Vol. 14 No. 2 Thailand Development Research Institute June 1999

TDRI Quarterly Review

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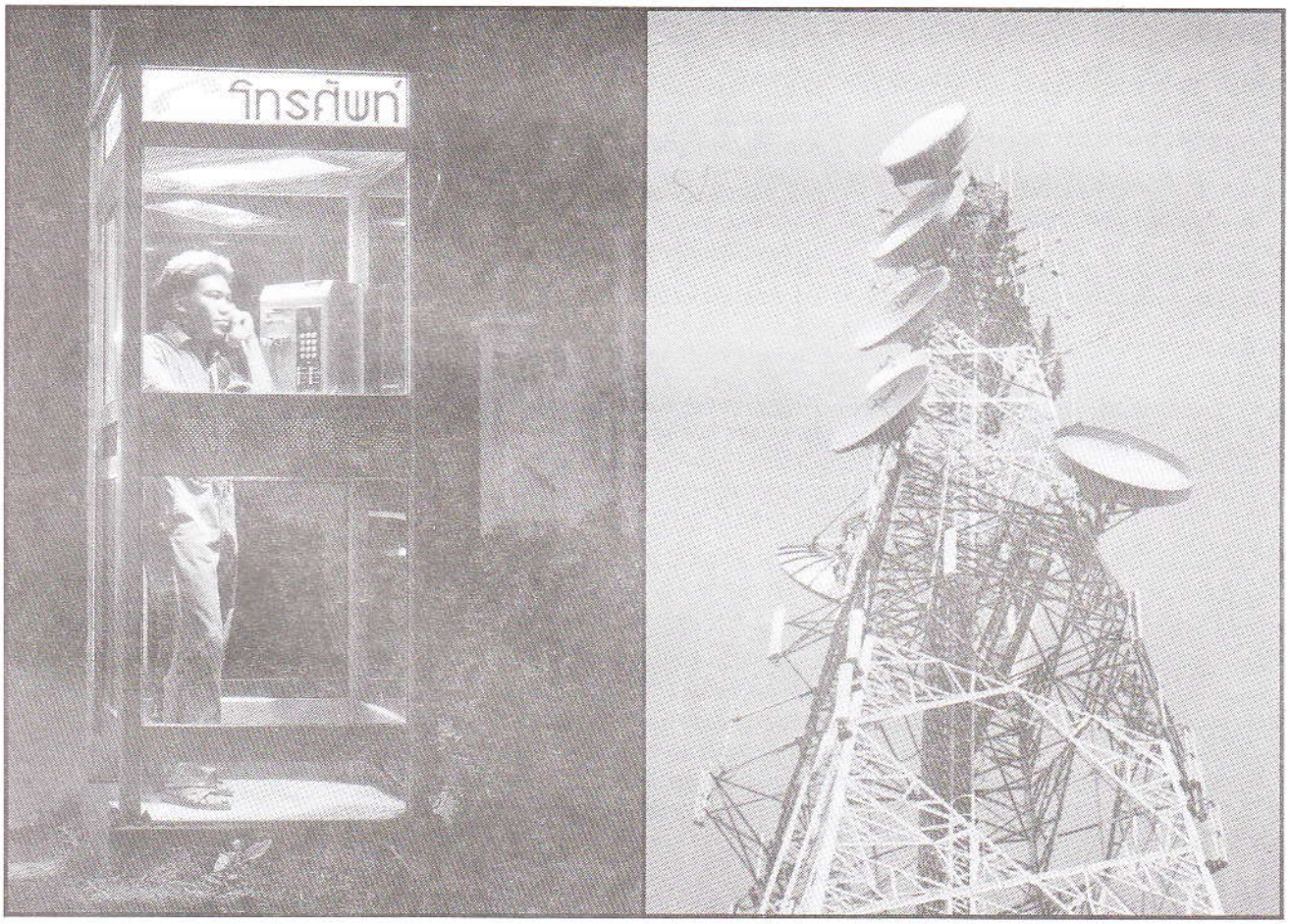

Prior to the liberalization of the Thai telecommunications industry, the Government needs to decide what to do with the 30 plus Build-Transfer-Operate concessions. (See related article on page 3).

ISSN 0857-2968

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The Preliminary Report of the Telecommunications Concession Conversion Study*

This preliminary report presents the results of the first phase of the Telecommunications Concession Conversion Study. The results are derived from:

- The review of two separate reports on the concession conversion study, one undertaken by the Working Group to Investigate Implications of Concession Conversion[1] and the other by a consortium comprised of Dhana Siam Securities Co., Ltd., Baring Brothers Ltd. and Credit Suisse First Boston (Singapore) Ltd.;
- The review of other relevant information and studies as well as opinions obtained from major stakeholders.

The objective of this study is to determine the conceptual framework and procedural methods to be used in determining whether or not to recommend the conversion of the existing telecommunications concessions to the State Enterprises Policy Committee.

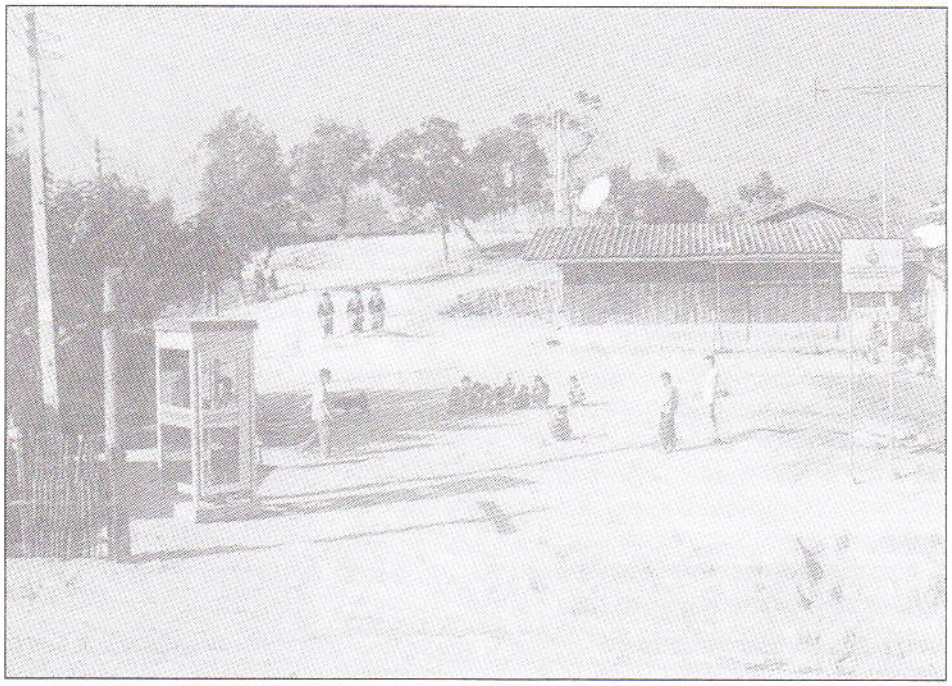
The scope of the study is three-fold:

1) To consider whether the conversion of existing concessions is necessary;
2) To recommend a clear framework, mechanism and a specific time frame for the conversion process should conversion be found desirable; and
3) To determine the direct and indirect benefits that could be derived from concession conversion.

The research team analyzed two major dimensions of concession conversion: its principles and its methods.

PRINCIPLES

Principles refer to the conceptual framework to be used during the decision-making process with regards



The goal of introducing liberalization to the Thai telecommunications industry is to create a competitive open environment where effective competition is encouraged and functional.

* *This is an unofficial translation of the executive summary of the preliminary report submitted to the Ministry of Finance by the Thailand Development Research Institute as part of the project entitled "A Review of Telecommunications Concession Conversion Proposals." The recommendations made in the report were endorsed by the State Enterprise Policy Committee on June 16, 1999.*

to the question of whether or not it is desirable to convert or not to convert the existing concessions. These principles will also be used to help determine what compensation, if any, should be offered. This framework is to be applied universally to all concessions regardless of the methods to be used.

METHODS

These are the methods to be applied to the process of concession conversion, taking into account differences in the service segment and the particular details of each concession. Different sets of alternatives may be required for different concessions, so as to reflect the different nature of each individual concession and each service offered in the concession. Various methods are used in order to make concession conversion more appropriate, practical and acceptable to both parties in each concession.

Prior to proceeding with the decision on whether or not to convert existing contracts, it is critical to determine appropriate, fair and unambiguous principles that are generally understandable and acceptable by all of the involved parties, i.e., policy makers (the Government), concession providers (state enterprises), concessionaires (private businesses), users of telecommunications services and the general public.

The preliminary report deals with the first dimension of concession conversion—that is, the principles to be applied to all concessions. Conversion methods will be presented in the final report.

Background on Telecommunications Concessions and Future Market Liberalization

Prior to the Sixth National Economic and Social Development Plan, investment in the Thai telecommunications infrastructure sector had lagged behind that of other infrastructure sectors. During the Sixth National Plan, however, economic growth surged to unexpectedly high levels, leading to a severe shortage of telephones and other telecommunications services.

As the public sector could not invest enough in the expansion of telephone services to match the rapidly increasing demand, the Government realized that private sector participation and investment was needed. The law, however, did not, and still does not, allow private enterprises to own the network equipment assets that are meant for public services. It was at this juncture that the Build-Transfer-Operate (BTO) concession was granted to circumvent legal restrictions. The BTO concession allows the state (as concession provider) and private companies (as investors of the network construction and service providers) to jointly share monopoly profits from the provision of telecommunications services. An example of this is the revenue sharing scheme that operates using the monopoly rights of state enterprises, namely the Telephone Organization of Thailand (TOT) and the Communication Authority of Thailand (CAT), the Post and Telegraph Department and the Ministry of Transport and Communications.

It is true that the BTO concession had substantially alleviated service shortages in telecommunications service and facilitated economic expansion at that time. However, the granting of over 30 BTO concessions within the span of a couple of years has led to a tangled telecommunications environment which could substantially hinder the liberalization process. The conditions, rights and restrictions imposed by these BTO concessions are, furthermore, not in line with market liberalization. Thus the continuation of many concessions is bound to deliver less consumer benefits from the future liberalization of markets when compared to the benefits that have been enjoyed by other liberalized markets. It is therefore necessary that the Government provide a clear policy direction on concession conversion.

Benefits of Effective Competition Under a Fully Liberalized Telecommunications Environment

The purpose behind the liberalization of the Thai telecommunications industry is the creation of an open, competitive environment where effective competition is encouraged and practical. It is hoped that an open competitive telecommunication environment will not only enhance the country's competitiveness, but will also bring about a myriad of consumer benefits including:

- Lower prices
- Increased service choice and innovation
- Improved service quality
- Substantial increases in investment and job opportunities to build, upgrade and operate networks and services
- Optimal use of existing networks which will enhance overall telecommunications sector efficiency and facilitate economic growth
- Better quality of life as a result of adequate and quality networks and services at lower costs to connect instantly and cheaply both at the national and international levels.

Conceptual Framework and Principles for Concession Conversion

The conceptual framework to convert or not to convert the BTO concessions has as its primary concern preparing for an effective, open and competitive market once the state monopoly is terminated.

Along these lines, the decision to convert or not to convert the existing BTO concessions should rely on principles that reaffirm the Thai telecommunications

liberalization policy and its objective to establish the most conducive environment for effective competition as soon and as completely as possible, as follows.

Principle 1 *The market for each telecommunications service shall be free from monopoly power either from any sole operator or a single dominant operator that can easily use its market power against its competitors to the disadvantage of consumers.*

Principle 2 *The playing field of each service shall be made level for both old operators and new entrants legally licensed to provide telecommunications services. All players will be subject to the same rules and regulatory restrictions, enjoy similar rights, and contribute equitable share of obligations according to the future Telecom Act. This is to ensure fair competition, where no player is in an advantageous or a disadvantageous position unless such a position is derived from competitive ability.*

Principle 3 *All operators shall not possess any vested interests in each other, either in the form of share cross-holding or revenue sharing, as this could lead to monopolistic behavior or the unfair determination of service fees. Such cases would diminish effective competition and, hence, benefits to the consumer.*

There is no denying that the change of policy to terminate monopolies and foster competition in the telecommunications industry will definitely affect the existing BTO concessions one way or another. As a result, the decision-making process and the implementation of concession conversion should take into consideration impacts arising from such a policy change. This leads to Principles 4 & 5 below.

Principle 4 *Each private concessionaire shall not receive future benefits of any kind greater or lesser than those that could be expected from the specified terms and conditions of the concession, and for the entire remaining period of each BTO concession.*

The net compensation (that is, from private concessionaires to the relevant state enterprise in the case of positive impacts on the future earnings of private concessionaires, or from the relevant state enterprise to private concessionaires in the case where the impacts are negative) is to be calculated as follows.

Principle 5 *Compensation calculations will follow the following guidelines:*

i) Private concessionaires will be compensated should their revenue stream decrease as a result of concession conversion. On the contrary, they will compensate the state should their revenue stream increase, as from the termination of revenue sharing for instance. In any event, the amount of compensation to be made shall be calculated to cover the entire duration of each concession.

*ii) Should the termination of the state monopoly and the subsequent liberalization of the telecommunications industry result in an **increase** or **decrease** in the revenue stream of private concessionaires, they **will compensate** the state, or **will be compensated** by the state, accordingly. The calculation of the impact on the future revenue stream as a result of liberalization will also take into account the specific details of each individual contract.*

iii) Any impact occurring as a result of normal business risk, such as the economic slump, business strategy or market factors, shall not be accounted for by the compensation calculation and offsetting package.

The Case where Concession Conversion is to Occur

Should the decision be made to convert concessions, the subsequent concession conversions may range from the amendment of certain conditions of the concession to the termination of the entire concession should it be deemed contradictory to the free market philosophy outlined in Principles 1-3. This is to be done in order to create a level playing field where competition between private concession holders and the TOT/CAT can be allowed to occur as soon as telecommunications liberalization takes place. The competitive capability of the Thai telecommunications industry would therefore be increased as a result.

In the case of concession conversion, the transfer of physical asset ownership from the state to private concessionaires is not necessary. However, the state must take immediate action to remove undue restrictions or conditions on rights-of-use that hinder free competition or tilt the playing field. Such undesirable conditions include the following:

- Revenue sharing between the two would-be competitors
- Sharing of business benefits or risks
- Restrictions on the right to expand or to fully utilize networks to maximize returns and minimize costs
- Restrictions to the adjustment of service tariffs

The following principles should apply when concession conversion occurs.

Principle 6 *Both parties to a contract need to mutually agree on the terms for concession conversion. However, the framework for concession conversion must be defined by Principles 1-5 above.*

Principle 7 *Immediately following market liberalization, the private concessionaire shall be duly awarded an operating license covering the same type and scope of services as those specified in the BTO concession. The concessionaire will also be compensated for any additional obligations that are incurred over and above those specified in the concession, such as license fee payments for the extent of services specified in the concession and for the remaining period of the concession. However, the concessionaire must bear any obligation related to any additional future rights above and beyond these specified in the concession contract.*

The Case where Concession Conversion is not Undertaken

In case the parties cannot agree on concession conversion, competition can still occur through the entry of new players. However, as past experiences have shown, the growth of new entrants' market share will be rather slow, thus undermining Principle 1 and hindering the effectiveness of the competition so generated.

In addition, the failure to convert BTO concessions, or to convert only some of them, may, under certain conditions, lead to a situation where the TOT and the CAT remain sole operators of such telecommunications services as basic telephone service and mobile phone service, even after market liberalization. Moreover, the TOT and the CAT would also be the sole operators of nearly all telecommunications sectors if they were to merge into one holding company, as outlined in the Telecommunications Master Plan, and still had private concessionaires as business partners. This scenario is thus heavily inclined to the existence of only one operator exercising near absolute market dominance in some or all markets if the future regulatory body is not strong or experienced enough. Even in the United States, a strong and experienced Federal Communications Commission (FCC) is still far from being able to curtail the monopoly power of Regional Bells Operating Companies (RBOCs) and achieving a sufficient level of competition in the local telephone service markets across the U.S.

The following principle should thus be observed if the conversion of some concessions does not take place.

Principle 8 *The Government shall seek and implement measures to decrease limitations and obstacles to effective competition between the TOT and the CAT in markets when they are already competing either directly or through their private concessionaires.*

The preliminary report also includes an analysis of the recommendations proposed by the report of the Working Group to Investigate Implications of the Concession Conversion and the report by the consortium comprising Dhana Siam Securities Co., Ltd., Baring Brothers Ltd., and Credit Suisse First Boston (Singapore) Ltd., based on the conceptual framework and the set of principles detailed here. The views and opinions of major stakeholders obtained from brainstorming sessions and written documents have also been taken into consideration.

THE NEXT STEP

The next step will be to design methods for converting each concession using the conceptual framework and principles established for inclusion in the Final Report to be submitted to the Ministry of Finance and subsequently to the State Enterprise Policy Committee.

ENDNOTE

[1] The Working Group was set up by the Subcommittee to Investigate Methods for the Privatization and Liberalization of the Telecommunications Industry, under the State Enterprises Policy Committee.

Intellectual Property Rights and Agricultural Plant Genetic Resource

Benjavan Rerkasem*

The world has benefited enormously from the modern innovation of high yielding crop varieties (HYV's) that were the hallmark of the Green Revolution. Central to the realization of this benefit was the free exchange of plant genetic resources and the unrestricted movement of genetic material. Local varieties, farmers' varieties, landraces[a] and wild relatives from various countries were sent to the world's genebanks and international crop breeding programs, e.g., those at the International Rice Research Institute (IRRI), International Centre for Maize and Wheat Improvement (CIMMYT), Asian Vegetable Research and Development Center (AVRDC). In return, improved varieties and lines were provided to national breeding programs, where they were either released to farmers after appropriate testing or had some of their selected genetic traits incorporated into locally adapted varieties. This highly effective yet simple and open arrangement, however, can no longer be taken for granted.

The change has been brought about by a world-wide trend that has witnessed the extension in scope of intellectual property rights (IPR) to cover plant genetic resources. The threat comes from the inequitable application of IPR legislation, in which protection is extended to some varieties, mostly those bred and claimed by seed companies and institutions, but leaving all others, including traditional, locally developed varieties, landraces and raw germplasm, as public property available to all.

THE BASMATI PATENT

The danger of asymmetry in the application of IPR was brought home to many, especially in the developing world, by the granting of a US patent entitled "Basmati rice lines and grains" (US005663484A) to RiceTec Inc., a US seed company based at Alvin, Texas, on September 2, 1997 (Box 1).

The name Basmati applies to a group of high quality, aromatic traditional varieties of rice from certain areas of Asia. Asia's high quality rice varieties, which also include Thailand's Thai Fragrant jasmine rice, while not so high yielding as the modern semi-dwarf type, occupy the higher end of the world rice market and are priced up to twice as much as ordinary rice. Basmati has long been an important export earner for Pakistan and to a lesser extent India; Thailand's rice exports are dominated by Thai Fragrant jasmine. Valued traits of these are embodied in the genetic make-up of the traditional varieties that have long been considered open resources.

By granting the Basmati patent to RiceTec, the US Patent Office had essentially deprived Pakistan, India or anyone else of their prior use-rights to all the genetic traits and genes that give rise to the essential characteristics of Basmati and other similar aromatic fine grain rice, and so denied them the right to sell such grain, in North, Central or South America, or Caribbean Islands.

CLAIM STAKING A COMMON GENETIC RESOURCE—THE BASMATI LESSON

A very major proportion of the world's valuable agricultural germplasm now lies in the public, common access, pool of plant genetic resource. Pakistan's Basmati rice varieties and Thailand's premier Thai Fragrant jasmine, KDML 105, are all freely available to anyone from IRRI or many of the numerous rice improvement programs in various countries where rice is grown. Valued traditional varieties as well as raw germplasm, landraces and wildtypes of all of the plants with any economic value have now been acquired, not only by the international public research centers such as CIMMYT, IRRI and AVRDC, but also by private as well as public genebanks and crop breeding programs all over the world.

The wealth of genetic information in this openly accessible genepool includes all aspects of crop characteristics, from their adaptation, e.g., to harsh environments and poor soils, reaction to diseases, pests and

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BOX 1 PATENTING GENETIC TRAITS: "BASMATI RICE LINES AND GRAINS" (US005663484A[2])

A patent is a statutory privilege granted by a government to an inventor for a fixed period of years, which excludes others from manufacturing, using, or selling a patented product or from using a patented method or process. An invention is usually defined as an idea which permits the solution of a specific problem in a field of technology; it must provide a novel solution to a technical problem. Intellectual property rights are provided by means of "claims" to a set of inventive steps which form the novel technical solution.

The US Patent "Basmati rice lines and grains" (US005663484A) contains a total of 20 claims. Some of the claims were actually made on specific rice lines (claims 8, 9, 11). The others, however, are related to genetically controlled traits of the rice plant (claims 1, 2, 3, 4, 5, 6, 7, 10), its progeny (claim 14) and the rice grain (claims 12, 13, 15, 16, 17), and methods for selecting a rice plant for breeding and propagation based on some specific genetic traits (claims 18, 19, 20). Following are examples from each set of claims.

Claim 1: "A rice plant, which plant when cultivated in North, Central or South America, or Caribbean Islands

a) has a mature height of about 80 cm to about 140 cm;

b) is substantially photoperiod insensitive; and

c) produces rice grains having

i) an average starch index of about 27 to about 35,

ii) an average 2-acetyl-1-pyrroline content of about 150 ppb to about 2,000 ppb,

iii) an average length of about 6.2 mm to about 8.0 mm, a width of about 1.6 mm to about 1.9 mm and a length to width ratio of about 3.5 to about 4.5,

iv) an average of about 41% to about 63% whole grains, and

v) an average lengthwise increase of about 75% to about 150% when cooked."

Claim 8: "A rice plant produced from Bas 867 seed having the accession number ATCC 75941."

Claim 14: "A progeny plant of the rice plant of any of claims 1 to 11."

Claim 15: "A rice grain, which has

i) a starch index of about 27 to about 35,

ii) a 2-acetyl-1-pyrroline content of about 150 ppb to about 2,000 ppb,

iii) a length of about 6.2 mm to about 8.0 mm, a width of about 1.6 mm to about 1.9 mm and a length to width ratio of about 3.5 to about 4.5,

iv) a whole grain index of about 41 to about 63,

v) a lengthwise increase of about 75% to about 150% when cooked, and

vi) a chalk index of less than about 20."

Claim 18: "A method of selecting a rice plant for breeding or propagation, comprising the steps of:

a) preparing rice grains from rice seeds;

b) determining

i) the percent amylose (PA), and

ii) the alkali spreading value (ASV) to obtain the starch index (SI) of said grains;

c) summing said PA and said ASV to obtain the starch index (SI) of said grains;

d) identifying a rice plant which produces grains having an average PA of about 22 to about 29, an average ASV of about 2.9 to about 7, and an average SI of about 27 to about 35;

e) selecting a seed from said plant;

f) and growing said seed into a plant."

weeds, to various aspects of grain or product quality (nutritive, special taste and market characteristics). Very few of these traits that have been propagated and conserved over generations by farmers are likely to have been described and published in detail, at least not in such a way that would be interpreted by most patent laws as "prior disclosure," and so they are exempted from IPR claims in most countries.

The Indian government is challenging the Basmati patent in a Texas court, on the ground that the claims lack novelty. A campaign has also been organized by the Rural Advancement Foundation International, a Canadian NGO aiming to shame RiceTec into giving up the patent. Whatever the outcome of these legal and political actions, the Basmati patent has taught two valuable lessons on the management of the world's agricultural plant genetic resource.

Firstly, it has highlighted the danger of the traditional users' age-old rights to use valuable germplasm from the public genepool being appropriated by monopolistic ownership under the guise of IPR.[3]

Secondly, it has invalidated two important assumptions frequently used to defend the current IPR system, that (a) it costs countries nothing to provide germplasm for the breeding of new proprietary varieties that will later be patented,[4] and (b) only raw germplasm with little value is used in the breeding of the proprietary elite varieties.[5]

For obvious political reasons, many have characterized this equity issue in problems with IPR as a North Vs. South or developed countries Vs. developing countries issue. In fact, future IPR troubles over plant genetic resource may very well be between the developing countries themselves. Competition is likely to become increasingly fierce among countries in the same region which share many of the same crops and are competing in the same markets. For example, the Yuan Longping Hybrid Rice International Co., Ltd. has recently been established in China as a joint venture between Hunan Hybrid Rice Research Center (a government owned research organization of the Hunan province), Seed & Crops Digest, RiceTec and CBG Hybrid Rice, LLC.[6] With their use of the same strategy that RiceTec employed with Basmati in the US, Thailand can expect not only to be legally locked out of its most important fragrant rice market, China, but also to forfeit the use-rights to a set of very valuable rice genes.

According to some in Thailand, a "patent" application (supposedly called Jasmati rice patent) has actually been placed under consideration by the US Patent Office. But the problem in Thailand is that public debates on this issue are very poorly informed, and are full of misconceptions and very few hard facts. For example, it took a long time before published accounts began to refer to Jasmati as a trademark and not a patent along the same line as the Basmati Patent. This points to yet another problem: the woefully inadequate legal and technical capacity at the national level in most developing countries (perhaps excepting India) to deal effectively with the issue of IPR.

A NEW AND VERY DIFFERENT TRAGEDY OF THE COMMONS

Given that new and improved crop varieties are developed from common genetic resources, developing countries have been calling for free access to those commercially developed crop varieties.[7] Developed countries have rejected this claim on the grounds that IPR for commercial varieties is a necessary incentive to encourage private sector research. This counter argument has, however, failed to address the main issue of the loss of age-old use-rights to genetic resources, as valuable genetic traits and their embodying genes derived from the common pool are incorporated into proprietary varieties.

In order to protect their own age-old use-rights countries may contest patents in court, as India has successfully done with a US patent related to turmeric,[8] and is now doing with the Basmati patent. But their ability to keep up with future demands for crop genetic improvement, and hence sustainable crop production, would be seriously undermined if countries have to keep going to court to protect use-rights to their own plant genetic resource. Furthermore, very few countries have India's legal and technical clout,[9] and very few countries indeed can afford the financial expense of court actions in the USA or Europe. In any event, there is no reason why countries, especially poor ones, should have to squander their scarce resources trying to reclaim something that was theirs in the first place. It seems that the management of one of the world's most valuable and irreplaceable resource is inequitable as well as inefficient.

There is a real danger that yet another "tragedy of the commons" may now be in the making, but one which is much more catastrophic than any seen to date. Tragedies of the commons happen because the insufficient protection of property rights encourages overexploitation, eventually causing the degradation of the resource in question.[10] In the original "commons" of 17th century England, degradation of common land was prevented or reversed by the enactment of land ownership laws which empowered landowners to enclose the land with fences and provided incentive for conservation and improvement. The current IPR system, however, seems to be undermining instead of enhancing the effective management and conservation of common agricultural plant genetic resources.

Countries are now becoming increasingly reluctant to contribute to the maintenance of public international genebanks and breeding programs. Those who contribute germplasm fear they will lose not only access and control, but also their age-old use-rights. Those who contribute funds to the upkeep of international facilities are now questioning the return on their investment. This conflict is placing in jeopardy two valuable public services provided by the genebanks and breeding programs associated with the International Agricultural Research Centres (IARC's), (a) a most cost effective and technically reliable *ex situ* conservation of germplasm in the developing world, and (b) the transfer of an enormous range of genetic materials of all the important crops to various countries and regions each year (e.g., see Box 2 for example from CIMMYT, similar flows go out from all of the public breeding programs associated with the IARC's) which contributes toward the maintenance of *in situ* genetic diversity of the major crop species.

The Convention on Biological Diversity (CBD), one of the latest multilateral attempts to address problems associated with the exchange and use of plant genetic resources, appears to have a very limited capacity to deal with this problem. The CBD asserts (Article 15) that countries have sovereign rights to their indigenous genetic resources. The CBD, however, covers only ownership and status (and provision controlling access and benefits sharing) of those resources acquired after the convention had come into effect, i.e., after 1992. Some developed-country governments have come out firmly against making sovereign rights over plant genetic resources covered by the CBD retroactive.[e.g.11] Therefore, the CBD is unlikely to be of much help for the management of a very large portion of the common agricultural plant genetic resources, which had already been acquired by genebanks and breeding programs around the world long before 1992. Furthermore, perhaps even more importantly, the protection and conservation of valuable germplasm in a country's jurisdiction covered by the CBD is by no means guaranteed by national ratification of the convention. Genebanks are expensive to maintain, they are also technically exacting. An international survey has found that seed samples kept in many facilities have lost either their genetic diversity and/or viability, leading to the suggestion that these should be more appropriately called "gene morgues" rather than genebanks.[12] *In situ* conservation, on the other hand, has had limited success; traditional varieties continue to disappear from farmers' fields through out the world.

BOX 2 DISTRIBUTION OF GENETIC MATERIALS FROM CIMMYT TO BREEDING PROGRAMS IN VARIOUS COUNTRIES FOR THE GROWING SEASON 1998/99

	Number of entries
Bread wheat	
20th ESWYT (1) Elite Selection Wheat Yield Trial	50
7th HRWYT (1) High Rainfall Wheat Yield Trial	50
7th HTWYT (1) High Temperature Wheat Yield Trial	50
7th SAWYT (1) Semi-Arid Areas Wheat Yield Trial	50
32nd IBWSN International Bread Wheat Screening Nursery	250
10th HRWSN High Rainfall Wheat Screening Nursery	250
17th SAWSN Semi-Arid Areas Wheat Screening Nursery	100
9th WAWSN Warmer Areas Wheat Screening Nursery	70
F2 Spring x Winter	30
Durum wheat	
29th EDUYT Elite Durum Unreplicated Yield Trial	128
31st IDYN (1) International Durum Yield Nursery	50
31st IDSN International Durum Screening Nursery	290
Triticale	
31st ITYN (1) International Triticale Yield Nursery	50
31st ITSN International Triticale Screening Nursery	220
FWTCL (Facultative and Winter Triticales, including forage lines)	150
Barley (CIMMYT/ICARDA)	
22nd IBYT (1) International Barley Yield Trial	25
27th IBON International Barley Observation Nursery	140
8th EMBSN Early Maturity Barley Screening Nursery	50
9th HBSN Hull-less Barley Screening Nursery	50
F2 Spring x Spring	240
F2 Spring x Winter	60
Total	**2353**

Source: CIMMYT.

Many achievements in plant breeding, with or without contributions from biotechnology, can be truly innovative. New innovations in plant breeding, and therefore progress in crop genetic improvements, may indeed be encouraged by rewarding those who have invested resources to bring them about. There is, however, a fundamental flaw in the current IPR system as it has been applied to plant genetic resource in many countries, in allowing "inventors," by means of patents which are extremely inclusive in their claims, to appropriate monopolistic IPR over many genetic traits and genes that have not been a part of their own invention at all but have simply been acquired from the public genepool, thereby depriving others of their age-old use-rights to those genetic resources. This has created an atmosphere of mistrust between providers and users of agricultural plant genetic resources, to an extent that the management of a common but irreplaceable resource is being placed at grave risk.

ACKNOWLEDGEMENT

This paper has been partially developed as part of a study on university intellectual property at Chiang Mai University, with support from the Ford Foundation. The author also wishes to thank Dr Ammar Siamwalla for his valuable comments on an early version of this paper.

ENDNOTES

1 Landraces refer to traditional varieties kept and grown by farmers. It is somewhat of a misnomer, as it implies that these simply sprang out of the land, while the role of generations of farmers in the selection, propagation and conservation of agricultural genetic resource is now commonly acknowledged.

2 United States Patent No. 5,663,484, dated September 2, 1997. Basmati rice lines and grains.

3 This is somewhat akin to Newton's famous remark to Robert Hook, *"If I had seen further, it is by standing on the shoulder of giants"* being followed by something like ***"and by the way, I now own patents for those shoulders, and the giants too."***

4 Brown, W.R. 1988. "Plant Genetic Resources: a View from the Seed Industry." Pp. 218-230 in *Seeds*

and Sovereignty: the Use and Control of Plant Genetic Resources, edited by Kloppenburg JR. Durham, NC.: Duke University Press.

[5] Frisvold, G.B. and Condon, P.T. 1998. "The Convention on Biological Diversity and Agriculture: Implications and Unresolved Debates." *World Development* 26: 515-570.

[6] RAFI. 1998. Basmati Rice Patent. (www.rafi.org, August).

[7] UN FAO. 1983. Twenty-second session, Sixteenth meeting, C83/II/16. Rome: FAO.

[8] A root used as a spice and for curing wounds and other medicinal purposes throughout tropical Asia since ancient times.

[9] That the Basmati patent is being contested by India instead of Pakistan, which is actually the world's biggest Basmati rice exporter, may be another reflection of the importance of poorer countries' capacity to fight legal IPR battles.

[10] Hardin, G. 1968. "The Tragedy of the Commons." *Science* 162: 1243-1248.

[11] US Department of State. 1994. Correspondence between Warren Christopher, Secretary of State and Senator Robert Dole, August 16.

[12] NRC. 1993. *Crop Diversity: International Responses in Managing Global Genetic Resources: Agricultural Crop Issues and Politics*. Washington, DC: National Research Council, National Academy Press.

Agriculture and Climate Change

Shelley Grasty*

Climate change or global warming is caused by the release of 'greenhouse' gases into the atmosphere. These gases accumulate in the atmosphere and increase the effect of radiative forcing on the climate, resulting in a warming of the atmosphere. The changes in greenhouse gas concentrations are projected to lead to regional and global changes in climate and climate-related parameters such as temperature, precipitation, soil moisture, and sea level. However, the reliability of the predictions surrounding the effects of climate change is uncertain. There are no hard facts about what will definitely be the result of increases in the concentration of greenhouse gases within the atmosphere, and no firm timescales are known.

Agriculture is one sector that is important to consider in terms of climate change. The agriculture sector both contributes to climate change, as well as will be affected by the changing climate.

IMPACT OF AGRICULTURE ON CLIMATE CHANGE

Agriculture accounts for approximately one-fifth of the annual increase in anthropogenic (man-made) greenhouse gas emissions (Figure 1, IPCC 1996). The sector contributes to global warming through the emission of Carbon Dioxide (CO_2), Methane (CH_4) and Nitrous Oxide (N_2O) gases.

The greenhouse gases are so called because although they allow the transmission of light reaching the earth, they block the transmission of heat (infra-red radiation) trying to escape from the atmosphere, thus trapping the heat as in a 'greenhouse.' CH_4 has the highest global warming potential that is about 300 times the potential of CO_2, and about 20 times that of N_2O. The main sources of these gases are flooded rice fields, nitrogen fertilizers, improper soil management, land conversion, biomass burning, and livestock production and associated manure management. The livestock industry alone is said to account for between 5-10 percent of the overall contribution to global warming.

Carbon Dioxide (CO_2)

Deforestation, primarily due to agricultural expansion and land speculation, remains a major source of carbon emissions. When natural vegetation is converted into agricultural land, a large proportion of the soil carbon can also be lost as plants and dead organic matter are removed. This contributes approximately a third of the total CO_2 emissions globally.

CO_2 is also released during the burning of agricultural crop waste, for example, during the burning of sugar cane stubble and rice straw. In Asia, it is a common practice to burn large quantities of crop residue, including rice straw, since the burning kills insects and other pests as well as disease-causing organisms, and neutralizes soil acidity.

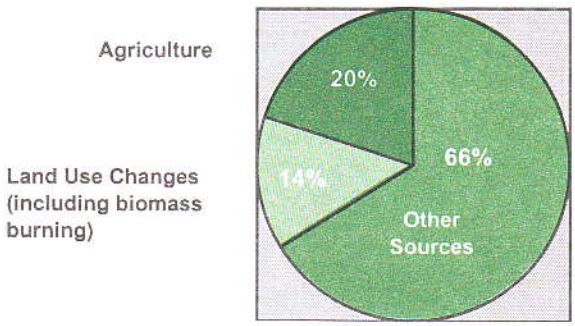

Figure 1 Contribution to Global Warming

* *Ms. Grasty is visiting researcher of TDRI's Natural Resources and Environment Program.*

Table 1 Methane Emissions from Agricultural and Other Sources in Selected Asian Countries, 1990 ('000 tons)

Country	*Livestock*	*Other Agriculture* [a]	*Waste*	*Total*	*Nitrous Oxide*
Bangladesh	520	473	74	1335	3
China	8940	18400	790	33830	1100
Indonesia	864	2039	--	3746	2769
Japan [b]	520	276	400	1316	54
Kazakhstan	939	--	1763	3555	7
Mongolia	301	--	15	329	0
Nepal	370	542	--	996	1
Philippines	315	559	138	1290	8

[a] including flooded rice fields; [b] 1994

Source: World Resources Institute, 1998.

To a lesser extent CO_2 is released from the fossil fuels used in agriculture production and from livestock production. High-intensity animal production has become the biggest consumer of fossil energy in modern agriculture (IPCC 1996).

Methane (CH_4)

Within the agriculture sector CH_4 is the most significant greenhouse gas released. Most of the releases come from paddy fields (91%), and less significantly from animal husbandry (7%) and the burning of agricultural wastes (2%). The quantification of emissions from rice paddies has proven difficult as the emissions vary with the amount of land in cultivation and also depend on fertilizer use, water management, density of rice plants and other agricultural practices. Among Asian countries, China is a very large source of CH_4 emissions.

Livestock and associated manure management contributes 16 percent of the total annual production of CH_4. These emissions are a direct result of the ability of cattle and buffalo to utilize large amounts of fibrous grasses that cannot be used as human food, or as feed for pigs and poultry. Cattle and buffalo account for about 80 percent of the global annual CH_4 emissions from domestic livestock.

Nitrous Oxide (N_2O)

Much of the agriculture-based N_2O emissions come from the use of nitrogen fertilizers, legume cropping and animal waste. Some N_2O is also released during biomass burning. Many farmers spread nitrogen fertilizers on their fields to enhance crop growth. Most of the nitrogen is taken up by the crop, but some leaches into surrounding surface and ground waters, and some of it enters the atmosphere. The flux of nitrogen depends on the microbial activity in the soil. For example, wet rice absorbs only one-third of the nitrogen in the fertilizers, while upland crops about half. The rest is denitrified and diffused into the atmosphere, contributing to global warming. However, the amount of N_2O emitted is much lower in volume than the amount of CH_4 (Table 1).

How much nitrogen is lost from the soil also depends on agricultural practices such as plowing and irrigation and on temperature, soil type and weather conditions. Another mode of agriculture-based N_2O release is during the breaking of new land when nitrogen bound in the soil and vegetation escapes to the atmosphere.

OPTIONS FOR REDUCTION OF GREENHOUSE GAS EMISSIONS

Improved land use practices may work toward the reduction of greenhouse gas emissions. For instance, significant decreases in CH_4 emissions from agriculture could be achieved through better management of rice paddies. Additionally, irrigated rice has been found to produce more CH_4 than deepwater rice (Charoensilp *et al.* 1998). The intermittent drying of soils, and reduced land disturbances such as zero tillage and mulching will also help reduce emissions. Changes in cultivation practices, such as a shift from transplanting to direct seeding, and appropriate water management can also contribute toward a decrease in CH_4 emissions. A reduction in the use of organic materials, or a shift to the use of mineral fertilizers will help decrease emissions, together with the appropriate application of these fertilizers.

Some structural changes in agriculture production could also be beneficial and may reduce the necessity for soil disturbances, e.g., a shift from traditional to high yielding varieties, or switching from rice to some other field crops, especially cassava. However, rice is an important crop in Asia.

The recent growth in Asia of intensively managed monogastric animals such as poultry and pigs has stabilized the level of emissions generated from the livestock industry, as these animals produce less emissions than the large ruminants. Opportunities for reducing CH_4 emissions from already intensively

managed cattle are somewhat limited because the CH_4 production per unit of cattle feed is small and the animals are for the most part already given a high-quality diet. However, additional CH_4 decreases are possible by improved nutrition of traditionally managed ruminant animals.

CH_4 emissions could also be reduced by improved treatment and management of animal wastes and by reducing biomass burning. These combined practices could reduce CH_4 emissions from agriculture by 15-56 percent. However, the problem is that these options usually involve a tradeoff between productivity and CH_4 reduction.

N_2O emissions could also be decreased with better treatment and management of animal wastes, and with better application of nitrogen fertilizers.

Energy use by the agriculture sector has decreased greatly since the 1970s. However, fossil fuel use in agriculture, and thus CO_2 emissions could be further reduced by, for example, minimum tillage, irrigation scheduling, solar drying of crops and improved fertilizer management.

Finally, it is important to note the role of forests and vegetation as sources and sinks of greenhouse gases. The emission of CO_2 is only one part of the carbon cycle. Assimilation of CO_2 also occurs where vegetation binds carbon into biomass. Carbon storage in the soil is important and dependent on the vegetation type. Vegetation and soils from unmanaged forests hold 20-100 times more carbon per unit area than agricultural land. Deforestation and land use changes have diminished the global storage of carbon as well as the capacity to bind CO_2, with the result that more CO_2 is being released into the atmosphere.

IMPACT OF CLIMATE CHANGE ON AGRICULTURE

The effects of climate change on agriculture will differ across Asia. Determining how climate change will affect agriculture is complex; a variety of effects are likely to occur. Changes in temperature as well as changes in rainfall patterns and the increase in CO_2 levels projected to accompany climate change will have important effects on global agriculture, especially in the tropical regions. It is expected that food productivity (especially crop productivity) will alter due to these changes in climate, and due to weather events and changes in patterns of pests and diseases. Land areas suitable for cultivation of key staple crops could undergo geographic shifts in response to climate change.

Modeling climate change impacts on regional food supplies is difficult for a number of reasons, including: 1) uncertainties in regional climate change predictions; 2) the fact that our understanding of certain agricultural processes, in particular the 'fertilization' response of different crops to increased levels of atmospheric CO_2, and the likelihood of altered patterns and distributions of plant diseases, weeds, insects and pests, remains incomplete; and 3) uncertainty regarding the potential for adaptation of agricultural practices.

The global aggregate effect of climate change on agricultural production is likely to be small to moderate. However, regional impacts could be significant. Crop yields and changes in productivity will vary considerably across regions. These regional variations in gains and losses will probably result in a slight overall decrease in world cereal grain productivity.

Vulnerability to climate change depends not only on physical and biological response but also on socioeconomic characteristics. Low-income populations dependent on isolated agricultural systems are particularly vulnerable to hunger and severe hardship. In these areas where populations are already barely food-sufficient, even the slightest decline in yields could be very harmful. The most negative effects are foreseen in dryland areas at lower latitudes, and in arid and semi-arid areas, especially for those reliant on rainfed, non-irrigated agriculture. Many of these at-risk populations are located in South and Southeast Asia.

Whether or not they are located in resource-poor countries, there is also a strong indication that marginal agriculture and marginal farmers may be most vulnerable both to short term variations of weather and longer term changes of climate. This may be compounded when farming is practiced at or near the edge of its appropriate climatic region. Relatively small changes in climate in these areas could substantially alter the potential for agriculture, thus creating a mismatch between existing farming systems and prevailing climatic resources for agriculture.

Impacts on rice yields in South and Southeast Asia are likely to vary greatly (Matthews *et al.* 1994a, 1994b). Several major studies have been conducted for countries in East Asia, including China (mainland and Taiwan), North and South Korea, and Japan (IPCC 1996). Possible climatic impacts span a wide range depending on the climate scenario, geographic scope, and study. While large changes were predicted for China, the studies conclude that to a certain extent, warming would be beneficial, with yield increasing due to diversification of cropping systems. Studies for Japan have shown that positive effects of CO_2 on rice yields would generally more than offset any negative climatic effects.

Likely Negative Effects

Climate change could influence food production adversely due to resulting:

- geographical shifts and yield changes in agriculture,
- reduction in the quantity of water available for irrigation, and
- loss of land through sea level rise and associated salinization.

Geographic limits and yields of different crops may be altered by changes in precipitation, temperature, cloud cover and soil moisture as well as increases in CO_2 concentrations. High temperatures and diminished rainfall could reduce soil moisture in many areas, particularly in some tropical and mid-continental regions, reducing the water available for irrigation and impairing crop growth in non-irrigated regions.

Changes in soils, for example, the loss of soil organic matter, leaching of soil nutrients, and salinization and erosion are a likely consequence of climate change for some soils in some climatic zones.

The risk of losses due to weeds, insects and diseases is likely to increase. The range of many insects will expand or change, and new combinations of pests and diseases may emerge as natural ecosystems respond to shifts in temperature and precipitation profiles. The effect of climate on pests may add to the effect of other factors such as the overuse of pesticides and the loss of biodiversity which already contribute to plant pest and disease outbreaks.

Agriculture in low-lying coastal areas or adjacent to river deltas may be affected by a rise in sea level. Flooding will probably become a significant problem in some already flood-prone regions of Asia such as China and further south in Eastern Asia. Decreases in productivity are most likely in these regions which are already flood-insecure. The summer monsoon is predicted to become stronger and move north-westward. However, this increased rain could be beneficial to some areas.

In addition to changes in temperature and rainfall, changes in the frequency of extreme climatic events could be damaging and costly to agriculture.

Likely Positive Effects

While increases in temperature, changes in soil moisture, and shifts in patterns of plant pests and diseases, could lead to decreases in agriculture productivity, CO_2 fertilization could lead to some increases in agricultural productivity. Atmospheric CO_2 levels are expected to have a positive effect on some plants, increasing their growth rate, and cutting transpiration rates. Crop plants may also be able to use water more efficiently under higher CO_2 levels.

Plants can be classified as C_3, C_4 or CAM, depending on the photosynthetic pathways they employ. C_3 plants, including most trees and agricultural plants such as rice, wheat, soybeans, potatoes and vegetables, are likely to benefit from extra CO_2. The results of a large number of experiments have confirmed that elevated CO_2 concentrations generally have beneficial effect on most crops. Factors known to affect the response include the availability of plant nutrients, the crop species, temperature, precipitation and other environmental factors (IPCC 1996).

C_4 plants are mainly of tropical origin and include grasses and agriculturally important crops such as maize, sorghum, millet and sugarcane. The C_4 plants are expected to benefit less from increases in CO_2. CAM plants are a variant of C_4 plants, and these plants are not likely to be affected.

Increases in temperature may also bring beneficial effects. An important effect of an increase in temperature, particularly in regions where agriculture production is currently limited due to lower average temperatures, would be the extension of the growing season available for plants, and the reduction of the growing period required by these crops for maturation. This would benefit not only high altitude farming, where increases in yields and the variety of crops grown can be achieved, but also high latitude regions, where the poleward shift of the thermal limits of agriculture would increase the productive potential. However, soils and other factors may not enable much of this potential to be realized. Higher rainfall in some areas might also enable higher production, and provide more water for irrigation.

Effects on Livestock

Climate change could affect both livestock itself and dairy production. The pattern of animal husbandry may be affected by alterations in climate, cropping patterns, as well as ranges of disease vectors. In warm regions, higher temperatures would likely result in a decline in dairy production, reduced animal weight gain and reproduction, and lower feed-conversion efficiency. More mixed impacts are predicted for cooler regions. If the length and intensity of cold periods in temperate areas are reduced by warming, feed requirements may be reduced, survival of young animals enhanced and energy costs for heating of animal quarters reduced.

Climate change would also affect livestock through its impact on disease. Incidence of diseases of livestock and other animals are likely to be affected by climate change, since most diseases are transmitted by vectors such as ticks and flies, the development stages of which are often heavily dependent on temperature. Sheep, goat, cattle and horses are also vulnerable to an extensive range of nematode worm infections, most of which have their development stages influenced by climatic conditions.

In general, intensely managed livestock systems have more potential for adaptation than mixed livestock-cropping systems. Adaptation may be more problematic in pastoral systems where production is very sensitive to climate change, technology changes introduce new risks, and the rate of technology adoption is slow. Livestock production may also be affected by potential changes in grain prices brought on by changing yields in some areas, or by changes in rangeland and pasture productivity.

For developing countries, livestock are better able to survive severe weather events such as drought than are crops, and therefore a better option in terms of income protection and food security.

PREPARING FOR CLIMATE CHANGE

In the future, population growth without significant improvements in yield rates will mean more land must be used for rice cultivation and other crop production, and an increase in the number of farm animals. These factors will lead to an increase in CH_4 and other greenhouse gases released to the atmosphere.

Adjustments will be necessary in order to counterbalance any negative impacts of a changing climate. Farmers must have the ability to adjust to changes by adapting farming practices. Adaptation, such as changes in crops and crop varieties, improved water management and irrigation systems, and changes in planting schedules and tillage practices will be important in limiting the negative effects and taking advantage of the beneficial effects of changes in climate. More efficient use of mineral fertilizers and other adjustments in agricultural practices could also act to counteract the effects of climate change.

Various types and levels of technological and socioeconomic adaptations to climate change are possible. The extent of adaptation depends on the affordability of such measures, particularly in developing countries. Recent national studies show that the increased costs of agricultural production under climate change scenarios would be a serious economic burden for some developing countries. Other important factors will be access to know-how and technology, the rate of climate change, and biophysical constraints such as water availability, soil characteristics and crop genetics.

The biggest problem arises with the uncertainty surrounding the effects of climate change and the unknown time frames. It is still uncertain who will be most impacted by the changes, and this fosters a lack of initiative for taking action now to mitigate the effects of climate change. Thus, education will be a necessary factor in the preparation for climate change.

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NEWSBRIEF

THE 60th BIRTHDAY CELEBRATION OF DR. AMMAR SIAMWALLA

May 29, 1999 marked Dr. Ammar Siamwalla's 60th birthday anniversary. To celebrate the auspicious occasion, the Thailand Development Research Institute (TDRI) organized a series of activities in honor of its past President mentor and one of TDRI original founders. Dr. Ammar presently stays with TDRI as distinguished scholar.

The celebration kicked off on May 28, with a warm and cozy dinner celebration among TDRI senior staff, close friends and family of Dr. Ammar. *Picture (left) shows H.E. Mr. Anand Panyarachun, chairman of the TDRI Council of Trustees, presenting Dr. Ammar's portrait to Dr. Ammar as the birthday present from TDRI.*

On May 29, Thammasat University and TDRI jointly organized a seminar on "The Thai Economy in Acharn Ammar's View" at Thammasat University. Panelists were M.R. Akin Rabibhadana from the Urban Community Research and Development Institute Foundation, Mr. Rangsun Thanapornpun from Thammasat University's Faculty of Economics, Dr. Chaiwat Satha-anand from Thammasat University's Faculty of Political Sciences and Dr. Yos Santasombat from Chiang Mai University's Faculty of Social Science. Dr. Chirmsak Pinthong from Thammasat University's Faculty of Economics was the moderator.

The TDRI staff organized an in-house birthday celebration for "Acharn Ammar" on June 4.

To commemorate the occasion and to express TDRI's gratitude to "Acharn Ammar," the Institute published a book, *60th Birthday Anniversary of Acharn Ammar*, containing Dr. Ammar's 17 articles written during the span of 23 years. These articles, Thai and English, were published in books, journals and newspapers and fall into two categories: agriculture and macroeconomics. Articles on agriculture mainly deal with rice, rural credit and agricultural policy. Dr. Chalongphob Sussangkarn, TDRI President, Dr. Chirmsak, Dr. Nipon Poapongsakorn from Thammasat University's Faculty of Economics and TDRI, and Dr. Mingsarn Kaosa-ard, senior advisor to TDRI's Natural Resources and Environment Program contributed introductory notes.

The book *60th Birthday Anniversary of Acharn Ammar*

CONTRIBUTION FROM DR. AMMAR SIAMWALLA TO THE TDRI LIBRARY

On the occasion of his 60th birthday anniversary, Dr. Ammar Siamwalla kindly donated Baht 310,000 to the TDRI library. The fund will be set up as the TDRI Library Fund, and parts of the fund will be used to acquire electronic materials, such as CD-ROMs.

DR. ORAPIN SOPCHOKCHAI RECEIVES AWARD OF EXCELLENCE

Dr. Orapin Sopchokchai, TDRI's Research Director on Social Development Participation, Human Resources and Social Development Program, recently received the Award of Excellence in Contribution to Women's Development from the National Commission on Women's Affairs, the Prime Minister's Office. The award is granted out annually since 1993 to mark the International Women's Day. *Picture shows Dr. Orapin (far left) with grantees of the different awards, and Deputy Prime Minister Bhichai Rattakul and Minister at the Prime Minister's Office Khunying Supatra Masdit (center)*

Updated TDRI Publications List

PUBLISHED DOCUMENTS

รายงานทีดีอาร์ไอ

WB22 "บทบาทของสถาบันวิจัยภาครัฐในการลอกเลียนอย่างสร้างสรรค์: ยุทธศาสตร์เพื่อการอยู่รอดของอุตสาหกรรมไทย," *รายงานทีดีอาร์ไอ* ฉบับที่ 22, โดย สมเกียรติ ตั้งกิจวานิชย์, พฤษภาคม 2542.
Price: ฿30 (US$1) Weight: 140 grams

WB21 "สื่อสารโทรคมนาคม : แปรรูปอย่างไรไม่ผูกขาด," *รายงานทีดีอาร์ไอ* ฉบับที่ 21, โดย สุเมธ วงศ์พานิชเลิศ, กุมภาพันธ์ 2542.
Price: ฿30 (US$1) Weight: 140 grams

OTHER DOCUMENTS FROM TDRI PROJECTS

PO3 *รายงานผลการวิเคราะห์และวินิจฉัยข้อเท็จจริงเกี่ยวกับสถานการณ์วิกฤตทางเศรษฐกิจ*, เสนอโดย คณะกรรมการศึกษาและเสนอแนะมาตรการเพิ่มประสิทธิภาพการบริหารจัดการระบบการเงินของประเทศ (ศปร.), ฉบับพิมพ์ครั้งที่สี่, มกราคม 2542, 205 หน้า.
Price: ฿150 (US$4) Weight: 500 grams

PO4 ครบรอบ ๖๐ ปี อาจารย์อัมมาร, พฤษภาคม 2542, 365 หน้า.
Price: ฿300 (US$9) Weight: 800 grams

PO5 *Impact of Rice Research*, Edited by Prabhu L. Pingali and Mahabub Hossain, 1998, 428 pp.
Price: ฿950(US$28) Weight: 700 grams

TDRI OFFPRINT SERIES

OP22 ทำไมเราจึงตกหล่มเศรษฐกิจ, โดย อัมมาร สยามวาลา, คัดจาก *จุลสารไทยคดีศึกษา* ปีที่ 14 ฉบับที่ 2 (พฤศจิกายน-มกราคม 2541), 12 หน้า.
Price: ฿50 (US$2) Weight: 60 grams

TDRI RESEARCH REPORTS

Human Resources and Social Development Program (HRS)

H94 Social Impacts of the Asian Economic Crisis in Thailand, Indonesia, Malaysia and the Philippines. March 1999, 134 pp.
Price: ฿280 (US$8) Weight: 560 grams

H93 แผนปฏิบัติการด้านการขนส่ง พ.ศ. 2542-2549 กระทรวงคมนาคม, มกราคม 2542.
Price: ฿430 (US$13) Weight: 900 grams

H92 Transportation Master Plan 1999-2006, Executive Summary, January 1999, 53 pp.
Price: ฿150 (US$4) Weight: 300 grams

H91 แผนหลักการขนส่ง พ.ศ. 2542-2549 บทสรุปสำหรับผู้บริหาร, มกราคม 2542, 77 หน้า.
Price: ฿150 (US$5) Weight: 380 grams

H90 แผนหลักการขนส่ง พ.ศ. 2542-2549 กระทรวงคมนาคม, มกราคม 2542.
Price: ฿700 (US$20) Weight: 1200 grams

H89 แผนแม่บทการพัฒนากำลังคนเพื่ออุตสาหกรรมการผลิตและบริการของประเทศไทย พ.ศ. 2541-2549: รายงานฉบับสมบูรณ์, 154 หน้า, กันยายน 2541.
Price: ฿260 (US$8) Weight: 560 grams

H88 แผนปฏิบัติการด้านการขนส่ง และการสื่อสาร พ.ศ. 2540-2544 กระทรวงคมนาคม, พฤษภาคม 2541.
Price: ฿400 (US$11) Weight: 700 grams

H84 Study on Project Appraisal for Planning, Ministry of Transport and Communications: Executive Summary, March 1998, 20 pp.
Price: ฿150 (US$4) Weight: 200 grams

H83 โครงการศึกษาประเมินโครงการเพื่อการวางแผน กระทรวงคมนาคม บทสรุปสำหรับผู้บริหาร, มีนาคม 2541, 17 หน้า.
Price: ฿150 (US$4) Weight: 200 grams

H82 โครงการศึกษาประเมินโครงการเพื่อการวางแผน กระทรวงคมนาคม รายงานฉบับสมบูรณ์, มีนาคม 2541.
Price: ฿1,500 (US$43) Weight: 1.5 kilograms

International Economic Relations Program (IER)

I20 Economic Crisis and the Role of Technical Assistance, December 1998, 99 pp.
Price: ฿240 (US$7) Weight: 800 grams

Macroeconomic Policy Program (MEP)

M49 ผลกระทบของการกระตุ้นเศรษฐกิจโดยมาตรการทางภาษีและการเพิ่มการใช้จ่ายภาครัฐ, มีนาคม 2542, 28 หน้า.
Price: ฿80 (US$3) Weight: 300 grams

M48 การวิเคราะห์ดัชนีชี้นำภาวะเศรษฐกิจสำหรับประเทศไทย, โดย ปราณี ทินกร, กันยายน 2541, 64 หน้า.
Price: ฿170 (US$5) Weight: 500 grams

M47 การจัดทำการสำรวจข้อมูลภาวะธุรกิจ, โดย ปกรณ์ วิชยานนท์, และ ยศ วัชระคุปต์, กันยายน 2541, 50 หน้า.
Price: ฿130 (US$4) Weight: 400 grams

M46 การสร้างแบบจำลองพยากรณ์ภาวะเศรษฐกิจระยะสั้น, โดย ภาณุพงศ์ นิธิประภา, ทวีวรรณ สิทธิเดช, และ จิราภา อินธิแสง, กันยายน 2541, 67 หน้า.
Price: ฿150 (US$5) Weight: 450 grams

M45 Total Factor Productivity Growth in Thailand: 1980-1995, by Pranee Tinakorn, and Chalongphob Sussangkarn, July 1998, 52 pp.
Price: ฿160 (US$5) Weight: 500 grams

M44 Thailand's Financial Evolution and the 1997 Crisis, by Yos Vajragupta, and Pakorn Vichyanond, April 1998, 47 pp.
Price: ฿150 (US$5) Weight: 400 grams

Natural Resources and Environment Program (NRE)

N64 การท่องเที่ยวและผลกระทบต่อคนเลี้ยงช้างในจังหวัดสุรินทร์, โดย จามะรี เชียงทอง, สิงหาคม 2541, 51 หน้า.
Price: ฿130 (US$4) Weight: 300 grams

N63 Tourism Development in Thailand, by Mingsarn Kaosa-ard, David Bezic and Suzanne White, 29 pp.
Price: ฿90 (US$3) Weight: 600 grams

N62 Background Report for the Thai Marine Rehabilitation Plan 1997-2001, by Mingsarn Kaosa-ard, and Sunil S. Pednekar, April 1998, 111 pp.
Price: ฿210 (US$6) Weight: 500 grams

N61 โครงการกลยุทธ์และแนวทางการประสานความร่วมมือกับประเทศเพื่อนบ้านเพื่อเพิ่มขีดความสามารถในการแข่งขันด้านการเกษตรในระยะยาว, โดย มิ่งสรรพ์ ขาวสอาด และคณะ, มีนาคม 2541, 295 หน้า.
Price: ฿430 (US$13) Weight: 800 grams

N60 โครงการกลยุทธ์การพัฒนาประสิทธิภาพระบบบริหารจัดการการพัฒนาการเกษตรและอุตสาหกรรมต่อเนื่องเพื่อเพิ่มสมรรถนะของภาคเกษตร, โดย มิ่งสรรพ์ ขาวสอาด และคณะ, มีนาคม 2541, 138 หน้า.
Price: ฿240 (US$7) Weight: 400 grams

N59 โครงการศึกษาการจัดการทรัพยากรในลุ่มน้ำโขงไทย-ยูนนาน เล่มที่ 2: ภาคเหนือตอนบน, โดย สถาบันวิจัยเพื่อการพัฒนาประเทศไทย และศูนย์เศรษฐกิจ และเทคโนโลยี มณฑลยูนนาน, กุมภาพันธ์ 2541, 215 หน้า.
Price: ฿300 (US$9) Weight: 500 grams

N58 โครงการศึกษาการจัดการทรัพยากรในลุ่มน้ำโขงไทย-ยูนนาน เล่มที่ 1: มณฑลยูนนาน, โดย สถาบันวิจัยเพื่อการพัฒนาประเทศไทย และศูนย์เศรษฐกิจ และเทคโนโลยี มณฑลยูนนาน, กุมภาพันธ์ 2541, 157 หน้า.
Price: ฿240 (US$7) Weight: 400 grams

N57 แผนการจัดการอุทยานแห่งชาติดอยอินทนนท์ ระยะที่ 2 (2541-2550) บทสรุปสำหรับผู้บริหาร, โดย อภิชาติ ขาวสอาด และคณะ, กันยายน 2540, 37 หน้า.
Price: ฿90 (US$3) Weight: 200 grams

N56 ประมวลความรู้เรื่องอุทยานแห่งชาติดอยอินทนนท์, โดย อภิชาติ ขาวสอาด และคณะ, กันยายน 2540, 173 หน้า.
Price: ฿400 (US$12) Weight: 700 grams

N55 แผนการจัดการอุทยานแห่งชาติดอยสุเทพ – ปุย ระยะที่ 2 (2541-2550) บทสรุปสำหรับผู้บริหาร, โดย อภิชาติ ขาวสอาด และคณะ, กันยายน 2540, 36 หน้า.
Price: ฿90 (US$3) Weight: 200 grams

N54 ประมวลความรู้เรื่องอุทยานแห่งชาติดอยสุเทพ – ปุย, โดย อภิชาติ ขาวสอาด และคณะ, กันยายน 2540, 153 หน้า.
Price: ฿340 (US$10) Weight: 600 grams

Science and Technology Development Program (STD)

S35 Effective Mechanisms for Supporting Private Sector Technology Development and Needs for Establishing Technology Development Financing Corporation, March 1998, 112 pp.
Price: ฿340 (US$10) Weight: 500 grams

Sectoral Economics Program (SEP)

A77 สถานภาพของการพาณิชย์อิเล็กทรอนิกส์ในประเทศไทย, โดย สมเกียรติ ตั้งกิจวานิชย์, พฤษภาคม 2542, 36 หน้า.
Price: ฿90 (US$3) Weight: 280 grams

A76 Direction for Manpower Development for Long-Term Industrial Development: Executive Summary, December 1998, 28pp.
Price: ฿150 (US$5) Weight: 300 grams

A75 แนวทางการพัฒนากำลังคนรองรับการพัฒนาอุตสาหกรรมในระยะยาว: บทสรุปสำหรับผู้บริหาร, ธันวาคม 2541, 29 หน้า.
Price: ฿150 (US$5) Weight: 300 grams

A74 แนวทางการพัฒนากำลังคนรองรับการพัฒนาอุตสาหกรรมในระยะยาว: รายงานฉบับสมบูรณ์ และภาคผนวก (2 เล่ม/ชุด), ธันวาคม 2541.
Price: ฿930 (US$27) Weight: 1.9 kilograms

A73 The Economic Impact of the Liberalization of Oil Market, May 1998, 151 pp.
Price: ฿300 (US$9) Weight: 400 grams

A72 โครงการศึกษาการพยากรณ์การส่งออกสินค้าสำคัญ (20 รายการ) ของไทยในตลาดโลก, เมษายน 2541, 377 หน้า.
Price: ฿660 (US$18) Weight: 1 kilogram

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