ethical considerations of entitlement, and the reduction of transaction costs through clarification of rights. Of these rationales, the provision of incentives is perhaps the most important. In the absence of IP protection, new ideas and information that are disclosed are entirely in the public domain. Attempts to benefit commercially from a patented innovation—or at least recoup the necessary investments—may fail due to imitation. Knowing this, prospective inventors may underinvest in R&D. Moreover, where possible, inventors may exploit their inventions in secret. Thus, IP rights are designed to encourage innovation in two ways. First, they provide incentives for the generation of new ideas. Second, they stimulate further advancements through the dissemination of new ideas by way of publication, licensing, or other means.

[5] The authority for the U.S. patent system is enshrined as article 1, section 8 of the U.S. constitution ratified in 1788. Specifically, section 8, clause 8 of the U.S. Constitution states that Congress shall have power "To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries." Some European countries had patent protection many years earlier than that. (For example, the United Kingdom, which has the longest continuous patent tradition in the world, granted its first patent in 1449.)

Forms of Intellectual Property Protection Used in Plant Breeding

In plant breeding, patents and plant breeders' rights are the most relevant forms of IP protection. Increasingly, bioinformatics databases are important elements of the currently unfolding biotechnology revolution. Hence, copyrights—often applicable to databases and software—are likely to become increasingly important in the biotech sector. They do not, however, affect trade in products embodying the protected information. U.S. state trade secret laws have also been used to protect in-house breeding materials such as the inbred lines of maize used as parents of hybrids. However, trade secret law does not provide protection against independent discovery or reverse engineering of products by their purchasers. Hence, patents afford stronger protection than trade secret law for innovation embodied in products (Besen and Raskind 1991). Trademarks are used for the protection of certain names of biotechnologies, such as Monsanto's Roundup Ready™ technology or Aventis's Liberty® and LibertyLink® technologies. Trademarks protect only names and other symbols denoting products or technologies. They do not protect the technologies themselves. While they do not constitute a major impediment to the freedom to operate, they may be important elements of private commercialization strategies.

As patents are the most critical form of protection for agricultural biotechnology and have the most effect on the freedom to operate, the majority of the following discussion focuses on them. In addition, we deal briefly with plant breeders' rights.

Patents. The patent right is generally considered to be the most powerful in the IP system, enabling the patent holder to exclude all others from making, using, selling or offering to sell the invention in the country that granted the patent right, and importing it into that country[6] for as long as the patent remains valid.[7] In order to be patentable, an invention must satisfy certain criteria of novelty, non-obviousness, and utility or industrial application. In addition to these requirements, the inventor(s) are required to disclose the subject matter to the public in a manner sufficiently clear and complete for

[6] Article 28.1 of Trade Related Aspects of Intellectual Property (TRIPs) Agreement. This and all subsequent references to TRIPs legal articles are taken from GATT (1994).

the invention to be carried out by a person skilled in the art.[8] Thus, the granting of a patent is often characterized as being essentially an exchange between the authorities and the patentee: in return for an exclusive right of limited time, the patentee shares detailed information about the invention itself with the public. The policy driving this exchange is to promote advancement of technologies and arts through that disclosure. Some, economists among them, pay more attention to the role of the patent in encouraging innovation, which, if successful, usually furnishes a social purpose even in the absence of disclosure.

Over time, the scope of patent protection has gradually been expanded to include inventions involving living things. In the United States, the first steps in this direction were taken in 1930 with the passage of the Plant Patent Act, which protected asexually reproduced plants via an independently administered system. The scope of patentable subject matter was further expanded in 1980 to encompass genetically engineered organisms. In 1980, in the seminal case *Diamond v. Chakrabarty*, the United States Supreme Court held that such life forms are patentable.[9] Although the bacterium at issue in *Diamond v. Chakrabarty* was never commercialized, this ushered in a new era for utility patenting of life forms. Under the 1994 TRIPs (Trade Related Aspects of Intellectual Property) Agreement, patents are available for any invention,[10] whether products or processes, in all fields of technologies; members are allowed to implement only limited exclusions, including methods of treating humans and plants and animals other than microorganisms.

Under TRIPs, the status of plants as patentable subject matter is unclear and controversial. A member may exclude from patentability "plants and animals other than

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[7] "The term of protection available shall not end before the expiration of a period of twenty years counted from the filing date." Article 33 of TRIPs Agreement. See also Gutterman and Anderson (1997, p.61, n.36).

[8] Article 29 of TRIPs Agreement.

[9] 447 U.S. 303 (1980). The invention was a bacterium engineered to contain a gene whose product degraded oil and was believed to have significant value for treating oil spills. Notably, the original patent application was filed in 1972 and rejected. It was then appealed to the Patent Office Board of appeals who affirmed the rejection. The next appeal was to the Circuit of Customs and Patent Appeals (CCPA, now the Federal Circuit) who reversed the Board's decision. Finally, the Patent Commissioner sought certification with the Supreme Court who affirmed the CCPA's decision. The patent (U.S. patent no. 4259444) was issued on March 31, 1981.

[10] Article 27 of TRIPs Agreement.

micro-organisms, and essentially biological processes for the production of plants or animals other than non-biological and microbiological processes."[11] Protection of plant varieties, however, must still be provided "either by patents or by an effective *sui generis* system or by any combination thereof."[12] While many member countries of the WTO are still in the process of implementing a protection system for plants, the United States and Europe have led the way in allowing utility patents for plants and particularly for transgenic plants. In 1985, the United States Patent Office Board of Appeals ruled that asexually and sexually propagated seeds, plants, and tissue culture could be protected by utility patents.[13] More recently, the European Patent Office has held that transgenic methods and plants are not per se unpatentable.[14]

Plant breeders' rights and plant variety protection certificates. Plant breeder's rights (PBRs), or plant variety protection, is a traditional form of IP protection for plants, which has been codified in most developed countries and increasingly in less-developed countries. While there are differences between countries in implementation of PBRs, generally the laws grant protection to varieties that are novel, distinct, uniform, and stable. Thus, the variety must not have been previously sold, be clearly distinguishable from previous varieties, be uniform and breed true to type.

The holders of a plant breeder's right have a legal monopoly over commercialization of their varieties for a prescribed length of time, allowing the recovery of the cost of breeding commercially valuable new plant varieties.[15] Although the details of protection vary from country to country, in general, the sale, reproduction, import, and export of new varieties of plants are encompassed. Exceptions may be made, however, for both research and use of seed saved by a farmer for replanting. Moreover, in some countries, if a protected variety is used as the basis for genetic engineering, the engineered variety may not be used without permission (e.g., licensing) of the holder of the plant breeder's right.[16]

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[11] Article 27(3)(b) of TRIPs Agreement. This article is currently under review by members of the WTO.
[12] *Ibid*
[13] *ex parte* Hibberd, 227 U.S.P.Q.2d 443 (Pat. Off. Bd. App. 1985).
[14] European Patent Office, case number G 0001/98.
[15] See Alston and Venner (2000) for an analysis of the effects on private plant breeding of the 1970 U.S. Plant Variety Protection Act.
[16] UPOV Convention, 1991 Act. Details available from UPOV (2000).

Contractual and technological tools used to protect proprietary material. In addition to the legal protection afforded by patents, plant breeders' rights, trademarks, and so on, contractual provisions may be used to extend or establish IP rights, such as providing reagents under a restrictive technology transfer agreement. Such contracts include: *material transfer agreements* between technology developers and third-parties, which limit the transfer and use of materials such as vectors, genes, and plants developed by the transferor; *bag label contracts* between the manufacturer and the buyer of, for example, seed, which limit further uses of purchased material that would otherwise be allowable; *technology use agreements* between technology suppliers and farmers, which typically control the right to plant a given seed on a specific area of land for a certain period of time; and *licenses* between patent or property holder and licensee, which are negotiated grants of some or all of the holder's rights, such as allowing the use and sale of the technology.

Some genetic technologies impose technical limits on farmers' use of seeds from their harvest to replant or to sell for replanting. The most common is production of hybrid crops that generally have a lower yield through loss of "hybrid vigor" if replanted. Modern alternatives include genetic use restriction technologies (GURTS) that confer sterility on replanted seeds and are called varietal GURTS—popularly dubbed terminator technologies—, or that control the expression of specific traits in seeds, called trait-GURTS (CBD/SBSTTA 1999).

Infringement and the Freedom to Operate

Infringement and remedies. The nature of the patent system in the North makes it important for plant breeders to pay close attention to *freedom to operate* in order to avoid *infringement*. Infringement of a patent involves the unauthorized making, using, selling, or offering to sell the patented invention within the territory that granted the patent, or importing the patented invention into that same country during the term of the patent.[17] The patent right is *exclusionary*, and the patentee must know of the alleged infringement if she is to defend her right. Her first action upon identification of an alleged infringer is

[17] Furthermore, TRIPs allows a patent owner to prohibit importation of products made by processes patented in the importing country. Article 28.1(b) of TRIPs Agreement.

typically to inform him of her patent rights, and either offer to negotiate a license, or ask that the infringement cease. If unsatisfied by the response, the patentee can sue for relief in the appropriate court. The patentee may ask the court for an injunction to prevent the continuation of the infringement and may also ask the court for an award of damages.

In an infringement suit, the defendant may raise the question of the validity of the patent, which is then decided by the court. The defendant may also argue that what is being done does not constitute infringement. Infringement is determined primarily by the language of the claims of the patent. If what the defendant is making does not fall within the language of any of the claims of the patent, there is no infringement.

It can be extremely costly to pursue or defend against a claim of infringement. In the United States, where each party pays its own costs (other than in exceptional circumstances), a minimum estimate for litigation is $500,000, and cases often cost each party several million dollars net of any damages awarded.[18] Thus, the stakes are high and it behooves a manufacturer to avoid infringement. Unfortunately, in agricultural biotechnology, this can be difficult, as the number of patents is rapidly increasing, and the breadth of claims of some patents, the existence of patents with conflicting claims, and the slow pace of legal resolution of validity combine to make practice of basic technologies difficult, or at least legally hazardous, especially in the United States. In Europe, as well as some other countries, the validity of a patent grant can be challenged within the European Patent Office, but only for a limited time after the patent is allowed.[19] This procedure, known as an *opposition*, is an *inter partes* proceeding between the patentee and the challenger. The United States patent law does not allow opposition, but instead has a limited reexamination proceeding, which reexamines the patent only with regard to prior art not considered during examination.

The freedom to operate. There is a tension inherent in IP between its rationale—the provision of incentives for the development and dissemination of new

[18] Lerner (1995, p. 470) reports that for every 100 United States biotechnology patents, there are six patent suits, an extremely high figure relative to other areas of technology. He further estimates that patent litigation in the U.S. Patent Office and the federal courts initiated in the year 1991 lead to total legal expenditures of $1 billion 1991 U.S. dollars, compared with U.S. $3.7 billion spending by firms on basic research in that year. Note that the cost figure excludes litigation in state courts.

[19] In Europe the opposition period is nine months after grant.

technology—and the freedom to operate. The broader the monopoly rights conferred by IP, the larger the potential threat to the freedom to operate of innovators.

Assuming key technology is subject to a valid IPR in the jurisdiction in question, there are, broadly speaking, two kinds of obstacles to the freedom to operate. First, owners of technology may be unwilling to share or license it, or only do so after costly negotiations. Thus, it may be difficult to obtain essential research inputs. Second, owners of technology may litigate against alleged infringers, forcing the latter to incur the cost of assessed damages, and, in at least some European countries (e.g., United Kingdom), the patentee's legal defense if found to be infringing. In other jurisdictions, including the United States, even a victorious litigant usually has to pay her legal costs. Thus, prospective inventors must beware of IP claims on which their research inputs, processes, or research outputs might infringe or be alleged to infringe. These two kinds of obstacles are often closely connected. A tradeoff may occur between them: prospective technology users may have to weigh the risk of litigation against the costs or difficulties of obtaining licenses.

The diversity of innovations utilized in developing modern cultivars (cultivated varieties) can result in a balkanization of technologies due to conflict between the many competing parties holding rights—be they patents or assigned use rights via commercial contracts or licenses—to these technologies. This balkanization can seriously threaten to hinder subsequent innovation. Furthermore, as patenting becomes even more prevalent in biotechnology, the number of separate rights needed to produce a new innovation proliferates. If ownership of these rights is diffuse and uncertain, the multilateral bargaining problem can become difficult if not impossible to resolve. This is the "tragedy of the anticommons" noted by Heller and Eisenberg (1998).

The tragedy of the anticommons can be seriously compounded by uncertainty. Those who develop new technology, building on existing technologies, often know neither the extent to which the latter have been claimed as IP, nor the strength of any claims. The conduct of R&D and subsequent commercialization entail navigating a potential minefield of patent applications that have been filed but remain invisible pending publication by the patent office.[20] Public breeders in the United States received

[20] Such patents are sometimes called *submarine patents.*

a nasty surprise when a patent issued to Monsanto on the CaMV 35S promoter surfaced after they had used it in the breeding of crop cultivars on the brink of commercialization. More generally, individual inventors in the United States such as Jerome Lemelson became notorious for continuing prosecution of patent applications for long periods of time as others became locked in to their technology, then extracting large rents from infringements after the patent was issued.[21] The uncertainty emanating from submarine patents is becoming less important for those engaged in research elsewhere, as the United States has harmonized with the rest of the world by awarding a patent term of 20 years from the date of filing (previously 17 years from the date the patent was awarded) as well as beginning in November 2000 publishing patent applications within 18 months of filing. Publication may be excepted by petition, but only if the application is not the basis for an application filed in another country that does publish applications.[22]

IP strategies in light of the freedom to operate. The concept of freedom to operate is fundamental to the effective development and commercialization of any innovation and is particularly crucial in agricultural biotechnology in light of recent developments. Research providers and commercial entities need to be able to conduct their business without infringing on rights held by others. It should never be assumed that a license to use critical enabling technologies would be made available. If a research program or commercialization proceeds under the assumption that its implementation will ultimately be allowed, future negotiations may be placed in serious jeopardy. The negotiating position of the innovator typically deteriorates as innovation progresses.

In some situations, companies or public institutions controlling the IP rights may adopt a policy of not granting a license and instead retain the sole right to the use of the technology for commercial development or license it exclusively to an entity that will not grant others a license. Research licenses may be relatively easily obtained, but licenses to commercialize research outcomes can be more difficult to acquire; for example, IP owners may seek unreasonable or commercially unacceptable terms. Such companies

[21] This scenario could generally only be enacted in the United States, which does not allow public access to on-going patent prosecution; until 1 November 2000 did not publish patent applications; and prior to 7 June 1995 awarded patent terms for 17 years commencing from the date of issue.

[22] Some exceptions to publishing are allowed in the United States, but are not expected to have a major impact in agricultural biotechnology.

have the power to block the commercial applications of the technology by their competitors or their acquisition targets. For instance, the Centre for Legumes in Mediterranean Agriculture (CLIMA) in Australia developed a transgenic lupin cultivar with tolerance to the herbicide Basta,® but have been unable to reach agreement with AgrEvo to commercially release the plant (Ewing 2000). Likewise, researchers at Michigan State University developed a new turf grass containing a proprietary gene from one company and a promoter from another. Neither company would give permission for its material to be used in conjunction with that from another company, and so the turfgrass has been destroyed (Erbisch 2000).

Thus, where key technology is covered by IP rights, the commercialization of most biotechnology-based developments of value may be difficult or impossible. As indicated above, much of the key technology is owned by multinational companies, and in many cases, licenses on these technologies are not being provided or are not offered with acceptable conditions. With respect to the small set of commercially important crops, such behavior might reflect aggressive business strategies being used by these private corporations, for whom controlling equity is the main consideration, rather than license revenue *per se*. For the vast majority of crops that constitute less attractive technology markets, withholding a license might imply a reluctance to expose the IP holder to liability for damages or to hazards to its reputation.

The international dimension of intellectual property[23]

It is vitally important to keep in mind that there is no such thing as an "international intellectual property right." A patent or other IP right awarded in one country, for example the United States, does not confer property rights in the rest of the world. Patents and other IP rights are awarded by national governments, and the protection conferred extends *only* as far as the geographic boundaries of the country in which the

[23] Sources used in compiling this subsection include Gutterman and Anderson (1997), Barton (1998), Chisum and Stuart (1998), Walden (1996), and Long and D'Amato (2000).

right is awarded. Thus, to obtain protection in several countries, rights must be applied for and awarded in each.[24]

International treaties and organizations do, however, play an important role in IP rights. The primary purposes of international treaties on IP are to facilitate obtaining protection in multiple countries and to provide a uniform, minimal set of laws and standards in subscribing countries. Through treaties, countries may commit themselves to future changes in their laws and possible deadlines for implementing those changes.

International treaties on IP date back to the 19th century. The Paris Convention (1883) for the Protection of Industrial Property, which covers trademarks, patents, and trade secrets, and the Berne Convention (1886) for the Protection of Literary and Artistic Works, which covers copyrights, are still relevant to IP, although both have been revised and supplemented by later treaties. These treaties are now administered by the World Intellectual Property Organization (WIPO), a specialized agency of the United Nations. The international trade aspects dealt with in this paper mean that a number of more recent treaties are also noteworthy: The International Convention for the Protection of New Varieties of Plants (known as the "UPOV Convention," after a French acronym) of 1961 (revised in 1978 and 1991); the European Patent Convention (1977); the Patent Cooperation Treaty (1978), supplemented by the Patent Law Treaty (2000); the Convention on Biological Diversity (Biodiversity Convention, 1992), and the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPs 1994).

The European Patent Convention (EPC) established the European Patent Office (EPO), which now coexists with national patent offices. Persons wishing to acquire a patent for member states of the European Union may apply for national patents either through the EPO or through Patent Offices in the individual countries. Once granted, the "European patent" can take effect as a national patent in all or a designated number of member states upon registration, payment of fees, submission of appropriately translated documents, and miscellaneous other formalities. Any infringement of the European

[24] Regional patent offices, such as the European Patent Office (EPO), serve to streamline the patent procedure. To be valid in individual European countries, a patent awarded by the EPO must be registered in each country, although it does not undergo further examination.

patent is thereafter dealt with by the national courts.[25] For this reason, a European patent, though granted by the EPO, is not truly an international patent, but rather a bundle of national patents.[26]

The Patent Cooperation Treaty (PCT) is a special agreement under the Paris Convention among some 108 members of the Convention. The Paris Convention provides for the equal treatment toward nationals among member states with respect to patent rights. The PCT permits an applicant to make a single filing of a patent specification, which usually 20 to 30 months later is processed in designated countries according to their national procedures and criteria for granting or rejecting a patent. At the time of conversion, filing fees must be paid in each country. In summary, the PCT facilitates patent applications in multiple countries, but does not furnish an international patent. Recently, member states of the World Intellectual Property Organization have adopted by consensus an international treaty that will simplify and streamline procedures for obtaining and maintaining a patent. The Patent Law Treaty (PLT), which has been opened for signature, will enter into force once ten countries have ratified it.[27] The PLT achieves a major goal of international simplification by incorporating the requirements for PCT international applications into national and regional laws. Thus, under the PLT, the requirements and procedures for national and regional patent applications, and those for PCT international applications, will be harmonized. This will eventually lead to standardized formal requirements and streamlined procedures for all patent applications worldwide.

The Convention on Biological Diversity (CBD) also contains some provisions on IP rights, although the main aims of the CBD are conservation of biological diversity, sustainable use of its components, and the fair and equitable sharing of the benefits

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[25] EPC, Article 64.

[26] The filing in the EPO can be made in German, French or English. The filing fee depends in part on how many EP countries are designated. Annuities are paid to the EPO while prosecution is on-going. Once the grant is made and the patent is registered in the individual countries, the applicant pays annuities to each country. Also translation is made at the time of registration—Danish for Denmark, and so on. The fees are ever increasing; that is, the early years are comparatively inexpensive, but increase over time.

[27] See the WIPO website: http://www.wipo.int/news/en/index.html?wipo_content_frame=/pressroom/en/index.html, Press Release PR/2000/224,Geneva, June 2, 2000. See also *The Economist*, June 17, 2000.

arising out of the utilization of genetic resources.[28] In particular, Article 16(5) recognizes that intellectual property rights may have an influence on the implementation of the CBD and further obliges member states to cooperate in order to ensure that IP rights are "supportive of and do not run counter to" the objectives of the CBD. So that Parties can gain access to technology, member states must take appropriate measures, which furthermore are consistent with international law and are mutually agreed upon.[29] Essentially, the CBD preserves the rights of intellectual property owners as they are defined in international law, such as TRIPs.

Although aspects of IP protection may vary among countries, the TRIPs Agreement sets out minimum standards that each country belonging to the World Trade Organization (WTO) must implement. These standards have been discussed above. One of the most critical provisions, Article 27(1) of TRIPs, requires member states (about three-quarters of the world's countries) to allow patents for any inventions, "whether products or processes, in all fields of technology…." While this Article settled the long-standing conflicts over pharmaceutical product patents, Article 27 has created new complications regarding protection for biological matter and agricultural biotechnology in particular. The complications arise from the vagueness of Article 27(1) and exceptions to patentability allowed under Articles 27(2) and (3).

Because TRIPs does not define the term "invention," countries can determine that biological matter, such as genes, are merely a "discovery" and not an invention. Indeed, some countries are implementing legislation along these lines.[30] In addition, exceptions are allowed in order to protect *order public*; human, animal and plant life; and avoid serious harm to the environment.

More importantly, Article 27(3)(b) allows members to exclude from patentability "plants and animals other than micro-organisms as well as essentially biological processes for their production". The breadth of this exception is hotly debated, and the Article is under review by WTO member states. Thus, there is much uncertainty about

[28] Article 1, Convention on Biological Diversity. Details from UNEP (2000).
[29] Article 16(3) and 16(4).
[30] Decision 486, Article 15, promulgated by the Andean Community (Bolivia, Columbia, Ecuador, Peru and Venezuela) deems that biological material that exists in nature or can be isolated from any life form is not an invention (Commission of the Andean Community 2000).

what biological matter can be excluded. Although members are not required to allow plants to be patented, they must nevertheless provide protection of plant varieties, either by patents or by an "effective *sui generis* system" or by combination of both systems. This is a major change for most developing countries, which previously did not provide protection for plant varieties.

Much has been written about what constitutes an effective *sui generis* system and the latitude that countries have in determining the scope and content of the rights to be granted (see, for example, Leskien and Flitner 1997). Such a discussion is beyond the scope of this paper. Suffice it to say that while plant protection systems are relatively well established in developed countries, lesser-developed countries are currently struggling with how to comply with this provision of TRIPs. Because developing countries are unlikely to implement patent protection for plants, there will likely be a great deal of variability in rights accorded in each country.

A number of countries, mostly developed countries however, have subscribed to a particular *sui generis* system, the International Convention for the Protection of New Varieties of Plants (UPOV). The rights accorded under UPOV extend not only to the plants but also to plant parts, harvested materials, and "essentially derived variet[ies]".[31] Moreover, in the 1991 Act, the "farmers' exemption" that allows farmers to save seed for re-propagation is not required to be implemented by member states, but may be established.

Thus, it appears that in the fields of agriculture and agricultural biotechnology the type and scope of protection will vary greatly from country to country, and especially from North to South. Overall, this makes it more difficult to assess freedom-to-operate on an international level.

The Freedom to Operate in Agricultural R&D for Developing Countries

There is widespread misunderstanding regarding IPR and freedom to operate in developing countries. A survey (Cohen et al, 1998) of the use of proprietary biotech research inputs at selected CGIAR Centers showed considerable confusion on the part of researchers regarding the existence of relevant IPR and freedom to operate. The report

itself does not distinguish local validity of IPR from existence of IPR in some jurisdiction. As emphasized above, patents are valid only in countries in which they are issued.

Many current key technologies for plant breeding appear to be unprotected in developing countries. For example, in the case of plant transformation technology, particle bombardment technology appears to be controlled primarily by Monsanto/Agracetus and Dupont, with a complex web of cross-licensed partners. The key *Agrobacterium* technology for plant transformation is more diversely held in different implementations by numerous patents applied for, and patents awarded in different jurisdictions (United States, Europe, Australia, Canada, and Japan) to Monsanto, the Max Planck Institute, AstraZeneca/Mogen, Novartis, Japan Tobacco, and many others. The most widely used selectable markers for cereal transformation are controlled by Aventis/AgrEvo (phosphinothricin, Basta®); Monsanto (a particular implementation of the kanamycin resistance gene or G418 under control of CaMV 35S or 19S promoters); or Novartis (hygromycin resistance), which is patented or pending in Australia, Canada, Europe, the United States, Hungary, Ireland, Russia, Japan, Israel, Greece, and Denmark.[32] Possibly the most widely used promoter is the CaMV 35S promoter, which intellectual property is owned by Monsanto. Patents have been granted *only* in the United States and Europe,[33] and the only pending application is in Japan.[34] Patents in the United States claiming portions of the CaMV 35S promoter are held by Rockefeller University. Thus, there are no restrictions in less-developed countries on the use of these commonly employed genes.

The freedom to operate in R&D depends on choices—especially those concerning litigation, threats of litigation, and the grant or sale of use rights—made by owners of relevant proprietary technologies. In addition to IP laws, the incentives that shape these choices are affected by an array of factors, some of which are biosafety regulations, public relations, implementation of laws, and market characteristics. Biosafety

[31] Article 14, UPOV 1991.
[32] The filings were made in 1982-83 when neither Greece nor Denmark was part of the European Patent Office.
[33] European Patent EP 131 623 B2 and United States Patent Nos. 5,034,322, 5,352,605, and 5,858,742.

regulations are closely related to IP in biotechnology. In particular, in some countries official approval is required for the use, sale, and/or importation of transgenic crop or animal varieties. Just like IP or any other laws, biosafety regulations are primarily national in nature, while being affected by international treaties.[35]

Due to consumer resistance to agricultural biotechnology, the degree of which varies considerably among different countries, public relations are a serious issue for multinationals active in the field. For instance, a multinational may be reluctant to litigate against a nonprofit research agency for fear of damage to its public image and to its relations with governments and lawmakers of developing countries. In particular, multinationals will try to avoid being seen as obstacles to applications of technologies that benefit poor farmers and consumers. However, it would be a serious mistake to rely on such forbearance as a matter of policy, as implied by RAFI (2000, p. 31). If the stakes are high enough, multinationals have been willing to incur a good deal of opprobrium in enforcing their intellectual property rights against farmers in Canada and the United States. Moreover, owners of IPR include specialized smaller companies that have no reputation or goodwill to protect, and the need for cash that motivates them to protect their IPR wherever infringement occurs. The Enola bean and Texmati rice controversies are instructive here.

Jurisdictions also differ in the extent to which their laws are actually implemented. Knowledge of a country's IP and biosafety laws is necessary for assessing the local freedom to operate, but may not be sufficient. In addition to the possibility of the official law being implemented imperfectly, or not at all, one must beware of *de facto* rules that are not officially codified as law.

Among the many factors that affect the freedom to operate, we focus on a subset of market characteristics, namely global production and trade patterns. The willingness of owners of agricultural technology to cede use rights, or the minimum price at which they are willing to sell the rights to others is shaped, among other things, by the location and structure of crop production and, particularly, the pattern of trade. There are two,

[34] United States Patent nos. 5,352,605; 5,530,196; and 5,858,742; and European Patent, EP 131 623, which is currently being opposed.
[35] Such as the Biosafety Protocol, agreed upon in Montreal in January 2000.

often overlapping, sets of circumstances under which the freedom to operate in agricultural research may *not* be under serious threat.

First, proprietary technologies that are targeted at commercially unattractive markets may be transferred free of charge. Crops grown for subsistence use in developing countries are clearly of little commercial interest to developed-country multinational companies. In addition, technologies used in crops that are sold primarily to poor consumers in developing countries may not be of much commercial interest to multinationals. Thus, a grant of technologies owned by these multinationals to develop crops growing in those circumstances is, with some caveats, a realistic possibility. In fact, multinationals have in several prominent cases, donated technologies to nonprofit agricultural research agencies working on behalf of poor farmers in the developing world. Public-relations considerations are likely to play an important role in such cases. Sometimes, more complex market segmentation deals are announced, in which commercially viable uses of the technology are separated from uses that are of humanitarian rather than commercial value.

A well-publicized example of such a complex arrangement is the *Golden*Rice™ Vitamin A Rice Project in which AstraZeneca cooperated with nonprofit organizations to put nutritionally enhanced golden rice seeds containing a gene owned by AstraZeneca in the hands of poor farmers at no charge. *Golden*Rice™ contains enhanced levels of provitamin A in the endosperm of the seed (which remains after the rice is polished), which is potentially of great health benefits to millions of poor farmers and consumers in developing countries. AstraZeneca has acquired the commercial rights to *Golden*Rice™ from Greenovations, a small German company acting as an intermediary for the inventors. In return, Zeneca has licensed the inventors to enable distribution of the rice on a royalty-free basis to farmers who earn less than $10,000 per year and live in developing countries, leaving the company free to explore commercial prospects for the technology (Tait and Wrong 2000). In addition, Monsanto announced its intent to provide royalty-free licenses for all its technologies that support the further development of *Golden*Rice™ (Monsanto 2000).

Second, anyone is free to use technologies and know-how in crops that are developed, produced, and consumed in countries where the technology is not subject to local IP protection, irrespective of whether the crop is grown on a subsistence or commercial basis and whether the technology is subject to IP protection in other jurisdictions. This fact appears to be overlooked in discussion of the *Golden*Rice™ example and makes it difficult to know exactly what is being "donated" in prominent cases. According to Kryder et al. (2000), there are 70 patents associated with this technology, including both process patents (relevant to creation of the technology) and product patents (embodied in the rice itself). This case has been quoted as posing a nightmare with respect to freedom to operate, and so the Monsanto and AstraZeneca donations generated a grateful response. But what did poor rice consumers gain from the donations? Table 1 shows the top 15 rice importers, and the number of Vitamin A rice technology patents valid in each. It is clear that for most of the developing countries in the list few or no patents associated with Vitamin A rice are valid in each. And these numbers are overestimates. Some of the patents may not cover the application to Vitamin A rice, and others may be later invalidated.

[Table 1: *Vitamin A Rice Patents in Rice-Producing and Rice Importing Countries*]

Assuming Table 1 is correct, importation of Vitamin A rice into Iran from Bangladesh infringes no patents. Crops that are traded among countries in which the technologies are not subject to IP are not liable to claims based on the use of these technologies. But importers of Bangladeshi Vitamin A rice into Japan might be subject to successful prosecution for infringement of claims to any embodied material covered by Japanese patent claims. This could be so even if technologies are unencumbered by IP in Bangladesh.

Thus, developing-world crop breeders have freedom to operate with respect to crops produced in developing countries unencumbered by local IP protection of relevant inputs, processes, or products, and which, in addition, do not constitute infringing imports into countries in which IP protection prevails. IP problems might arise in technologies destined for crops grown in developing countries unencumbered by IP restrictions if those crops are subsequently exported in a form in which infringement is detectable to

countries in which IP is likely to prevail. Note that in such cases it is the importer, not the breeder, who may be infringing on IP.

Specific technologies may have IP protection in some developing countries (like Brazil, China, and Argentina) but not in others. The details would need to be considered on a case-by-case basis. Identification of those countries in which IP has been assigned for a specific technology is an essential task in delineation of traders' freedom to operate. It is also important to keep in mind the large number of relevant technologies that are typically involved in breeding a modern crop cultivar, as the Vitamin A rice example illustrates.

This is one element of the multi-pronged approach needed for managing and developing an IP strategy to allow breeders to pursue their missions. Determination of freedom to operate requires technical knowledge, a broad business overview, detailed understanding of patent claims in all relevant countries, understanding of markets and national jurisdictions, and knowledge of litigation and negotiation procedures in relevant jurisdictions. A comprehensive assessment of all these aspects is well beyond the scope of this paper.

In the next section we confine our attention to global production and trade patterns as a basis for assessing the impact of developed-country IPR on producers in developing countries with no relevant IPR, using new technologies and following recent trade patterns. Although production and consumption in such countries would not infringe, development of germplasm that infringes in the North could be problematic if the technology embodied in the product infringes patents in major export markets.

3. Production and Trade Patterns and the Freedom to Operate

Understanding the production and trade status of crops relevant to developing countries is not only important in helping to ascertain the implications of intellectual property rights but is also helpful to those endeavoring to structure assignments of use rights by the private sector to public and nonprofit plant breeders. The plant breeders we have in mind might work in national public-sector agencies or for nonprofit organizations with a focus on agriculture in less-developed economies. To make the analysis concrete, we focus on

crops that are covered by the international agricultural research centers (IARCs) that are members of the CGIAR. These include many of the crops most important to research agencies operating in less-developed economies, with tropical beverages being major exceptions.

Data Sources and Treatment

International production patterns for crops considered here drew from the on-line FAOSTAT database of the Food and Agriculture Organization of the United Nations. Crop production is reported on a calendar-year basis and refers to harvested production. Export values and corresponding quantity totals were obtained from FAOSTAT's "Agriculture and Food Trade" domain, wherein the trade data are classified according to the international SITC (revision 2) standard. The import and export totals by country reported in appendix tables 3a-d were obtained from FAO's "Commodity Balances" domain. They represent the *total* amount of each commodity traded (irrespective of its source or destination) in its primary-equivalent form. Appendix table 1 details the regional groupings of countries we used, and appendix table 2 provides details of the commodity categories included in the FAOSTAT (and COMTRADE) data used for this study.

To quantify *bilateral* trade flows among developing and developed countries for the CGIAR crops we used the Commodity Trade Statistics Data Base (COMTRADE) compiled by the United Nations Statistics Division. These data include annual trade statistics since 1962 lodged by about 110 countries. The United Nations Statistics Division convert value-of-trade data to current U.S. dollars using exchange rates supplied by each reporting country, or a weighted average exchange rate derived from monthly market rates. Wherever possible, trade volumes and quantities (if reported) are expressed in metric units.

For our analysis we used annual SITC (revision 3) data for the period 1992-98. Presuming trade statistics reported by developed countries are generally more reliable than those from developing countries, we estimated annual bilateral trade flows by querying the COMTRADE database treating developed countries as "reporters" and developing countries as "partners." Using this approach, we compiled a series that

includes annual trade flows among 29 developed countries treated as "reporters," and 168 developing countries and areas treated as partners (see table 1 for a listing of countries).[36] Thus “exports from developing countries" was our estimate of the imports reported by the developed countries from developing countries. Exports are valued in fob (free-on-board) prices, imports mainly in cif (cost, insurance, and freight) prices, and thus the reported total value of imports is generally larger than the corresponding value of exports.[37]

Agricultural commodities are traded in raw or primary and various processed forms. For example, wheat is traded as grain, flour, pasta, bran, starch, and so on, soybeans, as grain, crude and refined oil, oil cake, and soy sauce. We compiled the COMTRADE data at the most disaggregated level available to us in the SITC 3 series, namely the five-digit level. Most of the CGIAR crops are specifically represented at this level of disaggregation; the omissions are yams, sweet potatoes, cowpeas, pigeon peas, and plantains. Yams and sweet potatoes are lumped under “other roots, tubers” along with other products. Pigeon peas and cowpeas are most likely included under “other legumes.” Plantains are grouped under “bananas fresh or dried.” We recorded all identifiable forms of each CG crop. These were summed to form the respective commodity trade totals.[38] In total, 53 product categories were aggregated into 15 commodity totals (appendix table 2). It is possible that some fraction of these commodities was traded in some form not specified in the SITC Revision 3 series, but the degree of under-reporting for this reason is believed to be small.

International Production and Trade Totals

Using the FAO series, table 2 summarizes the 1997 production and international trade performance of the 20 crops currently researched by the CGIAR, arranged into three country groupings—the developing countries, transition economies, and the world. Columns a, c, and g report the 1997 quantity of exports from developing countries,

[36] Transition economies—principally the countries that formed part of the former Soviet Union—are not included in any of the bilateral trade flow evidence based on COMTRADE data.
[37] The exceptions are Canada, Mexico, and Australia whose imports are reported in fob prices.
[38] The COMTRADE product categories, reported in value terms, were simply summed irrespective of form. We did not attempt to convert the value data into some type of primary-form equivalent. To do so requires,

transitional economies, and the world, respectively; columns b, d, and h give the quantities produced for these same regional groupings. Columns a/f and c/f report the quantity of developing and transitional country exports expressed as a share of world exports while columns b/g and d/g give the corresponding regional quantities produced as a share of total world output. Column a/b expresses developing-country exports as a share of developing-country production; column c/d gives the same ratio for the transition economies, and f/g the corresponding ratio for the world. Crops were grouped according to CGIAR "areas of research," and within each group reported in descending order according to the quantity of production in developing countries (column b).

[Table 2: *Production and Trade Indicators, 1997*]

At least 95 percent of the world's production of rice, cassava, sweet potatoes, yams, bananas, plantains, chickpeas, pigeon peas, cowpeas, groundnuts and coconuts takes place in poor countries, as does 94 percent of the millet production and over two thirds of the sorghum output. (column b/g).[39] Poor countries produce a smaller but still significant share (46 percent) of global soybean production. Production of cereals other than rice is more geographically disbursed. Less than 50 percent of the world's production of wheat, maize, and barley is grown in the developing world, with the transition economies being significant producers of barley and wheat.

For many of the crops in table 2, total exports from developing countries represent a minor share of total developing-country production (column a/b). Developing-country exports of sweet potato, yam, plantain, chickpea, cowpea, pigeon pea, and millet are negligible (column a). Virtually all the production and consumption of these crops takes place in the developing world. For groundnuts and rice, slightly larger shares—but still less than 6 percent—of developing-country production is exported. More substantive but still comparatively small shares of developing-country bean and lentil production, as well as wheat, maize, and barley production, are exported. About one-fifth of the developing world's banana production, and one-third of its soybean production are exported.

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at a minimum, that corresponding quantity data for each commodity category for each country and for each year are available, but such data are only reported for some countries and commodities for several years.

[39] The status of cooking bananas in FAOSTAT is not entirely clear, but we surmise they are lumped together with dessert bananas under the heading of "bananas."

Appendix tables 3a through d give a more detailed country-by-country picture of the pattern of production. Countries are grouped into developing, developed, and transitional regions and commodities ranked within their respective group according to their share of 1997 production. As expected, the larger countries such as China, Brazil, India, and Indonesia figure prominently among the top 10 developing-country producers for many, but not all, of the commodities. Few African countries figure among the top 10 cereal and food legume producers, but do appear more frequently among the top 10 producers of root crops, groundnuts, and, especially, plantains (cooking bananas), where African countries account for almost three-quarters of world production. Plantain exports are small, but this crop is a very significant source of starch in African diets.

South-North Trade Flows

Table 3 summarizes the annual average trade flows between developing countries and the developed world for 15 CG commodities for the period 1994-98 using the COMTRADE data. The top panel in table 3 reports the value of developed-country exports to and from the developing world. The two right-hand columns indicate the overall developed-country trade balance, both in total and with respect to trade with developing countries. Developed countries are net exporters of wheat, maize, potatoes, sorghum, and lentils to the developing world, and net importers of all other crops in the table.

[Table 3: *Developed Country Trade, 1994-98 annual average*]

Developing countries as a group both import and export virtually all the crops. In part, this reflects seasonal differences in production and differences in the quality and form of the crops being traded. By total value, wheat is the major developed-country export crop with a developing-country destination—averaging more than $10.7 (current prices) billion per year (column a)—followed by soybeans ($4.5 billion), maize ($4.3 billion), barley ($1.1 billion), and rice ($982 million). As a developing-country export crop to the developed world, wheat ranks a distant sixth (column c). The top-ranking exports from LDCs to the developed world by value are soybeans, bananas, rice, and coconuts; each crop averaging more than one billion dollars per year, with soybean and banana exports averaging more than $4.5 billion per year.

The middle panel of table 3 indicates the relative trade significance of each crop within the 15-crop trade total and highlights the fact that a small number of commodities account for the lion's share of the overall trade total. Wheat, soybeans, and maize combined account for more than 85 percent of all developed-country exports to the developing world among the 15 crops listed here, while soybeans and bananas account for about 60 percent by value of the developed-country crop imports from the developing world.

The bottom panel in table 3 gives the developed-country share of total imports and exports, respectively, that come from and go to developing countries. Comparatively large shares—more than 40 percent—of the developed world's wheat, sorghum, maize, rice, barley, beans, and soybeans exports go to the developing world. The preponderance of the developed world's banana, coconut, cassava, and chickpea imports come from developing countries. Notably, wheat originating from developing countries is less than 6 percent of the total developed-world wheat imports (whereas Southern rice is 48 percent of total Northern rice imports while LDC maize accounts for only 7 percent of the developed world's total maize imports).

The trade flows between the developed and developing worlds are summarized graphically in figure 1, restating some of the data presented in the upper panel of table 3. Commodities in this figure are sorted in descending order, from left to right, according to the total value of developed-country imports from the developing world (column c table 3). The trade balance for developing countries for these 15 CG commodities is negative overall (column e table 3), due mainly to substantial developed-country wheat and maize exports to the developing world. Mainly, the only sizable exports from LDCs to developed countries are soybeans and bananas, followed well behind by rice, coconuts, and groundnuts. South-North exports of most of the other ten commodities are minimal.

[Figure 1: *Developed-Country Trade with LDCs, 1994-98 annual average*]

Developing-country exports to the developed world are not only concentrated in a few commodities, as depicted in figure 1, but the preponderance of exports originates from comparatively few countries. Just 9 LDC countries shipped 76 percent of the 15-crop total exports to the developed world (table 4). Soybeans, the number one LDC

export crop by value to the developed world (nearly 34 percent of the 15-crop total), came mainly from Brazil and Argentina. A sizable share of developing-country rice exports to the developed world was from Thailand (59 percent of total LDC rice exports to the developed countries), bananas came mainly from Costa Rica and Ecuador (each about 20 percent of total LDC-to-developed-country banana exports), and coconut exports were principally from the Philippines. Generally more than 50 percent of total LDC exports to the developed world for each crop originated from just one or two countries, and for each of Brazil, Costa Rica, Ecuador, Colombia, and Panama, over 97 percent of these exports involved just one of the crops considered. Over 80 percent of the crop exports from Thailand and Argentina involved just two commodities—rice and cassava in the case of Thailand, and soybeans and groundnuts in the case of Argentina.

[Table 4: *Developing Country Exports to the Developing World—Top Nine Countries, 1994-98 averages*]

Appendix tables 4a-o give more detailed region-to-region, country-to-region, and country-to-country trade flows for the 15 CG crops. These more spatially refined data serve to reinforce the finding described above that comparatively few LDC countries account for most of the total LDC exports to the developed world. Additionally, most of these LDC exports go to Western Europe (about 64 percent), followed by the United States (16 percent) and Japan (11 percent). Western Europe is the principal developed-world destination for developing-country exports of all but 3 CG commodities, the exceptions being wheat, sorghum, and barley.

It takes many years to bring new agricultural ideas and inventions to market. With this in mind, how indicative of future trade patterns are annual trade flows over recent past years and thus the likely freedom to operate of LDCs in future years? To gain a sense of the stability of the geographic pattern of South-North trade we tracked trade trends back to 1992. Total developed-country imports of the 15 CG crops grew from $41 billion in 1992 to $49 billion by 1996, dropping to $44 billion in 1998 (figure 2). This amounts to an annual rate of growth of 2.5 percent from 1992-98. The value of developed-country imports originating from LDCs grew by 1.7 percent per year. Despite some year-to-year variation in the LDC share of these developed-country imports, the share was comparatively stable, hovering around one third of the total. The pattern of

country-to-county trade between North and South was also quite stable. The same five Southern countries generally dominated trade to the North for the years 1992 to 1998 for each of the 15 CG crops.[40]

[Figure 2: *Developed-Country Crop Imports, 1992-98*]

According to the COMTRADE data, the value of wheat and rice exports from the LDCs to the developed countries grew rapidly, by over 10 and 6 percent per year respectively since 1992. In contrast, LDC exports of barley, beans, cassava, chickpeas, lentils, maize, millet, potatoes, and sorghum to the developed world declined. These crop-specific patterns of trade over the 1992-98 period are reflected in figure 3, which plots the share of total developed country imports of each of the 15 CG crops that originate in the LDCs for three sub-periods. The developed world relies little on the LDCs for its wheat and maize (and barley and potato) imports but a significant share of many of the other CG crop imports does come from the developing world. Notably the share of developed-country rice imports originating in developing countries grew considerably over the past years (29 percent in 1992 to 46 percent in 1998).

[Figure 3: *Share of Developed Country Crop Imports Originating from LDCs, 1989-98*]

Processed Products, Infringement and Detectability

To successfully litigate against the importation of crops that were developed with locally protected IP, the litigant must be able to establish the use of the IP. Many aspects of modern biotechnologies can be discerned in seeds and fruit parts, but not necessarily so if the crop is shipped in processed form. Tests based on protein or DNA, including sensitive polymerase chain reaction (PCR) based diagnostic methods, are largely if not wholly incapable of detecting substantive components of protected technologies in oils, carbohydrates, purified proteins, or some extracts. However, even if components are used and detected for which freedom to operate is available (e.g. public-domain or licensed selectable markers), some sort of evidence (e.g., subpoenaed notebooks) is necessary, to determine what process was used to generate the material. Hence it can be

[40] While total South-North trade in each commodity came from just a few countries, in any one year up to 30 Southern countries shipped some (usually minimal) barley to the North and 137 LDCs exported wheat to the developed world. The number of LDC countries shipping any of the remaining CG crops Northwards in any particular year was between 30 and 137.

considered that the substantive versus methodological components of IP verification must be viewed as being separate. The substantive detection is almost completely useless in refined products such as oils, sugar, and pure fiber, but even when it shows positive results for a particular component in, say, soybean meal, there may still be substantial investigation required to establish whether a particular process was used to insert that component—a potentially costly piece of detective work.

While trade in processed products makes it more difficult to detect IP use, whether IP infringement is more or less likely to occur when trading products in processed versus raw form is difficult to judge. IP claims can pertain to products, processes (e.g., of methods for making a plant and methods for processing it), and to the processed products themselves. However the law is unsettled regarding the reach of infringement of method claims to products resulting from these methods. For example, there may be no infringement for importing a product made by a patented process if it is materially changed by subsequent processes (such as shipping oil derived from soybean varieties whose creation is subject to process patents). However, relying on public policy arguments espoused in legislative history, the U.S. Federal Circuit in *Bio-Technology General Corp. v. Genentech Corp.* found infringement when a product was materially changed.[41] The COMTRADE data show that about 60 percent (by value) of LDC exports of coconuts to the developed world are in the form of oil, and about 54 percent of soybean exports are so traded. In contrast, bananas and rice are shipped almost entirely in raw form, in which IP should be more readily detectable.

In summary, the production and trade reveal that:

- Exports from developing to developed countries of CG crops are insignificant in relation to total agricultural exports from developing countries, developed country imports, or even in relation to domestic agricultural production, except for a few commodities, and only a small number of developing countries.
- The developing countries as a group account for more than 90 percent (and for quite a few of these crops more than 98 percent) of the world's production of rice, millet, cassava, sweet potato, yam, banana, plantain, chickpeas, cowpeas, pigeon

[41] 38 USPQ2d 1321 (Fed. Cir. 1996), in which the claim at issue recited a method of constructing a cloning vehicle and the imported product was a protein produced from a host cell containing the cloning vehicle. Compare this case to *Eli Lilly & Co. v. American Cyanamid Co.*, 38 USPQ2d, 1705 (Fed. Cir. 1996), in which the Federal Circuit held that an imported compound produced by a claimed method for an intermediate compound was not infringing.

peas, groundnuts, and coconuts. They also account for over 65 percent of the world's production of sorghum, beans, and lentils.

- For most CG crops, trade is dwarfed by output, meaning that for the majority of these crops output is never traded across international borders. Soybeans, coconuts, bananas, lentils, and beans are the only crops of the 15 studied for which more than 10 percent of developing-country production is exported.
- Just 2 crops (soybeans and bananas) account for 64 percent of LDC crop exports to the developed countries and just 4 countries (Brazil, Argentina, Ecuador and Costa Rica) account for 42 percent of the South-North trade in these 2 crops. Adding in exports of rice and coconuts amounts to 80 percent of the South-North trade total, with most of the rice shipments destined for the developed world coming from Thailand and coconuts from the Philippines.
- The principal destination for South-North trade in 9 of the top 10 developing-country crop exports—specifically soybeans, bananas, rice, coconuts, groundnuts, cassava, maize, beans, and potatoes—is Western Europe. Wheat is the only exception. To the extent that it is exported from LDCs it is mainly shipped to North America and Japan. However, these exports are dwarfed by wheat trade in the reverse direction from North America to LDCs.

Soybeans, the most valuable developing country export crop, is of minor importance in most LDC research portfolios. However, given the significance of soybean exports from Brazil and Argentina (accounting for 79 percent of South-North trade in this crop), a few comments on these are in order. In 1999, genetically modified soybeans occupied 90 percent of soybean acreage in Argentina (James, 2000 p.9). Roundup resistant seeds, reputedly smuggled from Argentina (Feder 1999), were planted on an estimated 8 percent of Brazilian soybean acreage,[42] notwithstanding that such seeds are still outlawed in Brazil.[43]

Roundup Ready™ soybean technology is not patented in Argentina, although seeds with this technology are generally protected under Argentina's 1974 seed law.[44] This case vividly highlights the local nature of IP—presently the only property rights to Roundup technology in Argentina are assigned to plant breeders whose seeds embody this technology (not to Monsanto, the technology's inventor). Thus, it is not illegal for

[42] See http://www.asa-casa-ssa.org/dbrief/

[43] This was confirmed in a recent decision of the Regional Federal Court in Brazil against Monsanto, which can appeal the decision to the Supreme Tribunal of Justice, Brazil's Supreme Court (Rich 2000).

[44] The GAO (2000 p.6) reports "Monsanto's 1995 application for a patent for Roundup Ready soybeans in Argentina was rejected. Monsanto appealed the decision, and an Argentine court overturned the rejection. Monsanto has petitioned for reconsideration of the patent application; as of December 1999, the application was pending."

Argentine seed companies to incorporate this technology in their seeds absent licensing agreements with Monsanto, although the shipment of soybeans grown from such seeds into the United States would make importers liable to litigation.

In a search of PCT applications and issued United States and European patents, we found three PCT patent applications directly related to transgenic bananas. Several others recite banana viruses and detection methods. However, there is presently little if any IP pertaining to biotechnologies in commercially grown bananas. The three principal fruit types of the genus *Musa* are dessert bananas, cooking bananas, and plantains.[45] The vast majority of bananas that are exported by LDCs are dessert bananas. Cooking bananas and plantains are important in terms of production and consumption but not in terms of exports. International (nonprofit) plant-breeding research deals with all three *Musa* types although CGIAR research is mostly confined to cooking bananas and plantains.[46]

An important South-North trade development noted above is the rapid rise in rice exports from LDCs to developed countries. They increased at a rate of over 6 percent per year from 1992 to 1998, with an average of 47 percent of all Northern rice imports in 1994-98 originating from Southern countries. Rice is the third most significant CG crop among the Northern imports from LDCs. In the 1994-98 period, just a few countries (Thailand, India, China, and Netherlands Antilles) accounted for over 99 percent of South-North trade in rice, with Thailand responsible for 59 percent of the LDC rice exports to the developed countries. There is probably potential for further growth, and the capacity is certainly there, as rice exports from LDCs to the developed world are still dwarfed by domestic production in the LDCs.

[45] The status of cooking bananas in FAOSTAT is not entirely clear, but we surmise they are lumped together with dessert bananas under the heading of "bananas."

[46] The International Institute for Tropical Agriculture (IITA)—a CGIAR center—conducts research on cooking bananas and plantains. The International Network for the Improvement of Bananas and Plantains (INIBAP), a program operated by the International Plant Genetic Resources Institute (IPGRI)—also a CGIAR center—, facilitates the international exchange of materials and technologies relating to all three *Musa* types, but does none of its own breeding. The *Centre de cooperation internationale en researche agronomique pour le developpement* (CIRAD), slightly smaller in size but roughly comparable in objectives to the CGIAR, operates a banana breeding program that emphasizes dessert bananas (Buddenhagen 1996).

In summary, the trade data suggest the conclusion that freedom-to-operate problems are most likely—among the crops under consideration—to arise in soybeans, bananas, and rice. However, soybeans are not at present the major focus of public research, whether by national or international agricultural research organizations working in or on behalf of the developing world. The types of bananas that dominate as an LDC food crop do not figure significantly in trade. And the percentage of rice output traded to the North is very small.

4. Conclusion

Many are concerned that rights over IP have locked out or severely curtailed LDC and international research agencies from access to and use of biotechnologies important for achieving necessary increases in the world food supply over the next several decades. According to our assessment this is not so—there is still substantial freedom to operate regarding research on most crops of most significance for food security in poor countries. While definitive views about the freedom to operate in any specific circumstance depend on the specifics regarding claims of the IP and the spatial pattern of IP, crop production, and trade, IP rights over biotechnologies relevant to agriculture are mainly held in (and therefore mainly relevant to) rich-country jurisdictions.

Intellectual property rights in the North affect farmers in the South if they export infringing products to the North. However, South-North trade in the food staples is limited overall, and in terms of the number of crops and the number of LDC countries that are involved in any significant sense. IPR-based limitations on export markets for food staples that embody technologies protected only in the North should not in general be considered an important impediment to the use of these technologies in such crops in the South.

This does not mean that freedom to operate is not a problem for LDC research on export-oriented cash crops such as horticultural products, tropical beverages, or dessert bananas. This paper deals mainly with food crops of significance to poor people.

Undue concern about the freedom to conduct LDC research (or research by those working on behalf of LDCs) is misdirecting policy and practical attention away from the

main constraints presently facing researchers on food crops for the South. The real constraints are an increasingly serious lack of investment in Southern research and a lack of local scientific skills to access the rapidly advancing stock of complex modern biotechnologies, whether they are protected by patents or not.[47] Biotechnology is challenging the adaptive capacity that has enabled poor countries to benefit from the advances in plant genetics and other relevant technologies in the past half-century, and lagging public resources are not being replaced by private-sector investments. Failure to invest in the adaptive capacity needed to evaluate, access, and regulate the technologies being developed in the North is currently a far greater constraint than freedom to operate. The current confusion over this issue itself illustrates the lack of capacity of researchers and decision makers to handle questions relating to IPR and freedom to operate in LDC plant breeding.

For the future, the extent of patenting of key biotechnologies in the South may grow as compliance with the IPR provisions of the TRIPS agreement is implemented in the South. The form of this implementation with respect to plant-breeding technology, domestically and in important export markets, is a crucial issue for future national freedom to operate of LDC researchers, and for LDCs' freedom to trade in agricultural products, both South-North and South-South. This issue ranks with implementation of farmers' rights as an important policy concern for plant breeders, farmers, and the food consumers of the South. But *domestic* freedom to operate is generally the dominant IPR issue; exports of important food staples that dominate agriculture are not important growth drivers in most developing countries.

Misconception of their present freedom to operate is a threat to the effectiveness of bargaining by breeders of food crops for the South for access to the scientific outputs from the more than $7 billion of private spending (1985 prices) on agricultural R&D in OECD countries. Institutional innovations bridging the private-public divide are beginning to emerge (Fischer et al. 2000). It behooves all parties to have a proper picture

[47] Pardey, Roseboom, and Craig (1999) point to the growing gap leading up to the early 1990s between the intensity of investment in agricultural research conducted in the North and the South. This gap seems likely to have changed little, or if anything deteriorated further, during the past decade.

of the present degrees of freedom regarding Southern agricultural R&D in order both to strike effective deals when tapping Northern intellectual property on behalf of the world's poor, and to know when such deals are not needed.

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Table 1: *Vitamin A Rice Patents in Rice-Producing and Rice-Importing Countries*

Top 15 Rice-Producing Countries	Number of Patents	Top 15 Rice-Importing Countries	Number of Patents
China	11	Iran	0
India	5	Brazil	10
Indonesia	6	Nigeria	0
Bangladesh	0	The Philippines	1
Vietnam	9	Iraq	0
Thailand	0	Saudi Arabia	0
Myanmar	0	Malaysia	0
Japan	21	South Africa	5
The Philippines	1	Japan	21
Brazil	10	Côte D'Ivoire	10
United States	44	Senegal	10
South Korea	10	United Kingdom	35
Pakistan	0	France	37
Egypt	0	Indonesia	6
Nepal	0	United States	44

Source: Kryder et al. (2000, table 4).

Table 2: *Production and Trade Indicators, 1997*

	Developing Countries[1]					Transition Economies[1]					World[1]			
	Exports		Production			Exports		Production			Exports			
	Quantity	Share Exp/Wexp	Quantity	Share Pdn/WPdn	Share Exp/Prod	Quantity	Share Exp/Wexp	Quantity	Share Pdn/WPdn	Share Exp/Prod	Value	Quantity	Production	Share Exp/Prod
Column code	a	a/f	b	b/g	a/b	c	c/f	d	e/g	c/d	e	f	g	f/h
	(1,000 mt)	*(percentage)*	*(1,000 mt)*	*(percentage)*		*(1,000 mt)*	*(percentage)*	*(1,000 mt)*	*(percentage)*		*(US$ mls.)*	*(1,000 mt)*		*(percentage)*
Cereals														
Rice	22,630	76.2	613,623	95.2	3.7	128	0.4	1,203	0.2	10.6	7,660	29,693	644,818	4.6
Wheat	15,268	12.1	285,793	46.8	5.3	7,374	5.8	116,427	19.1	6.3	20,641	126,093	610,546	20.7
Maize	22,639	22.4	263,992	40.6	8.6	1,884	1.9	45,215	7.0	4.2	14,069	101,016	650,113	15.5
Sorghum	809	12.7	43,619	69.4	1.9	2	0.0	67	0.1	3.2	769	6,373	62,822	10.1
Millet	108	46.9	26,344	93.5	0.4	21	9.1	1,616	5.7	1.3	55	230	28,187	0.8
Barley	1,800	7.0	24,854	16.0	7.2	2,342	9.1	47,951	30.9	4.9	3,788	25,752	154,984	16.6
Roots, Tubers, Banana and Plantain														
Cassava	11,220	94.2	164,909	100.0	6.8	0	0.0	0	–	–	2,801	11,905	164,909	7.2
Sweet Potato	55	67.7	128,363	98.5	0.0	2	2.0	0	–	–	34	82	130,257	0.1
Potato	970	7.2	111,747	38.6	0.9	357	2.6	98,273	34.0	0.4	2,553	13,494	289,345	4.7
Banana	12,137	90.1	57,616	98.4	21.1	72	0.5	0	–	–	4,707	13,464	58,562	23.0
Yam	23	99.8	30,037	98.9	0.1	0	–	0	–	–	18	23	30,376	0.1
Plantain	143	90.9	29,629	100.0	0.5	0	0.0	0	–	–	58	157	29,629	0.5
Food Legumes														
Soybeans	60,626	51.5	171,570	46.4	35.3	422	0.4	1,840	0.5	23.0	33,522	117,802	369,961	31.8
Beans	1,848	74.5	14,559	86.0	12.7	7	0.3	562	3.3	1.2	1,323	2,482	16,932	14.7
Chickpeas[2]	378	48.8	8,104	96.6	4.7	0	–	5	0.1	–	301	775	8,389	9.2
Pigeonpeas[2]	7	100.0	2,866	100.0	0.2	0	–	0	–	–	3	7	2,866	0.2
Cowpeas[2]	20	86.5	2,383	98.0	0.8	0	–	37	1.5	–	5	23	2,433	1.0
Lentils[2]	322	46.5	2,179	79.5	14.8	0	–	9	0.3	–	329	693	2,742	25.3
Oil Crops														
Coconut	30,005	90.6	99,708	98.4	30.1	11	0.0	0	–	–	8,629	33,131	101,333	32.7
Groundnuts	3,450	75.7	60,461	94.9	5.7	37	0.8	150	0.2	24.7	3,650	4,560	63,702	7.2

Source: Compiled from FAOSTAT (2000) "Commodity Balances" for columns a, b, c, d, f, and g. To estimate column e, we formed a price (i.e., unit value) by dividing the total value of exports by the corresponding total quantity for each commodity in its primary form, reported in FAOSTAT's "Agriculture and Food Trade" domain. We used this price to weight the total traded quantities reported in the Commodity Balances data obtained from FAO.

Note: "Exp" denotes exports; "wexp" denotes world exports; "prd" denotes production; and "wprd" denotes world production. All products are in crop-primary-equivalent form. In the production totals we also estimated and included production of oils and cakes that were converted in primary-equivalent form using average world conversion factors taken from FAO (2000). See Appendix Table 2 for details on product categories. Within each crop class, crops are arranged in descending order at 1997 developing-world production (column b).

1. Includes 124 developing and 27 transitional countries, and 178 countries in the world total.
2. For these crops, production data were taken from the "Agricultural Production" domain of FAOSTAT (2000).

Table 3: *Developed-Country Trade, 1994–98 Annual Average*

	Exports		Imports		Balance of Trade	
	to LDCs	Total	from LDCs	Total	with LDCs	Total
	a	b	c	d	e	f
Annual trade flows			*(thousand U.S. dollars)*			
Soybean	4,466,762	10,440,702	5,145,713	11,118,853	(678,951)	(678,151)
Bananas	3,555	888,659	4,651,434	5,379,999	(4,647,879)	(4,491,339)
Rice	982,054	2,305,332	1,242,062	2,596,468	(260,008)	(291,136)
Coconut	28,675	197,949	1,177,257	1,331,826	(1,148,582)	(1,133,877)
Groundnut	63,764	491,664	669,741	1,095,247	(605,976)	(603,583)
Wheat	10,676,906	21,261,677	600,116	11,400,189	10,076,789	9,861,488
Cassava	893	45,440	507,791	562,058	(506,898)	(516,618)
Maize	4,293,828	9,192,626	434,742	5,823,624	3,859,086	3,369,001
Beans	199,408	472,547	326,179	664,494	(126,772)	(191,947)
Potato	601,064	4,154,037	236,214	3,732,855	364,850	421,182
Chickpeas	60,390	76,105	92,021	106,974	(31,631)	(30,870)
Sorghum	355,282	745,732	82,319	530,640	272,963	215,093
Lentils	83,322	162,396	21,826	95,439	61,496	66,956
Millet	3,216	32,231	16,590	51,609	(13,373)	(19,378)
Barley	1,103,922	2,433,878	4,618	1,443,621	1,099,303	990,257
Total	*22,923,040*	*52,900,975*	*15,208,623*	*45,933,896*	*7,714,417*	*6,967,078*
Share of commodity total						
Soybean	19.49	19.74	33.83	24.21		
Bananas	0.02	1.68	30.58	11.71		
Rice	4.28	4.36	8.17	5.65		
Coconut	0.13	0.37	7.74	2.90		
Groundnut	0.28	0.93	4.40	2.38		
Wheat	46.58	40.19	3.95	24.82		
Cassava	0.00	0.09	3.34	1.22		
Maize	18.73	17.38	2.86	12.68		
Beans	0.87	0.89	2.14	1.45		
Potato	2.62	7.85	1.55	8.13		
Chickpeas	0.26	0.14	0.61	0.23		
Sorghum	1.55	1.41	0.54	1.16		
Lentils	0.36	0.31	0.14	0.21		
Millet	0.01	0.06	0.11	0.11		
Barley	4.82	4.6	0.03	3.14		
Total	*100*	*100*	*100*	*100*		
Share of respective import and export total						
Soybean	42.78	*100*	46.28	*100*		
Bananas	0.40	*100*	86.46	*100*		
Rice	42.6	*100*	47.84	*100*		
Coconut	14.49	*100*	88.39	*100*		
Groundnut	12.97	*100*	61.15	*100*		
Wheat	50.22	*100*	5.26	*100*		
Cassava	1.97	*100*	90.34	*100*		
Maize	46.71	*100*	7.47	*100*		
Beans	42.2	*100*	49.09	*100*		
Potato	14.47	*100*	6.33	*100*		
Chickpeas	79.35	*100*	86.02	*100*		
Sorghum	47.64	*100*	15.51	*100*		
Lentils	51.31	*100*	22.87	*100*		
Millet	9.98	*100*	32.15	*100*		
Barley	45.36	*100*	0.32	*100*		
Total	43.33	*100*	33.11	*100*		

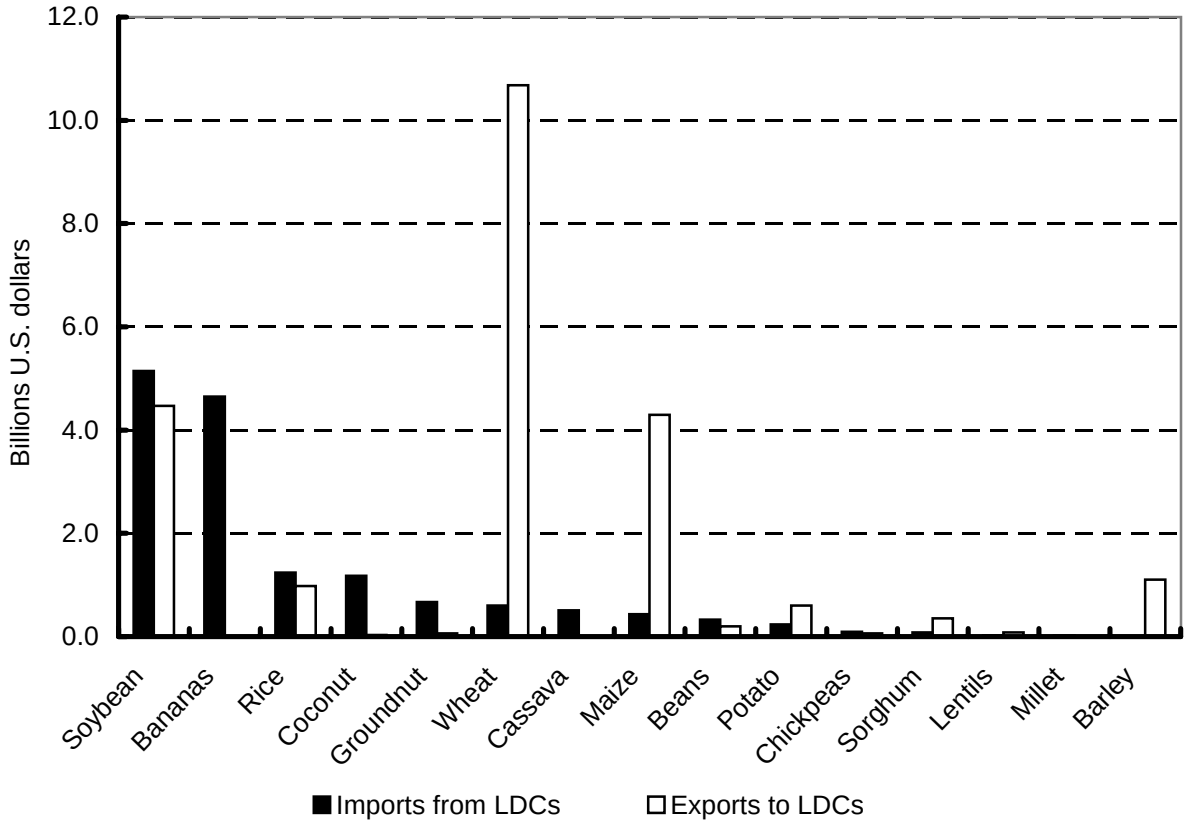
Source: Compiled from United Nations Statistics Division COMTRADE database (1999).
Note: Crops are arranged in rank order of total imports from LDCs (column c).

Table 4: *Developing-Country Exports to the Developed World—Top Nine Countries, 1994–98 Averages*

Origin	All CGIAR Commodities	Soybeans	Bananas	Rice	Coconut	Groundnut	Wheat	Cassava	Maize	Beans	Potato	Chickpeas	Sorghum	Lentils	Millet	Barley
Annual average exports by value						***(Thousands of U.S. dollars per year)***										
Brazil	3,068,757	3,044,148	2,852	1,207	1,406	10,003	1,077	510	4,843	1,733	967	–	–	–	–	–
Argentina	2,099,760	1,501,520	–	1,047	1,013	227,653	12,932	–	232,611	59,104	–	–	55,287	–	7,508	–
Thailand	1,279,176	3,553	6,003	728,786	8,492	–	76,411	433,047	4,008	17,752	616	–	166	140		–
Philippines	1,018,158	1,890	320,658	67	683,466	–	9,010	2,502	168	–	126	–	–	–	–	–
Costa Rica	983,076	107	957,633	–	712	–	646	23,891	–	–	42	–	–	–	–	–
Ecuador	975,244	–	974,634	–	–	–	58	372	–	19	–	–	–	–	–	–
China	942,887	187,176	3,581	142,723	837	209,950	138,909	2,277	69,438	161,587	3,490	63	8,548	5,999	8,217	91
Colombia	669,144	–	666,268	–	261	42	1,746	–	521	120	85	–	–	–	–	–
Panama	442,198	–	440,780	–	–	–	–	45	380	–	–	–	–	–	–	–
All other	3,730,224	407,321	1,279,025	368,233	481,069	222,093	359,328	45,148	122,774	85,864	230,887	91,957	18,318	15,687	865	4,527
Total	*15,208,623*	*5,145,713*	*4,651,434*	*1,242,062*	*1,177,257*	*669,741*	*600,116*	*507,791*	*434,742*	*326,179*	*236,214*	*92,021*	*82,319*	*21,826*	*16,590*	*4,618*
Share of country total																
Brazil	20.18	59.16	0.06	0.1	0.12	1.49	0.18	0.1	1.11	0.53	0.41	–	–	–	–	–
Argentina	13.81	29.18	–	0.08	0.09	33.99	2.15	–	53.51	18.12	–	–	67.16	–	45.26	–
Thailand	8.41	0.07	0.13	58.68	0.72	–	12.73	85.28	0.92	5.44	0.26	–	0.2	0.64	–	–
Philippines	6.69	0.04	6.89	0.01	58.06	–	1.5	0.49	0.04	–	0.05	–	–	–	–	–
Costa Rica	6.46	0	20.59	–	0.06	–	0.11	4.7	–	–	0.02	–	–	–	–	–
Ecuador	6.41	–	20.95	–		–	0.01	0.07	–	0.01	–	–			–	–
China	6.2	3.64	0.08	11.49	0.07	31.35	23.15	0.45	15.97	49.54	1.48	0.07	10.38	27.48	49.53	1.97
Colombia	4.4	–	14.32	–	0.02	0.01	0.29	–	0.12	0.04	0.04	–	–	–	–	–
Panama	2.91	–	9.48	–	–	–	–	0.01	0.09	–	–	–	–	–	–	–
All other	24.53	7.92	27.5	29.65	40.86	33.16	59.88	8.89	28.24	26.32	97.74	99.93	22.25	71.88	5.21	98.03
Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*
Share of commodity total																
Brazil	*100*	99.2	0.09	0.04	0.05	0.33	0.04	0.02	0.16	0.06	0.03	–	–	–	–	–
Argentina	*100*	71.51		0.05	0.05	10.84	0.62		11.08	2.81		–	2.63	–	0.36	–
Thailand	*100*	0.28	0.47	56.97	0.66	–	5.97	33.85	0.31	1.39	0.05	–	0.01	0.01		–
Philippines	*100*	0.19	31.49	0.01	67.13	–	0.88	0.25	0.02		0.01	–	–	–	–	–
Costa Rica	*100*	0.01	97.41	–	0.07	–	0.07	2.43	–	–	0	–	–	–	–	–
Ecuador	*100*	–	99.94	–	–	–	0.01	0.04	–	0		–	–	–	–	–
China	*100*	19.85	0.38	15.14	0.09	22.27	14.73	0.24	7.36	17.14	0.37	0.01	0.91	0.64	0.87	0.01
Colombia	*100*	–	99.57	–	0.04	0.01	0.26	–	0.08	0.02	0.01	–	–	–	–	–
Panama	*100*	–	99.68	–	–	–	–	0.01	0.09	–	–	–	–	–	–	–
All other	*100*	10.92	34.29	9.87	12.9	5.95	9.63	1.21	3.29	2.3	6.19	2.47	0.49	0.42	0.02	0.12

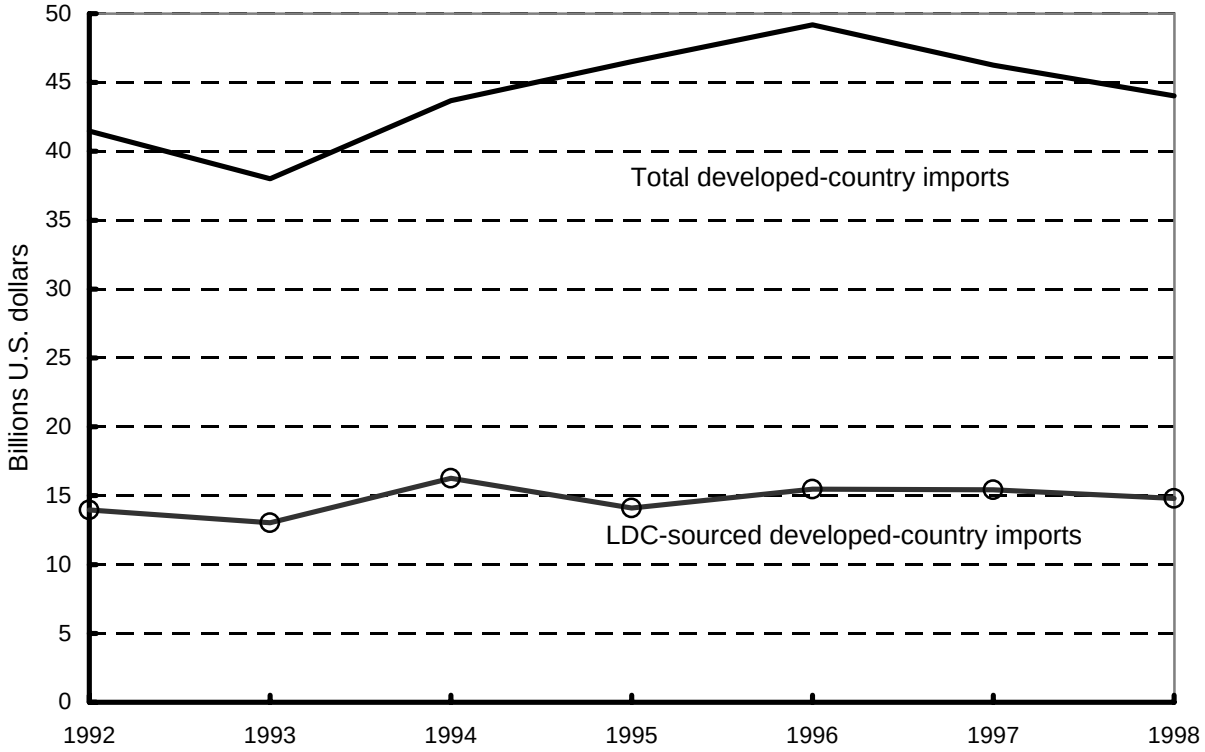
Source: Compiled from United Nations Statistics Division COMTRADE database (1999).

Figure 1: Trade between Developed and Developing Countries,
1994-98 annual averages



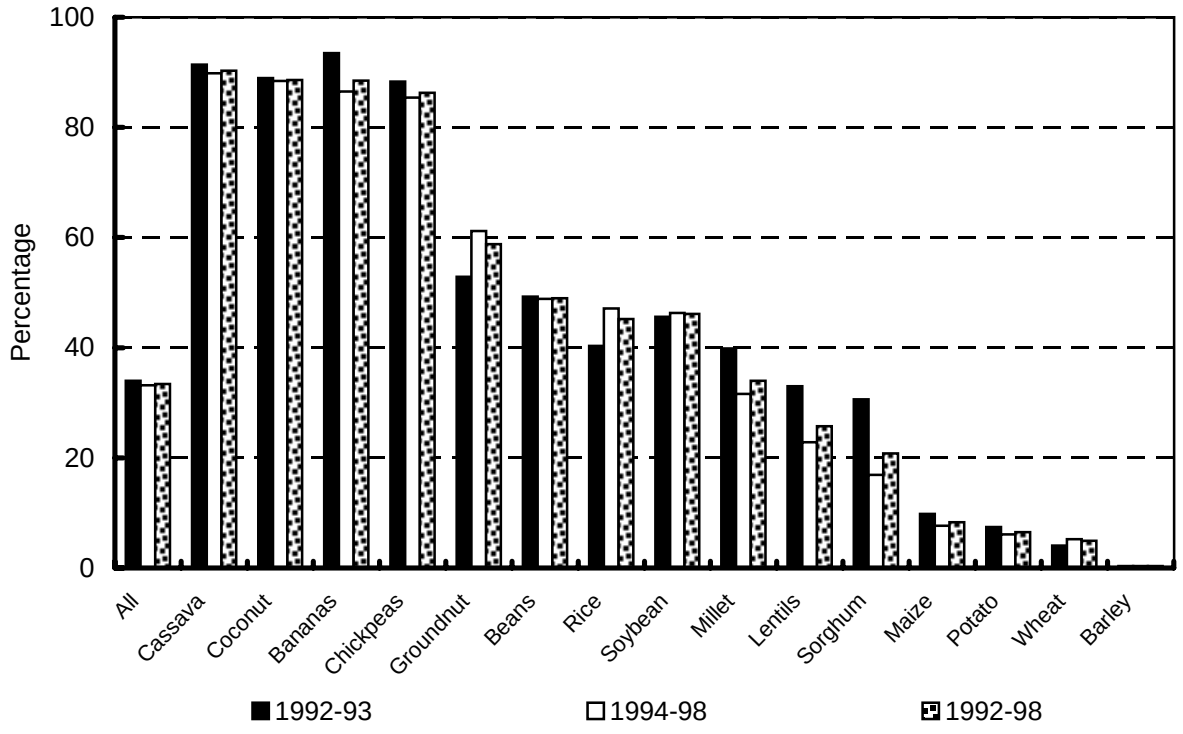
Source : Compiled from United Nations Statistical Division COMTRADE database (1999).

Figure 2: Total *Developed-Country and World Imports*



Source: Compiled from United Nations Statistics Division COMTRADE database (1999).

Figure 3: *Share of Developed-Country Imports Originating in LDCs*



Source : Compiled from United Nations Statistical Division COMTRADE database (1999).

Appendix Table 1: *Countries in Dataset*

Region/Country	FAO	COMTRADE	Region/Country	FAO	COMTRADE
Developed Countries			*Transition Economies*		
Australia	✓	✓	Albania	✓	
Austria	✓	✓	Armenia	✓	
Belgium		✓	Azerbaijan	✓	
Bel-Lux	✓		Belarus	✓	
Canada	✓	✓	Bosnia Herzg	✓	
China: Hong Kong	✓		Bulgaria	✓	
Denmark	✓	✓	Croatia	✓	
Faroe Islands		✓	Czech Republic	✓	
Finland	✓	✓	Estonia	✓	
France	✓	✓	Georgia	✓	
Germany	✓	✓	Hungary	✓	
Greece	✓	✓	Kazakhstan	✓	
Hong Kong		✓	Kyrgyzstan	✓	
Iceland	✓	✓	Latvia	✓	
Ireland	✓	✓	Lithuania	✓	
Israel	✓	✓	Macedonia	✓	
Italy	✓	✓	Moldova Republic	✓	
Japan	✓	✓	Poland	✓	
Macau	✓	✓	Romania	✓	
Malta	✓		Russian Federation	✓	
Malta and Gozo		✓	Slovakia	✓	
Netherlands	✓	✓	Slovenia	✓	
New Zealand	✓	✓	Tajikistan	✓	
Norway	✓	✓	Turkmenistan	✓	
Portugal	✓	✓	Ukraine	✓	
Singapore		✓	Uzbekistan	✓	
South Africa	✓	✓	Yugoslavia	✓	
Spain	✓	✓			
Sweden	✓	✓			
Switzerland	✓	✓			
United Kingdom	✓	✓			
United States	✓	✓			

Note: Our regional groupings of countries generally follows FAOSTAT (2000), with the exception that we classified Hong Kong, and Singapore as developed countries while FAOSTAT groups them with developing countries. FAOSTAT also includes the counties we label as "Transition Economies" in their group of developed countries, but identifies them as "Transition Markets" in a separate sub-category.

Appendix Table 1: *Countries in Dataset (continued)*

Region/Country	FAO	COMTRADE	Region/Country	FAO	COMTRADE
Developing Countries					
Afghanistan	✓	✓	Côte d'Ivoire	✓	✓
Af. Other NS		✓	Cuba	✓	✓
Algeria	✓	✓	Cyprus	✓	✓
Amer. Rest NS		✓	Djibouti	✓	
American Samoa		✓	Djibouti Afars-Issas		✓
Angola	✓	✓	Dominica	✓	✓
Anguilla		✓	Dominican Republic	✓	✓
Antigua and Barbuda	✓	✓	Ecuador	✓	✓
Areas NES		✓	Egypt	✓	✓
Argentina	✓	✓	El Salvador	✓	✓
Aruba		✓	Equatorial Guinea		✓
Bahamas, The	✓	✓	Eritrea	✓	✓
Bahrain		✓	Ethiopia	✓	✓
Bangladesh	✓	✓	Ethiopia PDR	✓	
Barbados	✓	✓	Falkland Islands		✓
Belize	✓	✓	Fiji		✓
Benin	✓	✓	Fiji Islands	✓	
Bermuda	✓	✓	Former Ethiopia		✓
Bhutan		✓	Free Zones		✓
Bolivia	✓	✓	French Guiana		✓
Botswana	✓		French Polynesia	✓	✓
Brazil	✓	✓	French Southern & Antarctic		✓
British Indian Ocean Territory		✓	Gabon	✓	✓
British Virgin Islands		✓	Gambia, The	✓	✓
Brunei		✓	Ghana	✓	✓
Brunei Darsm	✓		Greenland		✓
Bunkers		✓	Grenada	✓	✓
Burkina		✓	Guadeloupe		✓
Burkina Faso	✓		Guatemala	✓	✓
Burma		✓	Guinea	✓	✓
Burundi	✓	✓	Guinea-Bissau	✓	✓
Cacm NES		✓	Guyana	✓	✓
Cambodia	✓	✓	Haiti	✓	✓
Cameroon	✓	✓	Honduras	✓	✓
Cape Verde	✓	✓	India	✓	✓
Cayman Islands		✓	Indonesia	✓	✓
Central African Republic	✓	✓	Iran	✓	✓
Chad	✓	✓	Iraq	✓	✓
Chile	✓	✓	Jamaica	✓	✓
China (Peoples Republic of)	✓	✓	Jordan	✓	✓
Christmas Island			Kenya	✓	✓
Cocos (Keeling) Islands		✓	Kiribati	✓	✓
Colombia	✓	✓	Korea, North		✓
Comoros	✓	✓	Korea Dem. Pples. Republic	✓	
Congo, Democratic Republic	✓		Korea, Republic of	✓	✓
Congo, Rep	✓		Kuwait	✓	✓
Congo (Brazzaville)		✓	Laia NES		✓
Cook Islands		✓	Laos	✓	✓
Costa Rica	✓	✓	Lebanon	✓	✓

Appendix Table 1: *Countries in Dataset (continued)*

Region/Country	FAO	COMTRADE	Region/Country	FAO	COMTRADE
Developing Countries					
Lesotho	✓		Saudi Arabia	✓	✓
Liberia	✓	✓	Senegal	✓	✓
Libya	✓	✓	Seychelles	✓	✓
Madagascar	✓	✓	Sierra Leone	✓	✓
Malawi	✓	✓	Solomon Islands	✓	✓
Malaysia	✓	✓	Somalia	✓	✓
Maldives	✓		Spec Cats		✓
Maldive Islands		✓	Sri Lanka	✓	✓
Mali	✓	✓	St. Christopher-Nevis	✓	✓
Marshal Islands		✓	St. Helena (Brit. W. Af.)		✓
Martinique		✓	St. Kitts Nev	✓	
Mauritania	✓	✓	St. Lucia	✓	✓
Mauritius	✓	✓	St. Pierre and Miquelon		✓
México	✓	✓	St. Vincent	✓	
Micronesia, Federated State of		✓	St. Vincent and Grenadines		✓
Mongolia	✓	✓	Sudan	✓	✓
Montserrat		✓	Suriname	✓	✓
Morocco	✓	✓	Swaziland	✓	
Mozambique	✓	✓	Syria	✓	✓
Myanmar	✓		Taiwan (Estimated)		✓
Namibia	✓		Tanzania	✓	
Nauru		✓	Tanzania, United Rep. of		✓
Nepal	✓	✓	Thailand	✓	✓
Netherlands Antilles	✓	✓	Togo	✓	✓
New Caledonia	✓	✓	Tokelau		✓
Nicaragua	✓	✓	Tonga		✓
Niger	✓	✓	Trinidad and Tobago	✓	✓
Nigeria	✓	✓	Trust Territory of Pac. Isles.		✓
Niue		✓	Tunisia	✓	✓
Northern Mariana Islands		✓	Turkey	✓	✓
Oceania NES		✓	Turks and Caicos Islands		✓
Oman		✓	Tuvalu		✓
Pakistan	✓	✓	Uganda	✓	✓
Palau		✓	United Arab Emirates	✓	✓
Panamá	✓	✓	Uruguay	✓	✓
Papua New Guinea		✓	US Msc. Pac. Isles.		✓
Paraguay	✓	✓	Vanuatu	✓	
Perú	✓	✓	Vanuatu/New Hebrides		✓
Philippines	✓	✓	Venezuela	✓	✓
Pitcairn Islands		✓	Vietnam	✓	✓
Portuguese Timor		✓	Yemen	✓	
Qatar		✓	Yemen (Sanaa)		✓
Reunion		✓	Zaire		✓
Rwanda	✓	✓	Zambia	✓	✓
Sao Tome and Principe	✓	✓	Zimbabwe	✓	✓

Source: FAOSTAT (2000) and United Nations Statistical Division, COMTRADE database (1999).

Appendix Table 2: *Products and Commodities*

	FAO		COMTRADE	
Commodity	Code	Product/Description	Code	Product/Description
Bananas	2615	Bananas, fresh or dried	00573	Bananas (including plantains), fresh or dried
Barley	2513	Barley, unmilled	00430	Barley, unmilled
	2656	Beer (etc.), made from malt		
Beans	2546	Beans, excluding broad beans, hrs dry, shelled	05423	Beans, other than broad beans and horse beans, dried and shelled
Cassava	2532	Manioc (cassava) and manioc starch	05481	Manioc (cassava), fresh or dried, whether or not sliced or in the form of pellets
			59214	Cassava (manioc) starch
Chickpeas	191	Chickpeas, dried and shelled	05422	Chickpeas, dried and shelled
Coconut	2560	Coconut fibre and waste, coconuts, copra	26571	Coconut fibers (coir), raw
	2596	Oilcake, coconut, copra	42231	Coconut (copra) oil, crude
	2578	Coconut oil, fractions	42239	Coconut (copra) oil, refined, and its fractions
			05771	Coconuts, fresh or dried, whether or not shelled or peeled
			02231	Copra
			08137	Oil-cake, coconut, copra
			26579	Coconut fibers (coir), processed but not spun
Cowpeas	195	Cow peas, dry		
Groundnut	2591	Oilcake, of groundnuts	42131	Peanut (groundnut) oil, crude
	2572	Groundnut oil, fractions	42139	Peanut (groundnut) oil, refined, and its fractions
	2820	Groundnuts (peanuts)	22211	Groundnuts (peanuts), not roasted or otherwise cooked, in the shell
			22212	Groundnuts (peanuts), not roasted or cooked, shelled
			08132	Oil-cake, of groundnuts
Lentils	201	Lentils, dried, shelled	05423	Lentils, dried and shelled
Maize	2514	Bran (etc.) maize(corn); groats, meal maize (corn); maize (corn) flour; maize (corn) starch; maize, other unmilled; maize seed	08124	Bran, sharps and other residues derived from the sifting, milling or other working of maize (corn)
	2582	Maize (corn) oil, fractions	04721	Groats and meal of maize (corn)
			04711	Maize (corn) flour
			59212	Corn (maize) starch
			42161	Corn (maize) oil, crude
			42169	Corn (maize) oil, refined, and its fractions
			00441	Maize (corn) seed
			00449	Maize (not including sweet corn) unmilled, except seed
Millet	2517	Millet, unmilled	04591	Millet, unmilled
Pigeon peas	197	Pigeon peas		
Plantains	2616	Plantains		
Potato	2531	Flakes of potato; flour and meal of Potato; potato starch; potatoes, dried; potatoes, fresh, chilled; potatoes, unpickled, unfrozen; potatoes, unpickled, frozen	05642	Flakes, granules and pellets of potatoes

Appendix Table 2: *Products and Commodities (continued)*

	FAO		COMTRADE	
Commodity	Code	Product/Description	Code	Product/Description
Potatoes (continued)			05641	Flour and meal of potatoes
			59213	Potato starch
			05611	Potatoes, dried, whether or not cut or sliced, but not further prepared
			00541	Potatoes, fresh or chilled (not including sweet potatoes)
			05676	Potatoes, prepared or preserved otherwise than by vinegar or acetic acid, not frozen
Rice	2804	Bran (etc.), rice; rice husked; rice in the husk; rice,milled, semi milled	08125	Bran, sharps and other residues derived from the sifting, milling or other working of rice
	2581	Rice bran oil	00422	Rice husked but not further prepared (cargo rice or brown rice husked); not further prepared (cargo or brown rice)
			00421	Rice in the husk (paddy or rough rice)
Sorghum	2518	Grain sorghum, unmilled	00453	Grain sorghum, unmilled
Soybeans	2571	Soya bean oil, fractions	08131	Oil
	2590	Oilcake, of soya beans	42111	Soybean oil, crude, whether or not degummed
	2555	Soya beans	42119	Soybean oil, refined, and its fractions
			02222	Soybeans
			09841	Soy sauce
Sweet potatoes	2533	Sweet potatoes		
Wheat	2511	Bran (etc) wheat; durum wheat, unmilled; flour of wheat, meslin; groats, meal, pellts, wheat; other wheat, meslin, unmlled; pasta, uncooked, unprepared; toasted bread (etc); wheat gluten; wheat starch	08126	Bran, sharps and other residues derived from the sifting, milling or other working of wheat
			00411	Durum wheat, unmilled
			00461	Flour of wheat or of meslin
			00462	Groats, meal and pellets, of wheat
			00412	Wheat (including spelt) and meslin, unmilled
			00483	Macaroni, spaghetti and similar products (pasta uncooked, not stuffed or otherwise prepared)
			04841	Crispbread, rusks, toasted bread and similar products
			59217	Wheat gluten, dried or not
			59211	Wheat starch
Yams	2535	Yams		

Source: United Nations Statistical Division COMTRADE database (1999).

Appendix Table 3a: *Production of Cereals, 1997*

	Rice		Wheat		Maize		Barley		Sorghum		Millet	
Rank	Country	Share	Country	Share	Country	Share	Country	Share	Country	Share	Country	Share
Developing Countries												
1	China	32.7	China	20.2	China	16.5	Turkey	5.3	India	14.3	India	37.3
2	India	25.6	India	11.3	Brazil	5.6	China	2.6	Nigeria	11.6	Nigeria	20.9
3	Indonesia	7.6	Turkey	3.1	Mexico	2.8	Iran	1.6	Mexico	9.1	China	8.9
4	Bangladesh	4.4	Pakistan	2.7	Argentina	2.6	India	0.9	China	6.8	Niger	6.1
5	Viet Nam	4.4	Argentina	2.4	India	1.7	Morocco	0.9	Sudan	5.4	Mali	2.6
6	Thailand	3.7	Iran	1.6	Indonesia	1.5	Syria	0.6	Argentina	4.0	Sudan	2.3
7	Myanmar	3.4	Egypt	1.0	Nigeria	0.8	Ethiopia	0.6	Ethiopia	3.2	Burkina Faso	2.1
8	Philippines	1.7	Mexico	0.6	Egypt	0.8	Argentina	0.6	Burkina Faso	1.5	Uganda	1.8
9	Brazil	1.6	Syria	0.5	Philippines	0.7	Iraq	0.5	Egypt	1.2	Senegal	1.5
10	Korea Rep	1.2	Afghanistan	0.4	Thailand	0.6	Mexico	0.3	Mali	0.9	Tanzania	1.2
	Top five	74.7		39.7		29.1		11.3		47.2		75.8
	Top ten	86.6		43.9		33.5		14.0		58.0		84.7
	All	95.2		46.8		40.6		16.0		69.4		93.5
Developed Countries												
1	Japan	2.8	USA	11.1	USA	41.7	Canada	8.7	USA	26.4	USA	0.6
2	USA	1.3	France	5.5	France	2.8	Germany	8.7	Australia	2.3	Australia	0.1
3	Italy	0.2	Canada	4.0	South Africa	1.9	France	6.5	France	0.7	South Africa	0.0
4	Australia	0.2	Germany	3.2	Italy	1.8	Spain	5.5	South Africa	0.7	Spain	0.0
5	Spain	0.1	Australia	3.2	Canada	1.3	USA	5.3	Italy	0.3	Japan	0.0
6	Greece	0.0	UK	2.5	Spain	0.8	UK	5.1	Spain	0.1		0.0
7	Portugal	0.0	Italy	1.1	Germany	0.6	Australia	4.2	Greece	0.0		0.0
8	France	0.0	Denmark	0.8	Japan	0.6	Denmark	2.5	Israel	0.0		0.0
9	South Africa	0.0	Spain	0.8	Greece	0.3	Sweden	1.3		0.0		0.0
10		0.0	South Africa	0.4	Austria	0.3	Finland	1.3		0.0		0.0
	Top five	4.6		27.0		49.5		34.8		30.4		0.8
	Top ten	4.7		32.5		52.0		49.1		30.5		0.8
	All	4.7		34.1		52.4		53.0		30.5		0.8
Transition Economies												
1	Uzbekistan	0.1	Russian Fed	7.2	Romania	2.0	Russian Fed	13.4	Albania	0.0	Russian Fed	4.3
2	Russian Fed	0.1	Ukraine	3.0	Hungary	1.1	Ukraine	4.8	Uzbekistan	0.0	Ukraine	1.1
3	Kazakhstan	0.0	Kazakhstan	1.5	Yugoslavia	1.1	Poland	2.5	Russian Fed	0.0	Kazakhstan	0.2
4	Ukraine	0.0	Poland	1.3	Ukraine	0.9	Kazakhstan	1.7	Hungary	0.0	Hungary	0.0
5	Turkmenistan	0.0	Romania	1.2	Russian Fed	0.4	Czech Rep	1.6	Ukraine	0.0	Czech Rep	0.0
6	Macedonia	0.0	Hungary	0.9	Croatia	0.3	Belarus	1.5	Yugoslavia	0.0	Uzbekistan	0.0
7	Tajikistan	0.0	Czech Rep	0.6	Moldova Rep	0.3	Romania	1.2	Romania	0.0	Slovakia	0.0
8	Hungary	0.0	Bulgaria	0.6	Bulgaria	0.3	Hungary	0.9	Croatia	0.0	Slovenia	0.0
9	Kyrgyzstan	0.0	Uzbekistan	0.5	Slovakia	0.1	Lithuania	0.8	Moldova Rep	0.0	Moldova Rep	0.0
10	Bulgaria	0.0	Yugoslavia	0.5	Georgia	0.1	Slovakia	0.6	Slovakia	0.0	Croatia	0.0
	Top five	0.2		14.2		5.5		24.0		0.1		5.7
	Top ten	0.2		17.3		6.6		28.9		0.1		5.7
	All	0.2		19.1		7.0		30.9		0.1		5.7
World	*644,817,587*[1]	*100*	*610,545,794*[1]	*100*	*650,113,450*[1]	*100*	*154,984,272*[1]	*100*	*62,821,950*[1]	*100*	*28,187,121*[1]	*100*

Source: Compiled from FAOSTAT Database, Bulk FTP, using world average conversion factors (see table 1).

1. Reported in metric tons.

Appendix Table 3b: *Production of Roots, Tubers, Banana, and Plantain, 1997*

	Cassava		Potato		Sweet Potato		Yam		Banana		Plantain	
Rank	Country	Share	Country	Share	Country	Share	Country	Share	Country	Share	Country	Share
Developing Countries												
1	Nigeria	18.4	China	16.5	China	86.1	Nigeria	64.4	India	17.4	Uganda	31.4
2	Brazil	14.7	India	8.7	Uganda	1.5	Côte dIvoire	9.8	Ecuador	12.8	Colombia	8.8
3	Thailand	11.0	Turkey	1.8	Indonesia	1.4	Ghana	7.9	Brazil	10.4	Rwanda	7.6
4	Congo, Dem R	10.6	Iran	1.1	Viet Nam	1.3	Benin	4.6	Philippines	6.4	Congo, Dem R	6.4
5	Indonesia	9.1	Colombia	1.0	India	0.9	Togo	2.2	China	5.3	Ghana	6.1
6	Ghana	4.2	Brazil	1.0	Rwanda	0.8	Cent Afr Rep	1.1	Indonesia	4.8	Nigeria	5.7
7	India	3.6	Peru	0.8	Kenya	0.6	Congo, Dem R	0.9	Colombia	3.8	Côte dIvoire	4.9
8	Tanzania	3.5	Argentina	0.8	Burundi	0.5	Ethiopia	0.9	Costa Rica	3.8	Peru	4.5
9	Mozambique	3.2	Egypt	0.6	Tanzania	0.5	Haiti	0.8	Thailand	2.9	Cameroon	3.5
10	China	2.2	Bangladesh	0.5	Brazil	0.5	Chad	0.8	Mexico	2.9	Tanzania	3.1
	Top five	63.9		29.0		91.2		89.0		52.3		60.3
	Top ten	80.6		32.7		94.0		93.5		70.4		81.9
	All	100		38.6		98.5		98.9		98.4		100.0
Developed Countries												
1		0.0	USA	7.3	Japan	0.9	Japan	0.7	Spain	0.6		0.0
2		0.0	Germany	4.2	USA	0.5	Germany	0.5	Australia	0.4		0.0
3		0.0	Netherlands	2.8	South Africa	0.0	Portugal	0.0	South Africa	0.4		0.0
4		0.0	UK	2.5	New Zealand	0.0		0.0	Israel	0.2		0.0
5		0.0	France	2.3	Spain	0.0		0.0	Portugal	0.1		0.0
6		0.0	Canada	1.4	Portugal	0.0		0.0	USA	0.0		0.0
7		0.0	Japan	1.2	Italy	0.0		0.0	Greece	0.0		0.0
8		0.0	Spain	1.1	Israel	0.0		0.0	Japan	0.0		0.0
9		0.0	Italy	0.7	Australia	0.0		0.0	Italy	0.0		0.0
10		0.0	South Africa	0.5	Greece	0.0		0.0		0.0		0.0
	Top five	0.0		19.0		1.4		1.1		1.6		0.0
	Top ten	0.0		24.0		1.5		1.1		1.6		0.0
	All	0.0		27.4		1.5		1.1		1.6		0.0
Transition Economies												
1		0.0	Russian Fed	12.8		0.0		0.0		0.0	Russian Fed	4.1
2		0.0	Poland	7.2		0.0		0.0		0.0	Kazakhstan	0.2
3		0.0	Ukraine	5.8		0.0		0.0		0.0	Hungary	0.0
4		0.0	Belarus	2.4		0.0		0.0		0.0	Czech Rep	0.0
5		0.0	Romania	1.1		0.0		0.0		0.0	Slovakia	0.0
6		0.0	Lithuania	0.6		0.0		0.0		0.0	Slovenia	0.0
7		0.0	Kazakhstan	0.5		0.0		0.0		0.0	Moldova Rep	0.0
8		0.0	Czech Rep	0.5		0.0		0.0		0.0	Croatia	0.0
9		0.0	Yugoslavia	0.4		0.0		0.0		0.0	Macedonia	0.0
10		0.0	Hungary	0.4		0.0		0.0		0.0		0.0
	Top five	0.0		29.3		0.0		0.0		0.0		4.4
	Top ten	0.0		31.6		0.0		0.0		0.0		4.4
	All	0.0		34.0		0.0		0.0		0.0		0.0
World	*164,908,774*[1]	*100*	*610,545,794*[1]	*100*	*650,113,450*[1]	*100*	*154,984,272*[1]	*100*	*58,561,777*[1]	*100*	*29,629,425*[1]	*100*

Source: Compiled from FAOSTAT Database, Bulk FTP, using world average conversion factors (see table 1).

1. Reported in metric tons.

Appendix Table 3c: *Production of Food Legumes, 1997*

	Chickpeas		Cowpeas		Beans		Lentil		Pigeon peas		Soybeans	
Rank	Country	Share	Country	Share	Country	Share	Country	Share	Country	Share	Country	Share
Developing Countries												
1	India	68.6	Nigeria	63.7	India	21.3	India	32.2	India	85.5	Brazil	17.5
2	Turkey	8.6	Niger	18.5	Brazil	17.7	Turkey	18.8	Myanmar	5.7	China	9.6
3	Pakistan	7.1	Myanmar	2.4	China	7.7	Bangladesh	6.2	Malawi	3.4	Argentina	8.7
4	Iran	3.2	Malawi	2.2	Mexico	5.7	Iran	4.7	Uganda	2.1	India	4.0
5	Mexico	2.4	Mali	2.1	Indonesia	5.1	Nepal	4.5	Tanzania	1.4	Mexico	1.4
6	Ethiopia	1.5	Uganda	2.0	Myanmar	5.0	China	3.9	Nepal	0.7	Paraguay	1.1
7	Myanmar	1.1	Tanzania	1.7	Burundi	1.6	Syria	3.2	Dominican Rp	0.5	Bolivia	0.7
8	Bangladesh	0.7	Haiti	1.4	Korea D P Rp	1.6	Ethiopia	1.3	Venezuela	0.1	Korea Rep	0.6
9	Syria	0.7	Senegal	1.4	Argentina	1.6	Pakistan	1.3	Trinidad Tob	0.1	Thailand	0.5
10	Morocco	0.5	Mauritania	0.9	Turkey	1.4	Morocco	1.0	Haiti	0.1	Indonesia	0.4
	Top five	89.8		88.9		57.5		66.5		98.1		41.2
	Top ten	94.3		96.3		68.7		77.1		99.6		44.5
	All	96.6		98.0		86.0		79.5		100.0		46.4
Developed Countries												
1	Australia	2.3	South Africa	0.2	USA	7.8	Canada	13.8		0.0	USA	41.1
2	Spain	0.8	USA	0.1	Canada	0.9	USA	4.0		0.0	Netherlands	2.2
3	Portugal	0.1	Australia	0.1	Japan	0.6	Australia	1.3		0.0	Japan	2.1
4	Israel	0.1	Japan	0.0	South Africa	0.4	Spain	0.8		0.0	Germany	1.9
5	Italy	0.0		0.0	Australia	0.2	France	0.2		0.0	Canada	1.6
6	Greece	0.0		0.0	Spain	0.2	New Zealand	0.1		0.0	Spain	1.3
7		0.0		0.0	Greece	0.1	Greece	0.0		0.0	Italy	1.0
8		0.0		0.0	Italy	0.1	Italy	0.0		0.0	UK	0.4
9		0.0		0.0	Ireland	0.1	Israel	0.0		0.0	France	0.3
10				0.0	Portugal	0.1				0.0	Portugal	0.3
	Top five	3.3		0.5		10.0		20.1		0.0		48.9
	Top ten	3.3		0.5		10.6		20.2		0.0		52.3
	All	3.3		0.5		10.7		20.2		0.0		53.1
Transition Economies												
1	Bulgaria	0.0	Yugoslavia	1.2	Belarus	1.2	Russian Fed	0.1		0.0	Russian Fed	0.1
2	Kazakhstan	0.0	Macedonia	0.3	Yugoslavia	0.4	Bulgaria	0.1		0.0	Yugoslavia	0.1
3	Macedonia	0.0	Bosnia Herzg	0.1	Romania	0.3	Slovakia	0.1		0.0	Romania	0.1
4	Bosnia Herzg	0.0	Croatia	0.0	Ukraine	0.3	Hungary	0.0		0.0	Croatia	0.1
5		0.0	Slovenia	0.0	Poland	0.3	Tajikistan	0.0		0.0	Poland	0.0
6		0.0		0.0	Moldova Rep	0.2	Azerbaijan	0.0		0.0	Hungary	0.0
7		0.0		0.0	Bulgaria	0.1	Slovenia	0.0		0.0	Bulgaria	0.0
8		0.0		0.0	Croatia	0.1	Macedonia	0.0		0.0	Uzbekistan	0.0
9		0.0		0.0	Albania	0.1	Croatia	0.0		0.0	Ukraine	0.0
10		0.0		0.0	Macedonia	0.1	Bosnia Herzg	0.0		0.0	Czech Rep	0.0
	Top five	0.1		1.5		2.4		0.3		0.0		0.4
	Top ten	0.1		1.5		3.1		0.3		0.0		0.5
	All	0.1		1.5		3.3		0.3		0.0		0.5
World	*8,388,650*[1]	*0*	*610,545,794*[1]	*100*	*650,113,450*[1]	*100*	*154,984,272*[1]	*100*	*2,865,901*[1]	*100*	*369,961,368*[1]	*100*

Source: Compiled from FAOSTAT Database, Bulk FTP, using world average conversion factors (see table 1).
1. Reported in metric tons.

Appendix Table 3d: *Production of Oil Crops, 1997*

	Groundnut		Coconut	
Rank	Country	Share	Country	Share
Developing Countries				
1	China	32.3	Philippines	33.1
2	India	31.1	Indonesia	27.2
3	Nigeria	9.9	India	16.2
4	Sudan	2.9	Viet Nam	3.3
5	Myanmar	2.3	Mexico	3.1
6	Senegal	2.0	Sri Lanka	2.5
7	Indonesia	1.8	Thailand	2.4
8	Argentina	1.3	Papua N Guin	1.2
9	Congo, Dem R	1.1	Malaysia	1.2
10	Chad	0.9	Mozambique	1.1
	Top five	78.4		83.0
	Top ten	85.5		91.2
	All	94.9		98.4
Developed Countries				
1	USA	3.6	Germany	0.9
2	South Africa	0.5	Japan	0.4
3	Netherlands	0.4	Ireland	0.2
4	France	0.1	UK	0.1
5	Australia	0.1	Sweden	0.0
6	Japan	0.1	China, H.Kong	0.0
7	Greece	0.0	New Zealand	0.0
8	Italy	0.0	Spain	0.0
9	Israel	0.0	Denmark	0.0
10	Portugal	0.0		0.0
	Top five	4.6		1.6
	Top ten	4.8		1.6
	All	4.9		1.6
Transition Economies				
1	Czech Rep	0.1	Poland	0.0
2	Uzbekistan	0.1		0.0
3	Bulgaria	0.0		0.0
4	Poland	0.0		0.0
5	Slovakia	0.0		0.0
6	Yugoslavia	0.0		0.0
7	Kazakhstan	0.0		0.0
8	Georgia	0.0		0.0
9		0.0		0.0
10		0.0		0.0
	Top five	0.2		0.0
	Top ten	0.2		0.0
	All	0.2		0.0
World	*63,701,898*[1]	*100*	*610,545,794*[1]	*100*

Source: Compiled from FAOSTAT Database, Bulk FTP, using world average conversion factors (see table 1).

1. Reported in metric tons.

Appendix Table 4a*: Soybean Exports by Developing Countries, 1994–98 Annual Average*

A. Country to country (top 20)

	Origin	Destination	Value	Share
			(1,000 US$)	%
1	Brazil	France	694,516	13.50
2	Brazil	Netherlands, The	433,358	8.42
3	Brazil	Spain	399,448	7.76
4	Brazil	Germany	398,274	7.74
5	Argentina	Italy	298,215	5.80
6	Brazil	Italy	220,791	4.29
7	Argentina	Netherlands, The	218,000	4.24
8	Brazil	Japan	214,666	4.17
9	Argentina	Spain	200,477	3.90
10	Argentina	Germany	179,545	3.49
11	Brazil	Belgium	164,946	3.21
12	Brazil	United Kingdom	153,521	2.98
13	Argentina	Denmark	139,086	2.70
14	Argentina	Belgium	124,401	2.42
15	Brazil	Denmark	120,167	2.34
16	Brazil	Portugal	107,354	2.09
17	China (PRC)	Japan	94,844	1.84
18	Paraguay	Netherlands, The	90,443	1.76
19	China (PRC)	Hong Kong	74,070	1.44
20	Argentina	France	70,024	1.36
	Total		*4,396,149*	*85.43*

B. Country to region (top20)

Origin	Destination	Value	Share
		(1,000 US$)	%
Brazil	Developed	3,044,148	59.16
Argentina	Developed	1,501,520	29.18
Paraguay	Developed	219,284	4.26
China (PRC)	Developed	187,176	3.64
India	Developed	61,490	1.19
Malaysia	Developed	47,043	0.91
Taiwan (estimated)	Developed	14,560	0.28
Areas NES	Developed	11,170	0.22
Uruguay	Developed	10,737	0.21
Bolivia	Developed	9,365	0.18
Mexico	Developed	8,232	0.16
Korea, Republic of	Developed	5,907	0.11
Indonesia	Developed	4,429	0.09
Thailand	Developed	3,553	0.07
Zimbabwe	Developed	2,415	0.05
Philippines, The	Developed	1,890	0.04
Zambia	Developed	1,872	0.04
Chile	Developed	1,850	0.04
Trinidad and Tobago	Developed	1,593	0.03
Algeria	Developed	1,099	0.02
Total		*5,139,331*	*99.88*

C. Subregion to region (total)

Origin	Destination	Value	Share
		(1,000 US$)	*%*
Developing	Western Europe	4,367,714	84.88
Developing	Eastern Asia[1]	596,874	11.60
Developing	Southern Africa	49,025	0.95
Developing	Southeast Asia	50,520	0.98
Developing	North America	48,142	0.94
Developing	Australia/NZ	25,754	0.50
Developing	West Asia	7,686	0.15
Total		*5,145,714*	*100*

Source : Compiled from United Nations Statistical Division, COMTRADE database (1999).

[1] Includes Japan, Hong Kong, and Macau.

Appendix Table 4b*: Banana Exports by Developing Countries, 1994–98 Annual Average*

A. Country to country (top 20)

	Origin	Destination	Value	Share
			(1,000 US$)	%
1	Costa Rica	United States	361,840	7.78
2	Ecuador	United States	347,154	7.46
3	Philippines, The	Japan	305,293	6.56
4	Ecuador	Germany	220,137	4.73
5	Colombia	United States	204,345	4.39
6	Panama	Germany	188,669	4.06
7	Guatemala	United States	181,791	3.91
8	Honduras	United States	180,406	3.88
9	Costa Rica	Germany	170,734	3.67
10	Colombia	Germany	156,224	3.36
11	Cote d'Ivoire	France	96,167	2.07
12	Cameroon	France	93,875	2.02
13	Colombia	Belgium	88,784	1.91
14	Costa Rica	Belgium	86,056	1.85
15	Ecuador	Italy	85,973	1.85
16	Ecuador	Japan	76,633	1.65
17	Ecuador	Belgium	73,213	1.57
18	Mexico	United States	67,387	1.45
19	St. Lucia	United Kingdom	63,678	1.37
20	Jamaica	United Kingdom	63,495	1.37
	Total		*3,111,853*	*66.90*

B. Country to region (top20)

Origin	Destination	Value	Share
		(1,000 US$)	%
Ecuador	Developed	974,634	20.95
Costa Rica	Developed	957,633	20.59
Colombia	Developed	666,268	14.32
Panama	Developed	440,780	9.48
Philippines, The	Developed	320,658	6.89
Honduras	Developed	240,460	5.17
Guatemala	Developed	220,608	4.74
Cameroon	Developed	128,069	2.75
Cote d'Ivoire	Developed	123,920	2.66
Mexico	Developed	75,337	1.62
St. Lucia	Developed	64,868	1.39
Jamaica	Developed	63,698	1.37
Taiwan (estimated)	Developed	48,361	1.04
Martinique	Developed	46,971	1.01
Dominican Republic	Developed	45,176	0.97
Belize	Developed	32,728	0.70
Venezuela	Developed	30,828	0.66
St.Vincent/Grenadines	Developed	28,700	0.62
Dominica	Developed	26,518	0.57
Surinam	Developed	23,694	0.51
Total		*4,559,908*	*98.03*

C. Subregion to region (total)

Origin	Destination	Value	Share
		(1,000 US$)	*%*
Developing	Western Europe	2,576,637	55.39
Developing	North America	1,601,175	34.42
Developing	Eastern Asia[1]	462,781	9.95
Developing	Southeast Asia	10,403	0.22
Developing	Southern Africa	407	0.01
Developing	Australia/NZ	25	0.00
Developing	West Asia	6	0.00
Total		*4,651,434*	*100*

Source : Compiled from United Nations Statistical Division, COMTRADE database (1999).

[1] Includes Japan, Hong Kong, and Macau.

Appendix Table 4c*: Rice Exports by Developing Countries, 1994–98 Annual Average*

A. Country to country (top 20)

	Origin	Destination	Value	Share
			(1,000 US$)	%
1	Thailand	Hong Kong	138,505	11.15
2	China (PRC)	Japan	130,816	10.53
3	Thailand	United States	129,059	10.39
4	Thailand	Singapore	113,186	9.11
5	Thailand	Japan	109,648	8.83
6	Thailand	S.Afr.Cus.Un	71,291	5.74
7	India	United Kingdom	58,717	4.73
8	Thailand	France	51,902	4.18
9	Netherlands Antilles	Netherlands, The	44,946	3.62
10	India	United States	30,564	2.46
11	Thailand	Canada	26,008	2.09
12	India	S.Afr.Cus.Un	24,563	1.98
13	Netherlands Antilles	Portugal	22,065	1.78
14	India	France	22,022	1.77
15	Thailand	Israel	15,927	1.28
16	Thailand	Australia	14,452	1.16
17	Thailand	Italy	11,875	0.96
18	Netherlands Antilles	Germany	10,278	0.83
19	Aruba	Netherlands, The	10,043	0.81
20	Thailand	Germany	9,469	0.76
	Total		*1,045,335*	*84.16*

B. Country to region (top20)

Origin	Destination	Value	Share
		(1,000 US$)	%
Thailand	Developed	728,786	58.68
India	Developed	164,644	13.26
China (PRC)	Developed	142,723	11.49
Netherlands Antilles	Developed	92,976	7.49
Pakistan	Developed	21,583	1.74
Guyana	Developed	17,419	1.40
Surinam	Developed	17,357	1.40
Vietnam	Developed	17,345	1.40
Aruba	Developed	11,625	0.94
Montserrat	Developed	6,312	0.51
Uruguay	Developed	2,846	0.23
Egypt	Developed	2,404	0.19
Areas NES	Developed	2,281	0.18
Turks/Caicos Isles	Developed	1,709	0.14
French Guiana	Developed	1,636	0.13
Burma	Developed	1,513	0.12
Brazil	Developed	1,207	0.10
Argentina	Developed	1,047	0.08
Sri Lanka	Developed	695	0.06
Madagascar	Developed	634	0.05
Total		*1,236,743*	*99.57*

C. Subregion to region (total)

Origin	Destination	Value	Share
		(1,000 US$)	*%*
Developing	Western Europe	394,174	31.74
Developing	Eastern Asia[1]	395,493	31.84
Developing	North America	210,338	16.93
Developing	Southeast Asia	123,713	9.96
Developing	Southern Africa	78,827	6.35
Developing	Australia/NZ	20,743	1.67
Developing	West Asia	18,776	1.51
Total		*1,242,062*	*100*

Source : Compiled from United Nations Statistical Division, COMTRADE database (1999).

[1] Includes Japan, Hong Kong, and Macau.

Appendix Table 4d*: Coconut Exports by Developing Countries, 1994–98 Annual Average*

A. Country to country (top 20)

	Origin	Destination	Value	Share
			(1,000 US$)	%
1	Philippines, The	United States	329,357	27.98
2	Philippines, The	Germany	110,351	9.37
3	Philippines, The	Netherlands, The	94,354	8.01
4	Indonesia	Germany	65,720	5.58
5	Indonesia	Netherlands, The	39,089	3.32
6	Indonesia	United States	36,147	3.07
7	Philippines, The	Belgium	25,491	2.17
8	Philippines, The	Japan	23,963	2.04
9	Philippines, The	Italy	21,009	1.78
10	Papua New Guinea	United Kingdom	19,027	1.62
11	Indonesia	Belgium	18,421	1.56
12	Indonesia	Spain	18,344	1.56
13	Malaysia	Singapore	18,239	1.55
14	Philippines, The	France	15,513	1.32
15	Indonesia	Italy	15,200	1.29
16	Papua New Guinea	Germany	13,764	1.17
17	Indonesia	France	13,530	1.15
18	Philippines	United Kingdom	13,388	1.14
19	Papua New Guinea	Japan	11,828	1.00
20	Philippines, The	Canada	9,766	0.83
	Total		*912,499*	*77.51*

B. Country to region (top20)

Origin	Destination	Value	Share
		(1,000 US$)	%
Philippines, The	Developed	683,466	58.06
Indonesia	Developed	250,972	21.32
Papua New Guinea	Developed	55,788	4.74
Sri Lanka	Developed	47,823	4.06
Malaysia	Developed	39,193	3.33
Cote d'Ivoire	Developed	24,851	2.11
Vanuatu/New Hebrides	Developed	10,788	0.92
Dominican Republic	Developed	10,574	0.90
Solomon Islands	Developed	9,030	0.77
Thailand	Developed	8,492	0.72
Mozambique	Developed	6,464	0.55
French Polynesia	Developed	4,845	0.41
American Samoa	Developed	4,619	0.39
Fiji	Developed	3,633	0.31
India	Developed	2,512	0.21
Marshal Islands	Developed	2,358	0.20
Mexico	Developed	1,797	0.15
Areas NES	Developed	1,749	0.15
Brazil	Developed	1,406	0.12
Argentina	Developed	1,013	0.09
Total		*1,171,373*	*99.50*

C. Subregion to region (total)

Origin	Destination	Value	Share
		(1,000 US$)	*%*
Developing	Western Europe	661,028	56.15
Developing	North America	402,726	34.21
Developing	Eastern Asia[1]	56,031	4.76
Developing	Australia/NZ	26,818	2.28
Developing	Southeast Asia	23,420	1.99
Developing	Southern Africa	5,537	0.47
Developing	West Asia	1,697	0.14
Total		*1,177,257*	*100*

Source : Compiled from United Nations Statistical Division, COMTRADE database (1999).

[1] Includes Japan, Hong Kong, and Macau.

Appendix Table 4e*: Groundnut Exports by Developing Countries, 1994–98 Annual Average*

A. Country to country (top 20)

	Origin	Destination	Value	Share
			(1,000 US$)	%
1	China (PRC)	Netherlands, The	62,154	9.28
2	Argentina	Netherlands, The	61,520	9.19
3	Senegal	France	49,009	7.32
4	Argentina	Germany	33,926	5.07
5	Argentina	United States	33,686	5.03
6	China (PRC)	Japan	25,000	3.73
7	Sudan	Italy	24,233	3.62
8	Argentina	France	19,955	2.98
9	China (PRC)	Hong Kong	19,525	2.92
10	Argentina	United Kingdom	18,102	2.70
11	India	United Kingdom	17,529	2.62
12	Sudan	France	15,706	2.35
13	China (PRC)	France	15,580	2.33
14	Vietnam	Singapore	15,409	2.30
15	China (PRC)	Germany	15,356	2.29
16	China (PRC)	Spain	14,917	2.23
17	Argentina	Canada	13,311	1.99
18	Senegal	Italy	12,863	1.92
19	China (PRC)	United Kingdom	11,996	1.79
20	Argentina	Belgium	10,884	1.63
	Total		*490,662*	*73.26*

B. Country to region (top20)

Origin	Destination	Value	Share
		(1,000 US$)	%
Argentina	Developed	227,653	33.99
China (PRC)	Developed	209,950	31.35
Senegal	Developed	81,723	12.20
Sudan	Developed	48,962	7.31
India	Developed	35,883	5.36
Vietnam	Developed	16,213	2.42
Brazil	Developed	10,003	1.49
Nigeria	Developed	8,487	1.27
Gambia, The	Developed	6,856	1.02
Nicaragua	Developed	5,745	0.86
Egypt	Developed	5,131	0.77
Mexico	Developed	3,533	0.53
Paraguay	Developed	1,369	0.20
Saudi Arabia	Developed	998	0.15
Zimbabwe	Developed	863	0.13
Uruguay	Developed	769	0.11
Malaysia	Developed	700	0.10
Chad	Developed	629	0.09
Antigua and Barbuda	Developed	547	0.08
Indonesia	Developed	390	0.06
Total		*666,405*	*99.50*

C. Subregion to region (total)

Origin	Destination	Value	Share
		(1,000 US$)	*%*
Developing	Western Europe	498,319	74.40
Developing	North America	64,733	9.67
Developing	Eastern Asia[1]	53,390	7.97
Developing	Southeast Asia	34,055	5.08
Developing	Australia/NZ	9,964	1.49
Developing	Southern Africa	9,080	1.36
Developing	West Asia	200	0.03
Total		*669,741*	*100*

Source : Compiled from United Nations Statistical Division, COMTRADE database (1999).

[1] Includes Japan, Hong Kong, and Macau.

Appendix Table 4f*: Wheat Exports by Developing Countries, 1994–98 Annual Average*

A. Country to country (top 20)

	Origin	Destination	Value	Share
			(1,000 US$)	%
1	Mexico	United States	83,465	13.91
2	China (PRC)	Hong Kong	68,745	11.46
3	Malaysia	Singapore	37,375	6.23
4	Thailand	Japan	33,976	5.66
5	China (PRC)	Japan	25,854	4.31
6	Mexico	Italy	21,856	3.64
7	China (PRC)	United States	20,305	3.38
8	Korea, Republic of	United States	19,636	3.27
9	Taiwan (estimated)	United States	17,304	2.88
10	Thailand	United States	16,160	2.69
11	Indonesia	Japan	15,924	2.65
12	Malaysia	Hong Kong	8,120	1.35
13	Korea, Republic of	Hong Kong	8,066	1.34
14	Turkey	United States	7,520	1.25
15	Spec Cats	Germany	7,255	1.21
16	Taiwan (estimated)	Japan	6,306	1.05
17	Taiwan (estimated)	Hong Kong	6,239	1.04
18	Turkey	Italy	5,942	0.99
19	China (PRC)	Singapore	5,522	0.92
20	Philippines	United States	4,913	0.82
	Total		*420,483*	*70.07*

B. Country to region (top20)

Origin	Destination	Value	Share
		(1,000 US$)	%
China (PRC)	Developed	138,909	23.15
Mexico	Developed	110,269	18.37
Thailand	Developed	76,411	12.73
Malaysia	Developed	53,006	8.83
Korea, Republic of	Developed	38,908	6.48
Taiwan (estimated)	Developed	38,484	6.41
Indonesia	Developed	21,507	3.58
Turkey	Developed	20,102	3.35
Argentina	Developed	12,932	2.15
Saudi Arabia	Developed	11,882	1.98
Philippines	Developed	9,010	1.50
Spec Cats	Developed	7,556	1.26
Syria	Developed	6,193	1.03
Vietnam	Developed	5,325	0.89
Chile	Developed	4,962	0.83
Sri Lanka	Developed	4,571	0.76
Nigeria	Developed	4,377	0.73
Jamaica	Developed	3,623	0.60
Areas NES	Developed	3,089	0.51
India	Developed	2,982	0.50
Total		*574,101*	*95.66*

C. Subregion to region (total)

Origin	Destination	Value	Share
		(1,000 US$)	*%*
Developing	North America	218,970	36.49
Developing	Eastern Asia[1]	197,249	32.87
Developing	Western Europe	104,051	17.34
Developing	Southeast Asia	52,651	8.77
Developing	Australia/NZ	16,468	2.74
Developing	Southern Africa	7,198	1.20
Developing	West Asia	3,530	0.59
Total		*600,116*	*100*

Source : Compiled from United Nations Statistical Division, COMTRADE database (1999).

[1] Includes Japan, Hong Kong, and Macau.

Appendix Table 4g*: Cassava Exports by Developing Countries, 1994–98 Annual Average*

A. Country to country (top 20)

	Origin	Destination	Value	Share
			(1,000 US$)	%
1	Thailand	Netherlands, The	179,755	35.40
2	Thailand	Spain	91,672	18.05
3	Thailand	Belgium	46,630	9.18
4	Thailand	Portugal	35,166	6.93
5	Thailand	Japan	24,194	4.76
6	Thailand	Germany	24,175	4.76
7	Costa Rica	United States	20,227	3.98
8	Indonesia	France	11,979	2.36
9	Indonesia	Spain	10,960	2.16
10	Thailand	Hong Kong	8,603	1.69
11	Thailand	Singapore	7,354	1.45
12	Thailand	United States	6,486	1.28
13	Indonesia	Japan	4,796	0.94
14	Indonesia	Italy	4,499	0.89
15	Thailand	France	2,785	0.55
16	Thailand	Australia	2,001	0.39
17	Costa Rica	Netherlands, The	1,609	0.32
18	Indonesia	Germany	1,465	0.29
19	Indonesia	Belgium	1,407	0.28
20	Philippines, The	France	1,287	0.25
	Total		*487,050*	*95.92*

B. Country to region (top20)

Origin	Destination	Value	Share
		(1,000 US$)	%
Thailand	Developed	433,047	85.28
Indonesia	Developed	36,439	7.18
Costa Rica	Developed	23,891	4.70
Philippines, The	Developed	2,502	0.49
Vietnam	Developed	2,309	0.45
China (PRC)	Developed	2,277	0.45
Ghana	Developed	1,314	0.26
India	Developed	1,157	0.23
Madagascar	Developed	524	0.10
Brazil	Developed	510	0.10
Taiwan (estimated)	Developed	467	0.09
Malaysia	Developed	398	0.08
Ecuador	Developed	372	0.07
Tanzania, United Republic	Developed	291	0.06
Argentina	Developed	288	0.06
Jamaica	Developed	273	0.05
Fiji	Developed	271	0.05
Dominican Republic	Developed	193	0.04
Benin	Developed	176	0.03
Tonga	Developed	168	0.03
Total		*506,866*	*99.82*

C. Subregion to region (total)

Origin	Destination	Value	Share
		(1,000 US$)	*%*
Developing	Western Europe	427,931	84.27
Developing	Eastern Asia[1]	38,866	7.65
Developing	North America	29,051	5.72
Developing	Southeast Asia	8,554	1.68
Developing	Australia/NZ	2,594	0.51
Developing	Southern Africa	794	0.16
Total		*507,791*	*100*

Source : Compiled from United Nations Statistical Division, COMTRADE database (1999).

[1] Includes Japan, Hong Kong, and Macau.

Appendix Table 4h*: Maize Exports by Developing Countries, 1994–98 Annual Average*

A. Country to country (top 20)

	Origin	Destination	Value	Share
			(1,000 US$)	%
1	China (PRC)	Japan	63,880	14.69
2	Argentina	Japan	61,621	14.17
3	Argentina	United Kingdom	42,400	9.75
4	Argentina	Spain	40,573	9.33
5	Chile	United States	36,933	8.50
6	Argentina	United States	19,068	4.39
7	Argentina	Germany	14,429	3.32
8	Argentina	S.Afr.Cus.Un	12,185	2.80
9	Argentina	Portugal	11,458	2.64
10	Chile	France	9,815	2.26
11	Areas NES	France	8,943	2.06
12	Argentina	Belgium	8,258	1.90
13	Kenya	S.Afr.Cus.Un	7,432	1.71
14	Zimbabwe	S.Afr.Cus.Un	7,107	1.63
15	Argentina	Netherlands	7,102	1.63
16	Mexico	United States	5,733	1.32
17	Malaysia	Singapore	5,511	1.27
18	Argentina	France	5,271	1.21
19	Argentina	Italy	3,433	0.79
20	Argentina	Norway	3,384	0.78
	Total		*374,538*	*86.15*

B. Country to region (top20)

Origin	Destination	Value	Share
		(1,000 US$)	%
Argentina	Developed	232,611	53.51
China (PRC)	Developed	69,438	15.97
Chile	Developed	51,928	11.94
Mexico	Developed	9,952	2.29
Zimbabwe	Developed	9,447	2.17
Areas NES	Developed	9,292	2.14
Turkey	Developed	8,016	1.84
Malaysia	Developed	6,006	1.38
Kenya	Developed	5,951	1.37
Brazil	Developed	4,843	1.11
Thailand	Developed	4,008	0.92
Indonesia	Developed	3,659	0.84
Peru	Developed	3,485	0.80
Vietnam	Developed	3,390	0.78
Burma	Developed	2,823	0.65
Venezuela	Developed	2,157	0.50
Spec Cats	Developed	1,575	0.36
Madagascar	Developed	1,256	0.29
Cyprus	Developed	779	0.18
Colombia	Developed	521	0.12
Total		*431,138*	*99.17*

C. Subregion to region (total)

Origin	Destination	Value	Share
		(1,000 US$)	*%*
Developing	Western Europe	178,004	40.94
Developing	Eastern Asia[1]	142,714	32.83
Developing	North America	68,149	15.68
Developing	Southern Africa	24,790	5.70
Developing	Southeast Asia	15,102	3.47
Developing	West Asia	5,498	1.26
Developing	Australia/NZ	485	0.11
Total		*434,742*	*100*

Source : Compiled from United Nations Statistical Division, COMTRADE database (1999).

[1] Includes Japan, Hong Kong, and Macau.

Appendix Table 4i*: Bean Exports by Developing Countries, 1994–98 Annual Average*

A. Country to country (top 20)

	Origin	Destination	Value	Share
			(1,000 US$)	%
1	China (PRC)	Japan	76,096	23.33
2	Argentina	Spain	28,484	8.73
3	China (PRC)	Italy	27,209	8.34
4	China (PRC)	S.Afr.Cus.Un	18,205	5.58
5	Argentina	Italy	13,897	4.26
6	Burma	Singapore	9,169	2.81
7	Thailand	Japan	8,662	2.66
8	Burma	Japan	8,000	2.45
9	China (PRC)	United States	7,335	2.25
10	Argentina	France	6,248	1.92
11	China (PRC)	Hong Kong	6,196	1.90
12	China (PRC)	Netherlands, The	5,748	1.76
13	China (PRC)	Spain	5,410	1.66
14	Argentina	Portugal	5,049	1.55
15	China (PRC)	France	5,031	1.54
16	Tanzania, United Republi	Netherlands, The	3,929	1.20
17	China (PRC)	Portugal	3,559	1.09
18	Madagascar	France	3,415	1.05
19	Turkey	Germany	3,229	0.99
20	Mexico	United States	2,682	0.82
	Total		*247,554*	*75.89*

B. Country to region (top20)

Origin	Destination	Value	Share
		(1,000 US$)	%
China (PRC)	Developed	161,587	49.54
Argentina	Developed	59,104	18.12
Turkey	Developed	16,438	5.04
Burma	Developed	19,016	5.83
Thailand	Developed	17,752	5.44
Peru	Developed	6,225	1.91
Ethiopia	Developed	6,505	1.99
India	Developed	3,978	1.22
Mexico	Developed	4,039	1.24
Tanzania, United Republi	Developed	4,850	1.49
Madagascar	Developed	4,120	1.26
Chile	Developed	4,709	1.44
Brazil	Developed	1,733	0.53
El Salvador	Developed	1,063	0.33
Syria	Developed	1,985	0.61
Bolivia	Developed	1,223	0.37
Egypt	Developed	2,088	0.64
Vietnam	Developed	679	0.21
Taiwan (estimated)	Developed	692	0.21
Morocco	Developed	736	0.23
Total		*318,523*	*97.65*

C. Subregion to region (total)

Origin	Destination	Value	Share
		(1,000 US$)	*%*
Developing	Western Europe	167,182	51.25
Developing	Eastern Asia[1]	105,584	32.37
Developing	North America	20,946	6.42
Developing	Southern Africa	16,155	4.95
Developing	Southeast Asia	13,659	4.19
Developing	West Asia	2,306	0.71
Developing	Australia/NZ	347	0.11
Total		*326,180*	*100*

Source : Compiled from United Nations Statistical Division, COMTRADE database (1999).

[1] Includes Japan, Hong Kong, and Macau.

Appendix Table 4j*: Potato Exports by Developing Countries, 1994–98 Annual Average*

A. Country to country (top 20)

	Origin	Destination	Value	Share
			(1,000 US$)	%
1	Egypt	United Kingdom	35,919	15.21
2	Morocco	France	27,844	11.79
3	Cyprus	United Kingdom	27,656	11.71
4	Egypt	Germany	24,119	10.21
5	Cyprus	Germany	23,720	10.04
6	Cyprus	Belgium	21,338	9.03
7	Egypt	Greece	10,482	4.44
8	Morocco	Germany	8,920	3.78
9	Egypt	Spain	5,002	2.12
10	Cyprus	Norway	4,722	2.00
11	Egypt	Italy	4,137	1.75
12	Spec Cats	Netherlands, The	4,001	1.69
13	Turkey	Greece	3,623	1.53
14	Turkey	Italy	2,829	1.20
15	Egypt	France	2,719	1.15
16	Cyprus	Ireland	2,263	0.96
17	Malaysia	Singapore	2,058	0.87
18	Cyprus	Austria	1,965	0.83
19	China (PRC)	Hong Kong	1,537	0.65
20	Turkey	Spain	1,361	0.58
	Total		*216,212*	*91.53*

B. Country to region (top20)

Origin	Destination	Value	Share
		(1,000 US$)	%
Egypt	Developed	84,675	35.85
Cyprus	Developed	83,416	35.31
Morocco	Developed	39,647	16.78
Turkey	Developed	10,562	4.47
Spec Cats	Developed	4,067	1.72
China (PRC)	Developed	3,490	1.48
Malaysia	Developed	3,241	1.37
Areas NES	Developed	1,164	0.49
Brazil	Developed	967	0.41
Tunisia	Developed	837	0.35
Mexico	Developed	693	0.29
Thailand	Developed	616	0.26
Taiwan (estimated)	Developed	432	0.18
Syria	Developed	349	0.15
India	Developed	220	0.09
Jamaica	Developed	203	0.09
Cuba	Developed	195	0.08
United Arab Emirates	Developed	177	0.08
Korea, Republic of	Developed	147	0.06
Philippines, The	Developed	126	0.05
Total		*235,225*	*99.58*

C. Subregion to region (total)

Origin	Destination	Value	Share
		(1,000 US$)	*%*
Developing	Western Europe	226,338	95.82
Developing	Eastern Asia[1]	4,255	1.80
Developing	Southeast Asia	3,519	1.49
Developing	North America	1,521	0.64
Developing	West Asia	423	0.18
Developing	Australia/NZ	91	0.04
Developing	Southern Africa	67	0.03
Total		*236,214*	*100*

Source : Compiled from United Nations Statistical Division, COMTRADE database (1999).

[1] Includes Japan, Hong Kong, and Macau.

Appendix Table 4k*: Chickpea Exports by Developing Countries, 1994–98 Annual Average*

A. Country to country (top 20)

	Origin	Destination	Value	Share
			(1,000 US$)	%
1	Mexico	Spain	34,352	37.33
2	Mexico	United States	7,100	7.72
3	Mexico	Italy	6,260	6.80
4	Turkey	Italy	5,980	6.50
5	Turkey	France	5,680	6.17
6	Turkey	Spain	5,424	5.89
7	Turkey	Israel	3,143	3.42
8	Turkey	Greece	3,081	3.35
9	Turkey	Portugal	2,781	3.02
10	Mexico	Portugal	2,744	2.98
11	Mexico	France	2,031	2.21
12	Turkey	United Kingdom	2,018	2.19
13	Mexico	Greece	1,770	1.92
14	Turkey	Germany	1,509	1.64
15	India	United Kingdom	1,091	1.19
16	Turkey	United States	703	0.76
17	Turkey	Netherlands, The	559	0.61
18	Mexico	Canada	531	0.58
19	Turkey	Canada	519	0.56
20	India	United States	414	0.45
	Total		*87,690*	*95.29*

B. Country to region (top20)

Origin	Destination	Value	Share
		(1,000 US$)	%
Mexico	Developed	55,592	60.41
Turkey	Developed	32,834	35.68
India	Developed	1,802	1.96
Lebanon	Developed	426	0.46
Morocco	Developed	302	0.33
Iran	Developed	157	0.17
Chile	Developed	147	0.16
Syria	Developed	143	0.16
Malawi	Developed	94	0.10
United Arab Emirates	Developed	70	0.08
China (PRC)	Developed	63	0.07
Burma	Developed	62	0.07
Thailand	Developed	52	0.06
Malaysia	Developed	45	0.05
Egypt	Developed	38	0.04
Peru	Developed	21	0.02
Argentina	Developed	17	0.02
Tanzania, United Republic	Developed	17	0.02
Cyprus	Developed	16	0.02
Ecuador	Developed	14	0.01
Total		*91,911*	*99.88*

C. Subregion to region (total)

Origin	Destination	Value	Share
		(1,000 US$)	*%*
Developing	Western Europe	78,052	84.82
Developing	North America	9,507	10.33
Developing	West Asia	3,445	3.74
Developing	Eastern Asia[1]	389	0.42
Developing	Southeast Asia	354	0.39
Developing	Southern Africa	151	0.16
Developing	Australia/NZ	122	0.13
Total		*92,021*	*100*

Source : Compiled from United Nations Statistical Division, COMTRADE database (1999).

[1] Includes Japan, Hong Kong, and Macau.

Appendix Table 4l*: Sorghum Exports by Developing Countries, 1994–98 Annual Average*

A. Country to country (top 20)

	Origin	Destination	Value	Share
			(1,000 US$)	%
1	Argentina	Japan	52,720	64.04
2	China (Ppls. Rep. of)	Japan	7,706	9.36
3	Sudan	Japan	7,482	9.09
4	Sudan	Italy	6,195	7.53
5	Argentina	Spain	1,705	2.07
6	Sudan	Belgium	1,489	1.81
7	Sudan	Norway	691	0.84
8	India	Japan	654	0.79
9	Argentina	Norway	486	0.59
10	Sudan	Germany	427	0.52
11	China (Ppls. Rep. of)	Belgium	326	0.40
12	China (Ppls. Rep. of)	Netherlands, The	317	0.39
13	Argentina	United States	301	0.37
14	Cyprus	Italy	171	0.21
15	Thailand	Japan	166	0.20
16	Sudan	Netherlands, The	138	0.17
17	Zimbabwe	S.Afr.Cus.Un	130	0.16
18	China (Ppls. Rep. of)	Germany	101	0.12
19	Areas NES	France	98	0.12
20	Greenland	Japan	98	0.12
	Total		*81,401*	*98.88*

B. Country to region (top20)

Origin	Destination	Value	Share
		(1,000 US$)	%
Argentina	Developed	55,287	67.16
Sudan	Developed	16,485	20.03
China (PRC)	Developed	8,548	10.38
India	Developed	826	1.00
Egypt	Developed	191	0.23
Cyprus	Developed	171	0.21
Thailand	Developed	166	0.20
Zimbabwe	Developed	111	0.13
Areas NES	Developed	98	0.12
Greenland	Developed	98	0.12
Korea, Republic of	Developed	88	0.11
Mexico	Developed	83	0.10
Panama	Developed	64	0.08
Chile	Developed	42	0.05
Zambia	Developed	17	0.02
Falkland Islands	Developed	17	0.02
Taiwan (estimated)	Developed	10	0.01
Tunisia	Developed	7	0.01
Brazil	Developed	6	0.01
United Arab Emirates	Developed	2	0.00
Total		*82,315*	*100.00*

C. Subregion to region (total)

Origin	Destination	Value	Share
		(1,000 US$)	*%*
Developing	Eastern Asia[1]	68,978	83.79
Developing	Western Europe	12,719	15.45
Developing	North America	400	0.49
Developing	Southern Africa	137	0.17
Developing	West Asia	67	0.08
Developing	Southeast Asia	19	0.02
Total		*82,319*	*100*

Source : Compiled from United Nations Statistical Division, COMTRADE database (1999).

[1] Includes Japan, Hong Kong, and Macau.

Appendix Table 4m*: Lentil Exports by Developing Countries, 1994–98 Annual Average*

A. Country to country (top 20)

	Origin	Destination	Value	Share
			(1,000 US$)	%
1	China (PRC)	France	4,076	18.67
2	Turkey	Germany	3,129	14.34
3	Turkey	United Kingdom	1,778	8.15
4	Turkey	Italy	1,737	7.96
5	Turkey	Israel	1,164	5.33
6	India	United States	1,109	5.08
7	Turkey	Spain	1,105	5.06
8	India	Canada	661	3.03
9	Turkey	France	645	2.96
10	Turkey	Netherlands, The	605	2.77
11	Turkey	United States	523	2.40
12	China (PRC)	Netherlands, The	505	2.31
13	Turkey	Canada	478	2.19
14	China (PRC)	Belgium	378	1.73
15	China (PRC)	Hong Kong	333	1.53
16	Turkey	S.Afr.Cus.Un	284	1.30
17	China (PRC)	S.Afr.Cus.Un	255	1.17
18	India	Australia	230	1.05
19	Turkey	Belgium	197	0.90
20	China (PRC)	Spain	180	0.82
	Total		*19,372*	*88.76*

B. Country to region (top20)

Origin	Destination	Value	Share
		(1,000 US$)	%
Turkey	Developed	12,306	56.38
China (PRC)	Developed	5,999	27.48
India	Developed	2,417	11.07
Afrrica Other NS	Developed	160	0.73
Argentina	Developed	153	0.70
Thailand	Developed	140	0.64
Madagascar	Developed	113	0.52
Lebanon	Developed	77	0.35
Malawi	Developed	55	0.25
Syria	Developed	52	0.24
Vietnam	Developed	33	0.15
Sri Lanka	Developed	32	0.15
Mexico	Developed	31	0.14
Tokelau	Developed	30	0.14
United Arab Emirates	Developed	27	0.13
Ethiopia	Developed	22	0.10
Panama	Developed	19	0.09
Nepal	Developed	18	0.08
Egypt	Developed	14	0.06
Venezuela	Developed	13	0.06
Total		*21,710*	*99.47*

C. Subregion to region (total)

Origin	Destination	Value	Share
		(1,000 US$)	*%*
Developing	Western Europe	15,999	73.30
Developing	North America	2,976	13.64
Developing	West Asia	1,266	5.80
Developing	Southern Africa	543	2.49
Developing	Australia/NZ	385	1.76
Developing	Eastern Asia[1]	379	1.74
Developing	Southeast Asia	277	1.27
Total		*21,826*	*100*

Source : Compiled from United Nations Statistical Division, COMTRADE database (1999).

[1] Includes Japan, Hong Kong, and Macau.

Appendix Table 4n*: Millet Exports by Developing Countries, 1994–98 Annual Average*

A. Country to country (top 20)

	Origin	Destination	Value	Share
			(1,000 US$)	%
1	China (PRC)	Japan	3,015	18.18
2	Argentina	Netherlands, The	2,544	15.34
3	Argentina	Belgium	2,063	12.44
4	Argentina	Germany	1,848	11.14
5	China (PRC)	Germany	1,373	8.28
6	China (PRC)	United Kingdom	1,246	7.51
7	China (PRC)	Netherlands, The	1,103	6.65
8	China (PRC)	Italy	328	1.98
9	China (PRC)	Hong Kong	312	1.88
10	Argentina	Switzerland	242	1.46
11	China (PRC)	Belgium	226	1.36
12	Argentina	United States	224	1.35
13	Argentina	France	212	1.28
14	China (PRC)	Denmark	212	1.28
15	Sudan	Netherlands, The	201	1.21
16	India	United Kingdom	166	1.00
17	Vietnam	Japan	124	0.75
18	Argentina	Denmark	111	0.67
19	Argentina	Spain	110	0.66
20	China (PRC)	France	107	0.64
	Total		*15,768*	*95.05*

B. Country to region (top20)

Origin	Destination	Value	Share
		(1,000 US$)	%
China (PRC)	Developed	8,217	49.53
Argentina	Developed	7,508	45.26
India	Developed	311	1.88
Sudan	Developed	202	1.22
Vietnam	Developed	124	0.75
Kenya	Developed	64	0.39
Uruguay	Developed	24	0.15
Korea, Republic of	Developed	20	0.12
Egypt	Developed	16	0.10
Burma	Developed	15	0.09
Zimbabwe	Developed	14	0.09
Philippines	Developed	12	0.07
Free Zones	Developed	8	0.05
Malaysia	Developed	8	0.05
Ethiopia	Developed	8	0.05
Taiwan (estimated)	Developed	6	0.04
Bolivia	Developed	5	0.03
Senegal	Developed	4	0.03
Brazil	Developed	4	0.02
Areas NES	Developed	4	0.02
Total		*16,574*	*99.90*

C. Subregion to region (total)

Origin	Destination	Value	Share
		(1,000 US$)	*%*
Developing	Western Europe	12,524	75.49
Developing	Eastern Asia[1]	3,535	21.31
Developing	North America	341	2.06
Developing	Southern Africa	84	0.50
Developing	Southeast Asia	67	0.41
Developing	West Asia	28	0.17
Developing	Australia/NZ	9	0.06
Total		*16,590*	*100*

Source : Compiled from United Nations Statistical Division, COMTRADE database (1999).

[1] Includes Japan, Hong Kong, and Macau.

Appendix Table 4o*: Barley Exports by Developing Countries, 1994–98 Annual Average*

A. Country to country (top 20)

	Origin	Destination	Value	Share
			(1,000 US$)	%
1	Turkey	Israel	1,458	31.58
2	Cyprus	Israel	1,041	22.53
3	Uruguay	Germany	599	12.98
4	Uruguay	Malta and Gozo	388	8.40
5	Argentina	Germany	243	5.25
6	Argentina	Israel	236	5.11
7	Areas NES	France	197	4.27
8	Turkey	Malta and Gozo	113	2.45
9	Korea, Republic of	United States	47	1.02
10	China (PRC)	United States	44	0.95
11	Thailand	United States	42	0.91
12	Cocos (Keeling) Isles	France	39	0.84
13	Thailand	Hong Kong	34	0.73
14	China (PRC)	Hong Kong	17	0.36
15	Spec Cats	Canada	13	0.29
16	El Salvador	United States	13	0.28
17	China (PRC)	Australia	11	0.23
18	China (PRC)	Singapore	10	0.23
19	Turkey	Ireland	9	0.20
20	China (PRC)	Canada	9	0.19
	Total		*4,563*	*98.81*

B. Country to region (top20)

Origin	Destination	Value	Share
		(1,000 US$)	%
Turkey	Developed	1,581	34.23
Cyprus	Developed	1,041	22.53
Uruguay	Developed	994	21.53
Argentina	Developed	483	10.45
Areas NES	Developed	197	4.27
China (PRC)	Developed	91	1.97
Thailand	Developed	84	1.83
Korea, Republic of	Developed	49	1.06
Cocos (Keeling) Isles	Developed	39	0.84
Chile	Developed	15	0.33
Spec Cats	Developed	13	0.29
El Salvador	Developed	13	0.28
Malaysia	Developed	13	0.27
Peru	Developed	2	0.04
Taiwan (estimated)	Developed	1	0.03
Egypt	Developed	1	0.02
Ecuador	Developed	1	0.01
Bunkers	Developed	0	0.01
Kenya	Developed	0	0.00
Brazil	Developed	0	0.00
Total		*4,618*	*99.99*

C. Subregion to region (total)

Origin	Destination	Value	Share
		(1,000 US$)	*%*
Developing	West Asia	2,735	59.22
Developing	Western Europe	1,608	34.83
Developing	North America	187	4.04
Developing	Eastern Asia[1]	50	1.09
Developing	Australia/NZ	20	0.43
Developing	Southeast Asia	18	0.39
Total		*4,618*	*100*

Source : Compiled from United Nations Statistical Division, COMTRADE database (1999).

[1] Includes Japan, Hong Kong, and Macau.