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BOOK REVIEWS

The Analysis of Response in Crop and Livestock Production. Third Edition. By JOHN L. DILLON AND JOCK R. ANDERSON (Pergamon Press, Oxford, 1990.) Pp. 251 + xii, ISBN 0-08-037493-X Hardcover, ISBN 0-08-037494-8 Flexicover.

Economists and, by association, agricultural economists are known for their unrealistic assumptions and imperfect forecasts. How many 'economist' jokes are there? We may protest that forecasting a system which has a mind of its own, indeed many minds of its own, is much more difficult than forecasting a mindless system like the weather or nutrient uptake by plants. But our indignation only seems to add to people's enjoyment. We are even chided by our colleagues in the agricultural sciences. The irony is that agricultural scientists make their own assumptions.

Some years ago I was a Master's student in beef cattle nutrition. In those days, I made two extreme assumptions without even realising it: 1) nutrients available in feedstuffs are perfect substitutes and 2) nutrients required by animals cannot substitute at all and are joint inputs governed by the law of the minimum. These two assumptions allow individual nutrients to be studied in isolation. Yet there are many interactions. To give one example, the first assumption can be unrealistic because the energy in some feeds is better for milk production and weight gain: the energy in other feeds is better for maintenance. A complex substitution process occurs in the digestion and metabolic pathways of the animal. To give another example, the second assumption is questionable because many nutrients can substitute for each other, particularly some forms of protein for energy.

Considering nutrients in isolation allows simple hypotheses to be tested. Data can be collected from controlled experiments and analysis of variance can be used to test statistical differences between means. This type of data is not suitable, however, for estimating an animal's complex response to uncontrolled conditions on the farm. Different experimental designs and statistical techniques are required. Further, the purpose of estimating the response is to make better decisions, probably under risk and over time.

Agricultural economists are good at statistics and decision-making. For decades now, we have been lecturing agricultural scientists on how to conduct research, with indifferent success. Dillon and Anderson continue the instruction with the third edition of the book, *The Analysis of Response in Crop and Livestock Production*. Their stated purpose is to present a primer on response analysis for students of agricultural science and agricultural economics and, thereby, enhance cooperative efforts in research. They begin by quoting from the father of the F-test, R. A. Fisher (p. vi):

'No Aphorism is more frequently repeated in connection with field trials, than that we must ask Nature few questions, or, ideally one question at a time. The writer is convinced that this view is wholly mistaken. Nature, he suggests, will best respond to a logical and carefully thought out questionnaire, indeed, if we ask her a single question, she will often refuse to answer until some other topic has been discussed.'

Traditional agricultural scientists are disciples of Fisher. Surely, Dillon and Anderson mean to imply that scientists have misinterpreted his teachings. They subtly expand on this point (p. 79):

'Via tests of statistical significance (the "cult of the asterisk") involving mechanical application of arbitrary probabilities of accepting a false hypothesis, traditional procedures . . . have aimed at protecting the researcher from "scientific error". In doing so, these procedures have led to a far greater error of research-resource waste. The farmer's problem is not whether or not there is a 5 percent or less chance that a crop-fertilizer response function exists. His problem is how much fertilizer to use. . . Indeed, . . . significance tests on response estimates are often posed in a ridiculous form — after thousands of feed and fertilizer experiments it is quite unreasonable to advance the null hypothesis that yield response in livestock or crops is unaffected by feed or fertilizer respectively.'

This is Dillon and Anderson at their most provocative. They also provide practical and novel experimental designs not contained in econometrics texts and mentioned only briefly in standard biometrics texts such as that by Nedecor and Cochran. They give sage advice on redirecting research from reductionist experiments to farming systems. These designs and advice are valuable contributions to multidisciplinary research.

I fear, however, that scientists will remain unconvinced. Let me continue to use animal nutritionists as an example. Those who have worked with scientists in other disciplines will, no doubt, have similar examples. In Australia, as in other countries, nutritionists have published state-of-the-art models for livestock response to feeding (see, for example, APC, 1990). These models are now used commercially to simulate animal production over time. They are built on the assumptions of perfect substitution among available nutrients in the feeds and no substitution among nutrients required by the animal. They are estimated from inappropriate experimental designs using inappropriate statistical techniques. And for commercial use, optimisation would be more appropriate than simulation.

A careful exposition of substitution theory using their own models might convince nutritionists that perfect substitution and no substitution are hypotheses to be tested, not imposed. A worked example of proper estimation methods might help convince them to redesign their experiments and apply more appropriate statistical methods. Instead,

Dillon and Anderson condense a textbook treatment of production economics and decision-making under risk into a few slim chapters. This textbook treatment is not linked to the complications that makes agricultural production response challenging to model. Whenever complications are encountered, Dillon and Anderson give a long list of references, often with little synthesis. Later, they discuss the linear response and plateau model, which has no substitution among nutrients, and refer to studies that test the model on macronutrients in crop production. But they fail to link the model with the production theory earlier in the book. Other than a chapter on experimental design, there is no discussion of system estimation. Proper experimental design is not enough. An introduction to proper statistical techniques is also required. Finally, the chapter on dynamic production response has not been updated since the previous edition of the book. Trapp (1989) considers this previous chapter to be one of the early bridges between static and dynamic theory but then he reviews some of the more recent developments which Dillon and Anderson ignore.

In summary, both agricultural economists and agricultural scientists will benefit from Chapter 5, which discusses proper experimental design for response estimation, and Chapter 8, which discusses the application of economic principles to research into farming systems. These two chapters make *The Analysis of Response in Crop and Livestock Production* worth having on the bookshelf. Chapter 4 on duality in response estimation, Chapter 9 on aggregate supply estimation and Chapter 10 on the benefits of research are new to the third edition and are interesting and readable. The remainder of the book is not. The book by Debertin (1986) is a more efficient use of time than Chapters 2 and 3 on response functions and production economics. Similarly, the book by Robison and Barry (1987) is better than Chapter 7 on risk. Although no other book is a direct substitute, Chapter 6 on production over time is out of date.

Does the *Analysis of Response in Crop and Livestock Production* provide a primer for students of agricultural science and agricultural economics and thereby enhance cooperative efforts in research? No. This book is an intermediate-to-advanced agricultural economics text which must compete with other texts on the bookshelf. To be fair, Dillon and Anderson have set themselves an almost impossible task. Had they succeeded, the book would have been a masterpiece.

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The Malaysian Economy: Spatial Perspectives. By GEORGE CHO. (Routledge, London, 1990.) Pp. 314 + xv.

Since independence in 1957, the Malaysian economy has enjoyed considerable success on a number of criteria. Over the period 1965 to 1980, it achieved a real growth rate of 7.4 percent of GDP and 4.9 percent for 1980 to 1989. In terms of per capita GNP, Malaysia achieved an annual average growth rate of 4.0 percent for the entire period 1965 to 1989. While these growth rates are the envy of a number of its developed national counterparts (Australia's per capita GNP growth rate over the same period was 1.7 percent), they remain impressive even by the standards of the dynamic ASEAN economies. Malaysia has also made improvements in a range of social indicators, with life expectancy increasing from roughly 50 years at the time of gaining independence to 70 years in 1990 and infant mortality decreasing from a rate of 105 per 1,000 life births in 1960 to 30 per 1,000 life births in 1990 (World Bank, 1991).

It is against this background that Cho, a Malaysian citizen permanently resident in Australia, sets out to analyse the factors underlying Malaysian development in his book, *The Malaysian Economy: Spatial Perspectives*. What makes Malaysia a particularly interesting case study is not only the degree of government intervention in social and economic arenas, but the nature of such intervention. The primary thrust of government intervention in Malaysia has been to promote income and wealth equality among social and ethnic groups. Essentially, however, this has translated to promoting economic opportunities of the Malays or, more generally, the *Bumiputera* (literally translated as 'sons of the soil' and primarily used to distinguish indigenous Malaysians from non-indigenous Malaysian Chinese and Malaysian Indians). Malays constitute just over 50 percent of the peninsular Malaysian population, with Chinese and Indians constituting roughly 35 and 10 percent respectively.

Understandably, therefore, the racial implications of Malaysian development policy is a recurring and indeed central theme of Cho's book. Cho in Chapter convincingly argues that the present-day multi-racial character of Malaysia is largely a function of British economic policy prior to World War II. Not only did British policy encourage mass non-Malay immigration, but actively promoted the participation

of Chinese and Indian workers in the more dynamic areas of the economy, namely, the mining and plantation sectors. In contrast, the Malays were largely left to their own devices in the agricultural sector and those geographical areas relatively left untouched by the expansion of the more dynamic sectors. The Chinese, in particular, were successful in branching out into other sectors of the economy, and were generally seen to occupy the economic and financial high ground. More profound though was increasing polarisation and tension between Malays, Chinese and Indians, culminating in the inter-ethnic riots of May 1969, in which it is officially estimated that roughly 200 people died. Cho, in various places throughout his book, identifies these riots as a watershed of Malaysian social and economic history. Cho is careful to avoid describing these riots as being purely racially oriented, but rather as an outcome of the inequality in the distribution of wealth among Malaysian socio-economic groups and also of rural-urban differences in economic opportunities. He stresses that these riots directly contributed to the introduction of the New Economic Policy (NEP), which spanned the period 1971 to 1990.

As Cho points out, the NEP's most fundamental aims were to reduce and ultimately eradicate poverty among all Malaysians irrespective of ethnic origin and to bring about social change to remove ethnic identification with economic function. The overall philosophy of the plan, especially during the early 1970s, was consistent with a growth with equity approach to development, in which the fruits of economic advancement would be directed towards the poor, without a 'disruptive distribution' of existing wealth. The NEP period saw the introduction of various intermediate plans. One of these, the Second Malaysia Plan 1971-75, was concerned with directly attacking poverty among the poorest groups. Indeed, in 1970 roughly half of all households in peninsular Malaysia, for example, received incomes below the poverty line, with 88 percent of these families residing in rural areas. Cho observes that 42 percent of 'poor' families lived in the northern, largely Malay states of Kelantan, Perlis, Terengganu and Kedah. Thus this plan, while in principle being concerned with poverty *per se*, essentially became one concentrated on improving the plight of the Malays. This becomes more obvious when one looks at a number of specific objectives of the plan, including, for example, increasing the Malay and *Bumiputera* share of corporate ownership and management from 2.4 percent in 1970 to 30 percent by 1990.

While the ethnic composition of Malaysia and the NEP feature heavily in Chapters 1 and 2 of Cho's book, the focus is much broader. In addition to the material just discussed, Chapter 1 provides details of Malaysian geographic characteristics, a brief description of its early history, details of its international and regional context (the latter obviously focusing on ASEAN) and general characteristics of the economy. The latter includes examination of the distribution of GDP by sector and, given the spatial emphasis, by state. Chapter 2 looks at

development planning from 1947 to 1990 with the aims of identifying the objectives of each plan, evaluating the success or failure of development expenditure by sector, and detecting any major shifts in economic policy. It is in this context that the NEP, along with *inter alia* the First and Second Five Years Plan of 1967-50 and 1961-66 and Sarawak and Sabah Development Plans of 1947-70 and 1948-70 respectively, are examined.

Chapters 3, 4 and 5 are more detailed examinations of Malaysian development policies. Chapter 3 specifically turns to initiatives in rural development, with the principal focus being on interaction between the rural population, rural institutions and the rather vaguely defined 'controllers' of the rural economy. The role of the Federal Land Development Authority (FELDA) features heavily in this chapter. Established in the early 1970s, FELDA was given the responsibility for developing previously unexploited land via resettlement of families. Cho argues that while FELDA schemes were quite successful in terms of the amount of additional land brought under cultivation (161,000 hectares by 1985), costs associated with them were extremely high, including the problem of environmental degradation. Chapter 4 looks at the transformation of Malaysian cities. The orientation of this chapter is essentially statistical, with the author examining urban population growth, the level of urbanisation, urbanisation by ethnic group, rural urban migration, and urban employment and unemployment. Chapter 4 concludes with an examination of urban management and planning, in which issues pertaining to the informal sector are highlighted. Chapter 5 highlights Malaysian industrial transformation. Patterns of industrial growth are examined, as are various strategies set out under the plans outlined in Chapter 2. Emphasis is placed on attempts to replace previous import-substitution industries with export-oriented industries, and on the important role that foreign investment has played in Malaysian industrialisation generally. In pointing out that a number of modern sector economic opportunities have been reserved for *Bumiputera*-only enterprises, Cho argues that this practice may indeed discourage foreign investment and disrupt modern sector development.

Chapter 6 is one of the more interesting sections of Cho's book. Consisting of five sections (not three as the Introduction claims), this chapter examines the socio-political economy of the 1980s. The first part returns attention to foreign investment, where it is again argued that foreign (and local) investment has also been discouraged, not only due to a perception of an over-emphasis on the redistribution and rectification of economic imbalances in favour of the Malays, but also due to the curtailment of civil liberties and government participation in business. The second section looks at complexities resulting from the cultural, ethnic and religious diversity of Malaysia. The United Malay National Organisation (UMNO) and Islam (including Islamic fundamentalism) are highlighted. The third section looks at the rights

and privileges of the Malay Sultanate, arguing that these 'rulers' can have a potentially divisive role in domestic affairs. The fourth section of Chapter 6 considers the special position of Sabah and Sarawak, while the fifth section assesses new directions in Malaysian public policy. Special attention in this section is paid to efforts to privatise public enterprises in a climate of financial scandals and corruption. The main argument, however, is that it is political instability, fuelled by communal unrest, which may be the most detrimental to Malaysia due to a resultant loss of overseas investment and unemployment.

Cho's book concludes, appropriately, with a postscript. Much attention is given to the speculative issue as to whether the NEP will continue after 1990, especially given that a number of its objectives could not be achieved. The ethnic focus of the book also assumes dominance in the postscript. Interestingly, it is not so much inter-ethnic disparity in wealth which is finally considered. Rather, it is intra-ethnic or, more specifically, intra-Malay disparities in wealth and opportunity which are seen as a source of potential disharmony.

Cho's book is certainly a welcome addition to the growing literature on Malaysia specifically, and the South East Asian economies generally. Its strength is in its descriptive detail. It is comprehensive and provides an abundance of data from primary sources. These data are generally well presented and utilised. A number of controversial aspects are dealt with objectively, especially the often emotive issues of inter-ethnic economic opportunity. To this extent, the author is to be complemented. In addition to often poor structuring of the book (which has resulted in a degree of repetition and unnecessary overlap between chapters), its principal weakness concerns its conceptual analysis. Examples include the introduction to Chapter 2 and the section in Chapter 3 entitled 'Rural Poverty and Uneven Development'. In the latter, the well-known 'trickle down' hypothesis is erroneously equated with the equally well-known Kuznets' bell-shaped pattern of income inequality. Moreover, the Kuznets' cycle is only partially represented with the reader left with the impression that this cycle involves decreases in inequality only. This is made worse by a discussion of the Williamson hypothesis (1965). Initially labelled as a variant of the 'cumulative causation' theory, it is said that the Williamson hypothesis is that income differences tend to become larger in the early stages of economic development, then level off, and eventually decline with growing economic maturity. This is in fact a description of a Kuznets' cycle, albeit in the context of regional development. However, one should not make too much out of these criticisms since the overall orientation of Cho's book is descriptive. As such, it is well worth the attention of a reader wishing to gain a general insight into Malaysia's economy and its socio-economic development.

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Agricultural Biotechnology: Opportunities for International Development. By GABRIELLE J. PERSLEY (ED.) (International Service for National Agricultural Research, The Hague, 1991.) Pp. 528, ISBN 0 85198 643 9 (hardback) (US\$114.00 Americas only).

In this large book of many authors and 33 commissioned chapters the current status and potential for biotechnology in agriculture in development countries is assessed. A smaller companion volume *Beyond Mendel's Garden: Biotechnology in the Service of World Agriculture* has been written primarily for policy-makers and research managers. This book, however, includes chapters such as 'Biotechnology for Bankers' and 12 chapters on policy issues. The main uses for biotechnology in agriculture are currently seen as rapid propagation of useful microorganisms; clonal propagation of plants; new diagnostic identification techniques, for instance, for chemical contaminants of food; genetic engineering of species for desirable characters.

Biotechnology has been used traditionally in the preparation of food by fermentation procedures in developing countries. Tofu, tempe, soy and fish sauces are examples. There is still a great deal of scope for developments in fermentation technology. Modern biotechnology embraces the new areas of recombinant DNA technology, monoclonal antibody production and tissue culture. However, biotechnologies based on microbial products but not involving recombinant DNA are also becoming increasingly important in food production as well as in fuel production and waste treatments. This area is considered in one of the sections of the book: 'Plant production and agricultural microbiology'. Whitten and Oakeshoot make the point that there is considerable potential for biological pesticides such as mycoherbicides for controlling weeds although they are apparently unaware of a long-standing existing product of this type in The People's Republic of China, Lubao, for control of dodder in soybeans.

Other sections of the book include Forestry (only one chapter). Livestock and Fisheries and Commodity Impact Studies in which several specific crops are considered. Surprisingly, rice is not one of these. E. P. Cunningham, in a chapter entitled 'Animal Production' makes the point that the major challenge to biotechnology, and indeed to all food production, lies in the developing countries and not in the industrialised countries. Yet biotechnology in agriculture is being

driven by private company interests in industrialised countries. Here is the central dilemma which the book attempts to come to terms with. Issues such as the lack of patent protection for biogenetic inventions in developing countries while patent protection for machinery, fertilisers and herbicides is widespread are addressed: among the developing countries only Senegal and the Philippines, for instance, are signatories to the Budapest Treaty for deposition of microorganisms.

The need for strong public sector capacity in biotechnology in developing countries is highlighted. Biotechnology is knowledge intensive and often location specific in agriculture and the need for education is paramount. However, training of scientists in biotechnology without an effective public agricultural research system will be ineffectual.

This book is an essential reference manual for those institutions involved in agricultural research in developing countries as well as a thought-provoking read for those interested in the impact of science on society. It is nicely designed, sparsely but well illustrated, contains 22 pages of references, a brief glossary and an essential list of acronyms.

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Beyond Mendel's Garden: Biotechnology in the Services of World Agriculture. By G. J. PERSLEY (ED.) (C.A.B. International, Oxon, 1990). Pp. 155, ISBN 0-85198-682-X.

This is a stimulating, easy to read guide to the potential of biotechnology in world agriculture. Biotechnology provides a mechanism to harness fundamental scientific research for the benefit of mankind through increasing food production. The impact could be more pervasive than with the technologies associated with the green revolution. The publicity which has preceded the application of biotechnology has been immense and this is a unique feature of biotechnology (i.e., the large degree of publicity relative to the impact to date). It is clear that there are forces at work which may dramatically influence future world events. As agricultural economists, we cannot afford to be ignorant of the possibilities and opportunities.

In 1988, the World Bank commissioned a study to assess the potential of biotechnology to contribute to increased agricultural productivity. The study was co-financed by the World Bank and the Australian Government. Gabrielle Persley, a former colleague at ACIAR, played a major role in the study and wrote this volume. *Beyond Mendel's Garden* has a policy/socioeconomic orientation (and by implication is

more appropriate for lay reading) compared to its companion volume, edited by Persley (1990).

Those who took undergraduate biology may recall that Gregor Mendel (of the book's title) was the originator of the laws of inheritance, and thus laid the foundation for plant breeding techniques. While traditional plant breeding could be regarded as biotechnology, *modern* biotechnology has three underlying components:

- (1) recombinant DNA technology allowing the insertion of genes from the cell of one species to another;
- (2) monoclonal antibody production; diagnostic tools allowing rapid detection of individual proteins produced by the cells;
- (3) cell and tissue culture — allowing genetically engineered cells to reproduce.

The major applications of modern biotechnology are expected to be in diagnosing diseases and in producing plants with novel characteristics (including disease resistance) from the insertion of new genes.

David Hopper's contribution is succinct and insightful. Hopper believes that the key biotechnology of the future is genetic engineering. For genetic engineering to be applied in solving development country problems will require a research partnership to be formed between scientists in developed and developing countries. ACIAR has been at the forefront of this type of arrangement and, while there have been only a limited number of ACIAR biotechnology projects, the research partnership mode has proven to be successful.

With biotechnology the distinction between basic and applied research is blurred, thus promoting a debate over the role of public versus private sector institutions. The property right implications of biotechnology research raises similar issues regarding public/private sector domains. Development assistance for agricultural research has usually operated through the public sector but with biotechnology this may have to change. In particular the CGIAR system, which has served international agricultural research well in the past, may require considerable adaptation to unlock the potential benefits of biotechnology.

The initial impact of biotechnology is likely to be in developed countries where research infrastructure is located and where there is an ability to pay for private sector research. In trying to capture some benefits of biotechnology for developing countries, a linkage of development aid to private sector research institutions in developed countries represents a new challenge. The major reason for the increased role for the private sector is that the process and/or the products of the research are protectable.

The discussion on safety aspects of the release of new biotechnology products is illuminating. There is clearly considerable subjectivity surrounding the decision to release biotechnology products, and regulators have to rely substantially on the views of a limited number of highly specialised scientists. The notion that biotechnology products are less risky because they are more 'natural' (a notion which

is not expressed in the book) may be naive. In the very long term, the prospect of refining genetically engineered new biotechnology to be self-containing appears feasible. However if that level of sophistication is reached, one suspects that a genetically engineered world will be quite different from that which exists today.

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Fertiliser Policy in Africa: Lessons from Development Programs and Adjustment Lending, 1970-87. By UMA LELE, ROBERT CHRISTIANSEN AND KUNDHAVI KADIRESAN, MADIA Discussion Paper 5. (The World Bank, Washington D.C., 1991.) Pp. 76, ISBN 0 8213 1321 5.

The Economics of Fertiliser Use in Developing Countries. By ASHOK PARIKH. (Avebury, Aldershot, England, 1990.) Pp. 193, ISBN 0 566 05607 0.

An Outlook for Fertiliser Demand, Supply and Trade, 1988/89 to 1993/94. By KURT M. CONSTANT AND WILLIAM F. SHELDRIK, World Bank Technical Paper No. 137. (The World Bank, Washington D.C., 1991.) Pp. 122, ISBN 0 8213 1821 7.

World Regional Supply and Demand Balances for Nitrogen, Phosphate, and Potash, 1989/90 to 1995/96. By THE WORLD BANK, FAO, UNIDO INDUSTRY FERTILISER WORKING GROUP, World Bank Technical Paper No. 144. (The World Bank, Washington D.C., 1991.) Pp. 62, ISBN 0 8213 1882 9.

These four publications will be of some interest to people involved in agricultural policy formulation in developing countries. They are a valuable addition to the literature on the economics of fertiliser use in developing countries and on world fertiliser demand and supply. Their publication is especially timely given the need to increase world food production over the next decade and because most of the production increase is expected to come from more intensive use of variable inputs rather than from increasing land area. World food stocks have declined in recent years and world population is projected to increase from 5 billion now to 6 billion by the year 2000, with most of this population increase to occur in developing countries.

The discussion paper by Lele *et al.* and the book by Parikh are case studies of the economics of fertiliser use in developing countries. The former focuses on policy issues relating to development programs undertaken between 1970 and 1987 in six African countries, namely Malawi, Kenya, Tanzania, Cameroon, Senegal and Nigeria. These

countries recently participated in a major World Bank sponsored study. Despite massive amounts of donor assistance since the early 1970s fertiliser use per hectare cropped in Africa remains the lowest in the world and issues related to protecting land quality have largely been ignored. At the same time many of these countries have had problems financing rising food imports because of stagnant export earnings.

Major policy reforms in these countries during the 1980s were the removal of fertiliser subsidies and privatisation of import and distribution networks. The effects that these reform policies and earlier development projects have had on fertiliser use are reviewed by Lele *et al.* The paper is well presented and the depth and quality of the analysis undertaken is impressive. The authors have recognised that the performance of development policies depend on the interaction of a complex set of economic, social, political, institutional, and environmental factors and that policy initiatives need to be assessed on a country by country basis.

The quantitative analysis presented by Lele *et al.* is focused on demand and supply constraints. Supply of fertiliser is analysed in terms of macroeconomic factors (foreign exchange and budgetary constraints) and a range of institutional factors, including changes in import licensing, lack of working capital throughout the distribution chain, and poor transport facilities. Demand is analysed in terms of fertiliser prices and output, physical responses to fertiliser application in different locations, land potential, transport networks, and the ability of small farmers to undertake risky investments. A key part of the analysis is the estimation of response coefficients and benefit-cost ratios for fertiliser applications for the major crops grown in each country studied.

An important conclusion of the study is that despite major limitations, projects funded during the 1970s did facilitate greater fertiliser use among small farmers. Some of the limitations are now being addressed through policy reforms aimed at removing import restrictions, and improving distribution and packaging as well as information flows to farmers. However, the authors claim that neither these reforms nor the earlier programs adequately take into account the broader and longer term implications of the role of fertiliser in more intense food production. In their policy recommendations Lele *et al.* stress the need for complementary public sector involvement to meet the needs of farmers beyond the reach of the private sector and an urgent need to improve the knowledge base on fertiliser use on a location-specific basis.

The book by Parikh is an extensive but far from exhaustive investigation of the economics of fertiliser application. By choosing Bangladesh to explore various hypotheses with respect to fertiliser use, the author uses a case example which has many of the usual difficulties associated with developing countries in terms of limited infrastructure, risk management, low education levels and land tenure, as well as

particular difficulties such as land degradation in Bangladesh's unique physical environment.

The book begins with background information and details on the importance of agriculture in the Bangladeshi economy. The level of agricultural production is significantly affected not only by irrigation, technological advanced such as high yielding varieties of seeds and fertiliser application, but also by natural factors including droughts, floods and cyclones. Various hypotheses on fertiliser demand are examined in the book.

A country level study on fertiliser consumption is presented by Parikh. He estimates that 27 per cent of the nation's increase in crop output between 1975-76 and 1984-85 can be attributed to fertilisers, compared with contributions of 24 per cent and 12 per cent from high yielding variety seeds and irrigation respectively. In turn, irrigation, high yielding varieties of seed, technological diffusion, and intensity of cropping appear to be the main determinants of growth in fertiliser application.

Quantitative analysis of fertiliser demand is undertaken at a regional level. Analysis at this level is seen as vital for measuring the prospects for technological diffusion and the price and non-price response of farmers to adopting technology and associated changes in fertiliser consumption.

Farm level effects such as risk, access to credit and weather are also included in the analysis. Environmental risk and credit are discussed and an estimate of a risk aversion variable is made from farm level data. A comparison of crop yields and fertiliser consumption across small, medium and large farms shows owners to have a higher mean value of output per unit area than sharecroppers.

In relation to the econometric analysis presented by Parikh, the discussion of the text is refreshingly frank. Throughout, the reader is reminded of data limitations. In the concluding chapter, Parikh discusses unresolved theoretical issues. In particular, the author believes that fertiliser demand should be characterised at the farm level by a model of short-run disequilibrium, in which a farmer moves from one disequilibrium to another from year to year, until a long-run equilibrium is reached. In the modelling at the farm level, however, data were collected for one year only on 465 farms, and therefore could not capture this sort of movement.

Parikh's discussion of the policy implications of the analysis in the final chapter is a disappointing aspect of the book. Although he mentions a supply constraint that contributed to fertiliser shortages in 1984-85, no details are provided of how this constraint could be or was lifted. He also briefly discusses the importance of infrastructure investment, mentioning the need for government involvement to improve banking, credit and transport networks. He states that the government can achieve a lot through flood and drainage control. However, the limited discussion in the text may have been overtaken

by events due to the rapidity of environmental degradation, particularly following the 1988 flood. Given the significant differences observed between the yields of sharecroppers and owners, there may also have been scope for a discussion of policy as it affects land tenure. The author stresses, however, that much more research needs to be done. These omissions therefore are understandable.

The two World Bank technical papers will be welcomed by policy makers concerned with removing fertiliser supply bottlenecks. Technical Paper No. 137 contains an analysis and major review of international fertiliser markets, with forecasts of demand/supply balances for nitrogen, phosphate and potassium to 1994-95 and prices projections to 2005. In Technical Paper No. 144 data on these balances are reproduced and presented in more detail, with forecasts being extended to 1995-96. The projections are basically the work of the World Bank/FAO/UNIDO Industry Fertiliser Working Group and were finalised in Washington during November 1990. The group, which meets regularly, has members from an impressive list of international organisations representing interests in the manufacture, distribution and use of fertiliser. The authors claim that the analysis is done on a country by country basis and that a variety of methodologies are used, with due consideration being given to policy issues. Unfortunately only scant details are given of these methodologies so that it is not possible to give an objective assessment of the forecasting techniques used.

Nevertheless, Technical Paper No. 137 does contain a thorough discussion of the factors affecting demand and supply and a good coverage of important issues, including the impact that environmental considerations are having on fertiliser industries. Mention is made of programs which promote natural farming methods and a reduction in the use of pesticides and chemical fertiliser, most notably the 'Low Input Sustainable Agriculture' program which is being backed by the US Department of Agriculture. However, the authors are sceptical about the success of such programs and conclude that significant increases in chemical fertiliser applications will be needed to meet world food requirements to the year 2000, especially in developing countries.

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Economics, Canberra

Sustainable Development: Economics and Environment in the Third World. By DAVID PEARCE, EDWARD BARBIER AND ANIL MARKANDYA. (Aldershot, Edward Elgar, 1990.) Pp. 217 + xii, ISBN 1-85278-167-X Hardcover £34.50.

A well-worn joke defines an economist as someone who knows the price of everything, but the value of nothing. As a non-economist, one could often be forgiven for gaining the impression that economists assume away the distinction. Much of what the discipline seems to produce seems to stem from an assumption that everything does have a price, and then proceeds to deal with the problems of maximising welfare (as measured by the sum of those prices). To those who take the threat of global environmental crisis seriously, this amounts to an arcane quest to determine the Pareto-optimal number of deck chairs for the Titanic — with the market to determine their arrangement.

The impression is, of course, unfair to economists — at least, to many of them. There is a long and noble tradition among economists of dealing with the difficult margins of their discipline, but, while the margins feature more prominently among the work of resource and agricultural economists too many economists today seem too willing to ignore what cannot be measured and modelled. It is almost 30 years since Mishan, in advance even of the Club of Rome, questioned economic growth as a goal. There has not been too much questioning since.

This is a pity, because much that people value does not have a price, and is not traded in the marketplace, and one might expect a discipline to show a little more fascination with the penumbra. The potential benefits for society are high when one considers the seeming intractability of many environmental conflicts and the failure of economists and environmentalists to find any common discourse upon which to base solutions.

For these reasons, the present volume is an important one. It is also important because sustainable development is now becoming operationalised as a concept in international environmental policy. The volume is thus timely as well as significant.

The term 'sustainable development' has its origins in the 1987 Brundtland Report (of the World Commission on Environment and Development), although the earlier World Conservation Strategy embodied a similar notion. Canadian geneticist David Suzuki has dismissed the concept as an oxymoron, arguing (as with many environmentalists) that substantial negative growth is necessary if environmental crisis is to be averted. This prescription — or even a stable state prescription — has severe negative consequences for the developing nations.

It is this heightening of inequalities inherent in any required slowing, halting or reversal of material economic growth which leads the humane to search for sustainable development. It is not a necessary consequence of the desire to avert environmental crisis, but most

would prefer it to the Malthusian alternative. This, then, is the subject of the present book. To attempt a summary of its theoretical arguments would do it a considerable injustice. Suffice it to say that it addresses all the difficult issues of discount rates, economic appraisal and the natural environment and the relationship between ecology and economic progress, and does so with considerable care and aplomb.

What sets the book apart is the fact that it provides numerous studies of the application of the notion of sustainable development to cases in the Third World. There are studies of specific policy problems, such as upper watershed degradation in Java, forest management in Indonesia, and the sustainable management of Amazonia. But there are also nation-level case studies of the Sudan, Botswana and Nepal. These studies add considerable practical insight to what is already a substantial conceptual achievement in the earlier sections of the book.

The book is therefore to be recommended most highly. It should be read by all those interested in Third World development or global environmental economics. But it is of much wider interest and value than that, since it has much to offer to those interested in searching for policy-relevant tools to address environment-development conflicts in developed nations. There is far more distance between the economics discipline and environmentalists than is necessary or desirable. This allows environmentalists to dismiss economic growth as synonymous with material growth and environmental degradation, and to elevate (wrongly) the environment to a priceless natural aesthetic. It also allows developers to argue (again wrongly) that *any* environmental controls or restrictions detract from the sum of human welfare. This book goes a long way to building a bridge between the rival camps of nature mysticism and 'what has posterity ever done for me?' The question is, will they bother to read it?

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Climatic Risk in Crop Production: Models and Management for the Semiarid Tropics and Subtropics. By RUSSELL C. MUCHOW AND JENNIFER A. BELLAMY (EDS). Comprises the contributions to a symposium of the same title held in Brisbane in July 1990.

The introductory chapter of this collection of papers stresses the relevance of climatic variability for crop production particularly in tropical climates. J. R. Anderson presents a general framework for analysing the economic impacts of climatic variability of both micro- and macroeconomic levels. M. L. Parry integrates a range of empirical methods of analysing climatic impacts and comes up with a multi-level interactive simulation approach which combines biophysical, enterprise and regional/national perspectives for assessing management adjustments in different climatic scenarios.

Part II outlines various methods for estimating climatic risk on the bio-physical level. It becomes apparent that a vast number of models for yield simulation exist, each developed for a special purpose. The contributions deal with methodological approaches which range from various integrated water-balance and crop growth models that try to incorporate variability of water supply in semi-arid regions in a long-term perspective, to an improved rainfall model for weather prediction. Thus, it seems sensible when Ritchie calls upon modelling researchers to calibrate already existing sophisticated models for their purposes rather than develop new ones.

Part III gives more examples of model applications which expose the major difficulties of handling scarce data sets and quantifying variability in system linkages. The different papers give useful examples of how to methodically handle these scarcities or how to expand the models by integrating new parts into existing set-ups, thus increasing their overall complexity systematically. Part IV provides a collection of papers concentrating on model results. They come up with crop yield estimations and calculations of monetary returns by optimising different aspects of land management systems such as crop and cultivar selection, seed and fertiliser rates, soil surface management and irrigation with respect to the climatic variation affecting the sites under investigation.

In Part V the case of response farming in Kenya illustrates the importance of combined water balance — crop yield models as decision analysis tools. However, it also becomes apparent that despite the fact that models can be powerful tools which are not restricted to research purposes, computer-based decision aids generally still lack widespread acceptance by farmers for various reasons.

Part VI gives an impression of the latest state of the art in long-term weather forecasting and the potential of incorporating predictions into crop decision support systems.

This collection of essays stresses the importance of risk-related research and modelling into final contributions which widen the issue to the regional and national level, outlining benefits and costs with respect to the importance of agricultural risk management for society as a whole, thus drawing the circle to the introductory chapter.

In conclusion, this book provides a comprehensive collection of recent risk-related modelling research which is of high value of agronomists as well as economists and model-designers and its usefulness definitely exceeds applications to issues in tropical and sub-tropical climates, mentioned in the title. The presentation of these symposium proceedings is highly appealing, however it ought to be mentioned, that a chapter giving an overview of the essays would have helped the non-expert reader.

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