

THE ROLE OF TECHNOLOGY AND METHODS OF TECHNOLOGICAL CHANGE

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Summary

The FAO Indicative World Plan places greater emphasis on economic social and marketing aspects than upon purely technical advances in animal production. Aid should be directed strongly towards the needs of poorer communities whose relative economic position has worsened steadily despite 10-15 years of economic 'growth'. New types of more appropriate, 'village' technology are needed, which encourage widespread small-scale rural employment rather than capital- and energy-intensive growth on unsuitable Western models.

I INTRODUCTION

With a full decade of experience the U.N. Food and Agriculture Organization produced its "Indicative World Plan for Agricultural Development to 1985" (FAO 1970) of which the Livestock Production section concluded that -

- demand would increase more rapidly than production
- prices of livestock products would rise to levels at which demand would fall. These new prices would be beyond the reach of many, but higher prices for animal products relative to grains were necessary as an incentive to increase investment and output.
- pork and poultry products, with modern technology, and their intrinsically rapid biological cycles, should become relatively cheaper and output might readily be expanded to meet the early short-fall in animal products, despite their direct competition with human for cereals and concentrates.
- the slower reproductive cycles of ruminants mean a slower increase in output except in India where slaughtering of surplus cattle could increase meat production immediately.
- milk production could not be increased rapidly. Need will exist for substantial financial aid for purchases of milk and milk products by developing countries.
- need exists for greatly increased investment, coming substantially from within the developing countries **themselves, to provide more** concentrates, forages and byproduct fodder of all types.
- systems of land use and tenure must be rationalized in **many countries.**

The major function of Aid would be to -

- finance imports of protein foods in the immediate future
- concentrate more on marketing, including control of diseases that keep animal products out of some developed countries, and on training to provide technicians with broad qualifications in animal **production** and management.

- ensure better coordination of technical and financial aid, by supporting projects designed to yield reliable estimates of economic parameters as a guide to wise investment in agriculture.

II AUSTRALIA'S CONTRIBUTION IN VARIOUS TYPES OF AID

The U.N. has recommended that the developed nations should try to allocate 1% of their Gross National Product to assist the developing countries, 70% of this (0.7% of GNP) in the form of Official Development Assistance. In 1974 the total amount provided was about 40 thousand million \$US, equivalent to about one fifth of the total resources of the developing countries. This was still well below the target figure.

(a) Organization for Economic Cooperation and Development

The greater part of the world Aid flows through the OECD which includes many of the European countries, the U.S., Japan, Australia and New Zealand. In 1974 the 17 OECD countries sponsored Aid of over 27 thousand million \$US. Contributions by the U.N., EEC, the World Bank and Development Banks amounted to less than 5 thousand million \$US, as did those of the OPEC countries. Australia's contribution was 544 million \$US, of which 430 million \$US was Official Development Assistance. This was 0.55% of GNP and put Australia in the 'Top Six' (Anon 1976).

Australia's bilateral Aid is channelled through the Australian Development Assistance Bureau (formerly 'Agency') ADAB, to suitably qualified technical groups - State Department of Agriculture, University, CSIRO, professional consultant, engineering firm, etc. - contracting to execute the project in the field. In the animal production field Australian Aid includes a dairy project in Bangladesh, a sheep-breeding project in India, pasture improvement in S.E. Asia and the S.W. Pacific, improvement of animal health services and vaccine production, and a substantial animal husbandry research and development project at Bogor in West Java. Perhaps best-known is our contribution to education and technical training under the Colombo Plan. The Australian Vice-Chancellors' Committee operates the Australian-Asian Universities Cooperation Scheme, providing tertiary education opportunities, refresher training courses and assistance in research projects.

Australian commercial consultant firms too are operating projects in Africa, the Middle East, S.E. Asia and the S.W. Pacific, many of which deal with pasture and forage production and livestock improvement.

(b) FAO/UNDP Projects

Australia contributes to these via our subscription to UN as well as by providing individual technical experts for particular projects. These multilateral projects are commonly broader in scope than purely bilateral projects, the latter being limited generally to one institute or enterprise so as to remain clearly identifiable for prestige purposes and to ensure that the expenditure is easily controlled.

(c) Other forms of Aid

(i) International Centres

Eight major scientific centres with regional or even world-wide responsibilities in certain fields are financed by the Consultative Group for International Agriculture Research (CGIAR). The CGIAR, sponsored by FAO, UNDP and IBRD (World Bank), consists of a group of 13 donor countries including Australia, 3 Development Banks, 3 US Foundations and 3 Agencies, with representatives from the 5 major developing regions and a Technical Advisory Committee of scientists and economists. CGIAR is working to transform tropical agriculture in a technological sense, to create new Government policies, credit and marketing arrangements, storage facilities and technical advisory services, all supported by results of

research and practical testing. The Centres collaborate with national institutions but have responsibilities which transcend national boundaries and thus represent a whole new level of agricultural development functions.

(ii) World Bank Group

The International Bank for Reconstruction and Development (IBRD) set up initially to finance post-war reconstruction in Europe and elsewhere, and its affiliated International Development Association created to help newly-independent and developing countries with 'soft' loans, have functions which again are qualitatively distinct from those of normal Aid projects.

(iii) Regional Development Banks

The InterAmerican, the African and the Asian Development Banks all provide considerable sums for agricultural development as well as for other, e.g. industrial, development projects. Both Australia and New Zealand, as developed regional members, subscribe directly to the Asian Development Bank.

III ROLE OF ANIMAL PRODUCTION TECHNOLOGY

(a) Is inferior technology the first limiting factor?

In many cases the primary factor which limits improvement in animal production is a cultural or structural block in the process. Examples of these are the religious bar to the slaughter of cattle in India, the social pressures to own as many animals as possible regardless of productivity or to slaughter large numbers, including young females, for ceremonial feasting, and the religious bar to castration or dehorning or to the eating of pigmeats in Muslim countries.

There may be an urgent need for investment in pumps or dams or fertilizers or drainage canals or erosion control or animal healthcare, or for a method of marketing direct rather than through a middleman - none of these can be achieved without some system of rural credits and a technical or marketing advisory service that reaches right into the villages or perhaps a Government subsidy for work in the common or national interest.

Many countries need help first in setting-up or modifying intermediary structures specifically for small farmers who are ill-served by existing institutions or who may simply lack experience and confidence to use them (Ensminger 1976). There are many models for such improvements - village or tribal cooperative, State Farm or commune, 'moshav' or 'kibbutz'. There have been many successful Government-backed rural financial schemes - livestock credit schemes like the Fondo Ganadero in Colombia, or the Agencia de Desarrollo Ganadero in Spain which offers not only credit but a complete management and technical advisory service - systems like the 'Sumba Contract' for acquisition of improved livestock and the 'Bimas Ayam' scheme for 'packages' of improved chickens, feeding and health, in Indonesia.

In parts of Europe and Asia landholdings have become excessively fragmented after many generations of inheritance, so that cultivation or grazing has become inefficient. Schemes for 'consolidation' of such holdings are in operation in several countries but, because of the difficulty of convincing a large number of owners of the benefit of the scheme and of clarifying traditional rights of use or access, such schemes work only slowly if they are voluntary.

At the other extreme, large areas in Africa and the Near and Middle East are grazed by nomadic, or formerly nomadic, peoples. The separation of land ownership from livestock ownership has led to neglect of the land,

serious overgrazing and depletion of the vegetation, combined with increasing use of trees and shrubs, and of much dung, for fuel - an example of the classical 'Tragedy of the Commons' (Hardin 1968). Naveh (1965) suggested an integrated sociological/ecological approach to problems of arid regions of East Africa, and his ideas appear to have wider relevance.

In parts of Latin America huge estates of 'latifundistas' coexist with fragmented family small-holdings (Feder 1969). The productivity per hectare is much higher on the small-holdings.

Prior land reform of one sort or another may be essential to many types of technological improvement, whether the latter involves land and its forage or cropping productivity or genetic improvement of animals, regulation of stocking or watering places or transport and marketing. Some regions urgently need 'stratification' so that large grazing areas may be dedicated to stockrearing and developed suitably for that use, while other areas, nearer markets or with more suitable soils or rainfall, can be used more intensively for finishing.

It is evident, then, that the benefits which improvement in technology could bring are often dependent for their full realization upon prior advances, often more nearly politico- or socio-economic in nature, which may be more difficult to bring about than purely technical changes. The developing countries, unfortunately, have no great areas of new land to be opened up (with the notable exception of South America). They must soon look with growing urgency to the more efficient use of their present lands, and Aid must admit its vital role as a catalyst of social change.

(b) Transfer of Advanced Technology

The success of the 'Green Revolution' with hybrid maize and High Yielding Varieties (HYV) of rice and cereal grains suggests that many problems would be solved by adoption of suitable 'packages' of advanced technology. The short answer is that, generally speaking, advanced technology does not transplant easily and success is far from being automatic. Historically the introduction even in Mexico itself of CIMMYT's improved varieties needed 2 decades, as did hybrid corn even in the US 'corn belt' (USDA 1975). It needed a sustained extension effort, an intensified program of local selection and multiplication and a program of adaptive research to find suitable combinations of the expensive inputs - seed, fertilizers, water and insecticides. By 1969 only 12% of HYV farmers in India were using the full recommended 'package' much the same was true in the Philippines (USDA 1975).

The introduction of intensive cattle production systems and of improved sheep breeds into India has been conditional upon the adoption of other technical improvements; better fodder supply, better housing and water and veterinary care (Bhattacharya 1975). Simple isolated technological introductions do not always succeed, and often favour the better-educated, bigger farmer rather than the vastly more numerous and more needy subsistence farmer,

There are examples from nearer home - the North of Australia is a relatively under-developed region and there have been several major development schemes which sought to achieve efficient large-scale production by introduction of exotic technology. Fisher et al. (1978) concluded that, in 5 of the 6 projects studied, internal factors (ignorance of local soils, of crop agronomy, of local fertilizer requirements; unsuitable management for arid tropical conditions; unsuitable strain of seed selected in a different environment; failure to conduct pilot-scale investigations to ascertain probable level of yield in Northern Australian conditions) had contributed to the project's

failure more than had the external factors (costs, markets, transport, export infrastructure, etc.) on which failures are more often blamed. Kellogg (1975) cites the East African Groundnut Scheme as having failed because it was set up without any local exploratory work, on the assumption that as it involved known technology it would assuredly succeed in a superficially suitable region. He contrasts with that the successful Gezira Cotton Scheme in the Sudan, which was established soundly after several years of preliminary local investigation.

As the Indicative World Plan suggests, there are excellent prospects for rapid increases in poultry and pigmeat production, for theirs are technologies that have been found to transplant quite readily. Genetically-superior cross-bred pigs and chickens thrive in large 'industrial' establishments, well isolated from the local environment and its pathogens, and fed on mass-produced compounded fortified rations. With suitable feed ingredients and adequate technical supervision such enterprises produce at reasonably predictable rates in many parts of the world. There may remain peripheral problems such as the precise nutritional characteristics of the local rice bran or fishmeal, but their appropriate research technology too is readily transferred.

The Australasian pasture-grazing-animal symbiosis has been found to be transferable to cool temperate South America, to the semi-arid Mediterranean littoral, and to the semi-tropics and tropics of S.E. Asia and Central America. Not always completely transferable: local differences in climate may seriously affect the reseedling of subterranean clover or the life-cycle of intestinal parasites; mineral deficiencies or excesses may impair the establishment of tropical pastures. More fundamentally, methods of animal husbandry developed for our relatively enormous flocks and herds may be totally inappropriate for a society of small landholders with a system of values and of family, social and community commitments that we simple mechanistic technologists do not comprehend.

Within a 'package' of advanced technology there may be some stages which will go more readily than others. Thus within a scheme for the genetic improvement of cattle, for instance, it is comparatively easy to impart the methods of semen collection and processing, given the right equipment and an adequate laboratory. It is not so easy to train and motivate smallholders owning one or two cattle to identify them in oestrus and present them at the right time for insemination, nor to set up simple performance records at village level to assess the benefit that may come from the use of 'improved' cattle. Yet, as the IWP makes clear, the greatest importance should be attached to generating reliable economic predictions of the outcome of various alternative ways in which scarce development capital might be invested.

(c) 'Appropriate Technology' - Local Innovation

In all cases of technology transfer there is an urgent need initially for adaptive trials, closely related to current as well as to potential future local conditions, to test proven but exotic methods, in their new setting. These local trials should be undertaken in a spirit of willingness to modify the proposed new methods, rather than determination to show how good they are.

Reddy (1976) pointed out the fairly general lack of success in applying 'Western' ideas in developing countries, arguing that Western technology ('The Trojan Horse'), specifically suited to Western capital- and energy-intensive systems, had shown an intrinsic tendency to magnify economic inequalities.

"Technology is 'like genetic material; it carries the code of the society in which it was produced and tries to replicate that society.

provided it finds a compatible and conducive economic social and political environment. To the extent that the environment in a developing country is not uniformly favourable, this replication succeeds only in urban pockets. Thus the adoption of a Western pattern of technology **into** the context of a developing country must be viewed as the initiation of a 'package deal' which includes on the one hand metropolitan centres of affluence and on the other hand rural poverty".

In arguing for a more 'appropriate' technology Reddy distinguishes two possible errors which should be avoided:-

(i) uncritical acceptance of rules that may be perfectly right for developed countries e.g. that unit cost goes down with increasing scale of production and (ii) unquestioning use of private-sector techniques of investment appraisal which ignore the vital question of the social costs and benefits to the recipient country.

Singer (1976) also has affirmed that "large-scale farming, or modern industry, is much more efficient in terms of output per person employed but where there is surplus labour this is not relevant". He urges that emphasizing 'development' rather than 'growth of GNP' should imply the allocation of Aid specifically to benefit poorer sections of a community: "the coincidence of all conceivable development objectives in favour of small-scale farming (and similarly also of small-scale rural or urban non-agricultural production) means that this sector is now a well-recognized priority."

Such an 'alternative development technology', aimed at the village rather than at the city, seems most likely to come about through the adaptation of modern methods to traditional indigenous conditions, or the re-examination of traditional methods and concepts in the light of modern scientific principles (Whittle&one 1970). Preston (1977) argues cogently for such an approach, and indeed the flowering of agricultural research in Cuba in the last decade or so is a fine example of the beneficial application of exotic scientific methods to an indigenous '(sugar-cane) industry.

. All experience shows that communities, and even the original thinkers within them, are prisoners of their society's intrinsic 'taboos' and channels of thought. In many cultural and social matters the West has much to learn from the East, as some of our younger people are now doing. Conversely Western science and scientific method could now be the means by which many of the developing countries might break out of the channels of their society's orthodoxy. From collaboration might emerge 'hybrid' technologies appropriate to local needs, recognizably national in character and far more likely to earn enthusiastic acceptance because of their strong indigenous content. The methods would certainly be labour- rather than capital- or energy-intensive, avoiding excessive dependence on complex and costly equipment. Such method would probably be seen by both borrowers and lenders as a safer investment prospect than something glossy but alien and sophisticated.

IV POSSIBLE AUSTRALIAN CONTRIBUTIONS

Australia has a wide climatic range and considerable technical strengths, not all of which will be of immediate relevance to the needs of developing countries, Within the somewhat restricted field of topics and the 'low profile' attitude being advocated here, we seem able to offer assistance with confidence in:-

- animal breeding, performance recording
- arid and semi-arid tropical ecology
- grazing systems for humid tropics

- integrated cereal/forage legume systems in temperate Mediterranean climates
- land-use planning, regional development
- livestock identification and handling, yarding, marketing and slaughtering facilities.
- plant breeding and nutrition
- river control, dams, stock waters, irrigation, pollution
- simple rugged machinery - motors, pumps, filters, windmills, waterwheels, etc. particularly for agricultural use
- supply of disease-free animals or semen for upgrading programs
- tropical animal health care, preventive management

For some of these topics the necessary expertise at the appropriate level might be found in CSIRO - perhaps in more cases in State Departments, Universities, engineering or technical organizations either official or commercial.

The argument for starting with relatively unsophisticated 'village level' technology implies a strong element of local training, probably at two levels - there may be a need to re-educate national graduate-level counterparts to accept the view that certain simple fundamental facts must be established by survey or local experiment as an essential basis for a sound livestock industry. There will certainly be a need to train nationals, preferably with a rural background, to a modest level of technical competence in field, laboratory and records/administrative work. These people will be needed to provide active advisory, technical support, financial and marketing services, and during their in-service training opportunities should arise for selection of those most suitable for advancement to graduate education and responsibility.

An unfortunate legacy in the higher education systems in some countries is the production of graduates with far more theoretical than practical knowledge. Combined with a social attitude which views manual work as demeaning, this may pose real philosophical problems. Understanding of the deepseated nature of these attitudes, goodwill and personal example seem to reduce, if they do not eliminate, these difficulties.

V CRITERIA FOR FUTURE ANIMAL PRODUCTION PROJECTS

Livestock producers in developing countries include many subsistence farmers who are not able or willing to risk their annual stock increase or to invest in new ideas. Often they are not part of a market economy - their over-riding concern is to produce enough for their families. The only security they can count on is to follow traditional handed-down practices of the past. Many possible changes are beyond either their means or their technical and managerial skills. The transformation of their agriculture must be step-by-step, each advance, adding to their competence to evaluate and make decisions, enabling them to acquire simple consumer goods of local manufacture and thus initiate village industry and local employment. "Those who will be doing the big thinking and designing grand plans for mobilizing the world's resources . . . should accept with both understanding and humility that, in the final analysis, what happens will be decided by small farmers and the families who live by farming as a way of life." (Ensminger 1976).

The FAO Indicative World Plan sets out a convincing broad strategy for Aid and it is becoming widely accepted that Aid is more complex than simply trying to produce enough food for the world's population. The most intractable problems are social, political and economic rather than technical, and the detailed tactical planning of Aid projects should

reflect this fact-

Projects should aim to strengthen and upgrade national institutions servicing livestock production rather than bypass or replace them, and to this end should contain a strong national element in their planning and execution, subject to final recourse to expatriate expert advice on purely technical questions. Projects should initiate or sustain a long-term 'presence' in the host country so as to ensure full exploitation of technical training programs and to encourage the formulation of sound production estimates to guide national development planning.

The most important single consideration should be to avoid the imposition or replication of unsuitable Western livestock production systems, and to use Western scientific enterprise and experience to devise hybrid technologies appropriate to the competence, culture and future aspirations of the developing community.

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