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SUBSIDIES TO PROMOTE TECHNOLOGY ADOPTION IN TRINIDAD AND TOBAGO

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INTRODUCTION

Subsidies have been a part of the agricultural development scenario of Trinidad and Tobago for over 40 years now. In 1940 following a devastating outbreak of Witches' Broom disease, the cocoa subsidy scheme was introduced as the first official subsidy programme for Trinidad and Tobago. It involved the provision of free planting material and a cash subsidy for the replanting of cocoa fields on lands suitable for cocoa production. By 1948, cocoa production had risen from a low of 8 million pounds in 1945 to 18.2 million pounds in 1948 and 21.7 million pounds in 1953.¹ This was adequate evidence to conclude that subsidization was an effective means of stimulating agricultural production.

Since then the subsidy programme had evolved into a massive incentive scheme stimulated to a great extent by "the petroleum revenue bonanza", particularly in the middle 1970's to the early 1980's. With the present down-turn in the economy of Trinidad and Tobago, substantial adjustments have been instituted. There is still need for further alterations and stream-lining of incentives aimed at maximizing efficiency of agricultural production, and making the best use of our scarce financial resources.

The purpose of this paper is to firstly examine the development of the agricultural subsidy scheme of Trinidad and Tobago with special reference to subsidies geared toward technology adoption, and to determine whether or not there was any impact of such subsidies on technology adoption. Secondly, an attempt is made to identify some of the pros and cons of technology adoption, and to suggest ways and means of developing a subsidy scheme that would overwhelmingly impact on technology adoption in future.

THEORETICAL ASPECTS OF AGRICULTURAL SUBSIDIES

It is difficult to get a clear definition for agricultural subsidies. However, they can be defined as "public sector rewards to

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Roland A. Bosch, Carlisle Pemberton, Earlyn Nurse-Sambury and Emaline Harris (1985): The Economic Impact of the Subsidy and Incentive Programme (including guaranteed prices) on Agriculture in Trinidad and Tobago. Dept. of Agric. Econ. & Farm Management, Faculty of Agriculture, University of the West Indies, (Feb.), Report No.2, p.44.

the agricultural sector that directly change relative prices".² Three basic types of agricultural subsidies can be distinguished, viz: farm income subsidies, farm output subsidies and farm input subsidies.

Farm income can be regarded as negative tax to agriculture. Farm income subsidies discriminate in favour of non-agricultural incomes. Their effects are difficult to determine.

Farm output subsidies comprise five general classes of agricultural price support measures, viz:

- (i) direct agricultural output price support measures, which aim to raise farm output prices above the prevailing market price;
- (ii) agricultural output price stabilization measures which can either be fixed farm prices, guaranteed price range or minimum guaranteed prices and limited price guarantees (fixed amount of output);
- (iii) import restrictions on competing agricultural outputs;
- (iv) support of export prices; and
- (v) 'non-price' measures such as quality control legislation, public health legislation, which may impact on output prices even though in the longer term.

Farm input subsidies aim at reducing farm input prices either by money transfers or transfers in kind. Subsidies on fertilizers, herbicides, machinery, credit, land, hired labour and fuel, remission of import duties or indirect taxes can all be classified as money transfers for farm inputs with a 'ready' market.³

Limitations of Agricultural Subsidies

Figure 1 demonstrates a simplified relationship between farm income and the various parameters of agricultural production, and helps us identify the points at which subsidies are normally applied. Farm income is dependent on five (not entirely independent) variables. Of these five, only two (input and output prices) are directly influenced by subsidies. However, variations in volumes of output and input can easily affect the objectives of such price policies. Additionally, subsidies directed towards farm incomes do not guarantee increased farm investments by farmers. Farm investment is more likely to be a function of the profitability of farming than a function of income subsidies.

The ideal approach should be to shift production functions rather than 'fiddling' around with prices. The problem with this approach is that large investments and long gestation periods are compulsory, which is not necessarily in keeping with the political outlook of many governments. Hence, they opt for shorter run policies such as agricultural subsidies. As would be seen later, technology fits into the former perspective and it would not be strategic to merely apply across-the-board subsidies if one is to ensure technology adoption.

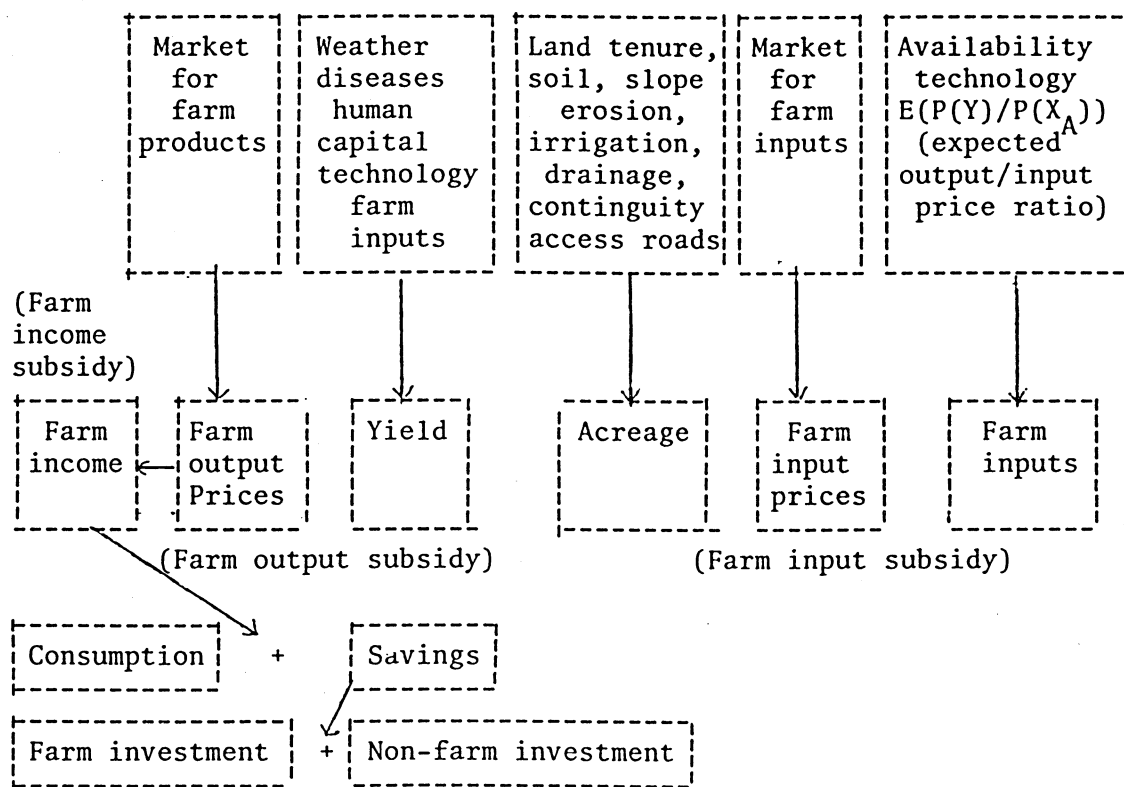
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Ibid. p.30

3

Ibid. p.26

FIGURE 1: PARAMETERS OF AGRICULTURAL PRODUCTION SHOWING POSSIBLE POINTS OF SUBSIDIZATION



Source: Adapted from: Bosch, R. et al. (1985). p.38.

A SHORT HISTORY OF AGRICULTURAL SUBSIDIES IN TRINIDAD AND TOBAGO

Two periods of agricultural development can be clearly distinguished, the period before the oil boom in 1973 and the period following. The development of the subsidy programme can be examined in this perspective as well.

Following the success of the cocoa subsidy scheme of the 1940's-1950's, the government extended the programme in 1959. The programme was then limited to farm input subsidies.

In 1960, the Citrus Development Scheme, in the form of a fertilizer subsidy, was launched.

In 1966, a minimum guaranteed price system (farm output subsidy) administered by the Central Marketing Agency (CMA) on behalf of the Ministry of Agriculture, Lands and Food Production, was introduced. It was geared for selected temporary crops, those of which the Government wished to stimulate production.

Notwithstanding substantial increases in Government assistance, the performance of the agricultural sector by the end of the sixties left much to be desired. Cocoa production had reduced again to about 8 million pounds as one major aspect of the decline. It was believed that the main reason for lack of stimulation of agriculture by the subsidy scheme was a dearth of information about the benefits to be derived from efficient fertilizer use. A national fertilizer scheme

was therefore introduced in 1967-69.⁴

By 1970 the subsidy programme was well established though on a relatively small scale. Between 1966 and 1973 (start of the oil boom) the money value of farm input subsidies increased from \$224,094 to \$1.9 million. By 1975 it jumped sharply to \$3.2 million (excluding guaranteed prices). By 1981 it had increased to 16.14, but then declined to \$8.5 million by 1982, reflecting the start of the economic down-turn.⁵ Between 1966 and 1983 there were also substantial changes in the coverage of items subsidised. Before 1973 the subsidy scheme covered the following input subsidies: land preparation, soil conservation, pasture establishment, water for agriculture, livestock housing, the national fertilizer scheme, blackpod in cocoa and froghopper control (Caroni Ltd.). The main input subsidies added to the scheme during the period 1973 to 1983 were:

Aerolate leaf spot (1974-1980); orchard establishment (1975 onwards); grazing under coconuts (1975 and onwards); spraying equipment and chemicals such as herbicides, insecticides, fungicides, nematicides and acaricides (1976 and onwards); purchase tax rebates on equipment and machinery used by farmers (1977 onwards); purchase of fishing boats (1979 onwards); vehicles used exclusively for agriculture (1980); coffee rehabilitation (1981).

All the above input subsidies (except froghopper control) were administered by the Ministry of Agriculture, Lands and Food Production. However, in 1975 and 1978 two subsidies on poultry feed and dairy feed, respectively, administered by the Ministry of Industry and Commerce and Consumer Affairs (MICCA), were introduced. Additionally, low interest loans from the Agricultural Development Bank had been made available around the same time.

In addition to farm input subsidies, a farm income tax exemption (farm income subsidy) was instituted in 1972 for approved agricultural holdings not exceeding 50 acres. This was extended to 100 acres in 1977. Other farm output subsidies were added from 1973 (start of oil boom). They were:

- (a) a deficiency payment on copra sold to Coconut Growers' Association (started in 1975);
- (b) guaranteed price payments for cocoa and coffee (from 1982);
- (c) a minimum guaranteed price for citrus solid to Cooperative Citrus Growers' Association (from 1975);
- (d) a deficiency payment to Trinidad Food Products (TFP), for milk purchased from local farmers;
- (e) subsidies on poultry, hatching eggs and pigs;
- (f) an agricultural import policy based on a system of import licences by the Ministry of Industry, Commerce and Consumer Affairs. For example, the import of tomatoes and cabbage prohibited since 1982; a levy of 5 per cent on all imported powdered milk and 10 per cent on evaporated milk in effect since 1973.

4

Ibid. p.68.

5

Ibid. p.68.

The Present Situation

Some major changes have been made in the subsidy programme since 1985. Most of the production subsidies have been discontinued in their normal form, and funds that would have been ordinarily associated with these are now channelled through soft loans from the Agricultural Development Bank. One notable exception is the subsidy on soil conservation which has continued as before. Subsidy on imported chemicals has also been curtailed; the subsidy is now being provided at source for locally manufactured agricultural chemicals. Subsidy on motor vehicles will be provided only for all-terrain vehicles.

The following adjustments have been made in the price support programme:

The price of cocoa, coffee and farmers' cane will be retained at existing levels for at least three years; citrus, copra and sorrel prices will be revised and kept under constant review; the price of paddy will remain at the existing level for the next two years; milk prices will be reviewed periodically; liveweight price of pigs will remain at the existing level for at least two years. Livestock feed subsidy and the minimum guaranteed price programme operated by the Central Marketing Agency (CMA) will be discontinued.

It is noteworthy that the following subsidies are retained, although modified.

- Equipment and machinery for agriculture in the form of duty free entry into Trinidad and Tobago and a 50% rebate on the CIF price up to a maximum of TT\$5,000.
- Agricultural spraying equipment in the form of a rebate of 50% on the purchase price.
- Wheel tractor for agriculture for which farmers will be granted the following concessions once every four years:
 - duty free entry into Trinidad and Tobago
 - a rebate of 25% of the cost of the tractor up to a maximum of \$6,000.
- All incomes derived exclusively from agriculture on farms up to 100 acres in size is exempted from income tax.

The Major Objectives of the Subsidy Programme

Over time the following have emerged as the major objectives of the programme:

- increase agricultural output;
- modernization of the agricultural sector through use of improved production technology and more efficient farming systems;
- maintaining a viable farming sector by ensuring that farm prices do not fall below production costs;
- increasing the well being of the rural community.

TECHNOLOGY IN AGRICULTURE

Technology in its true sense covers a rather broad scope. It not only includes physical innovations but also the knowledge associated with the application of such innovations. Technology transfer is a phenomenon associated with most developing economies vis a vis technological packages developed in more advanced countries. It mostly involves the transfer of final products, but in order to be effective,

must also include information pertaining to, among other things, the physical structure of the innovation, ways and means of maintenance, and how it is to be used. Moreover, the final products themselves are the embodiment of a continuous stream of new technical knowledge all combined to produce a unique entity.

However, not all technologies utilized in developing economies are direct transfers from advanced countries. Many developing economies have been responsible for developing their own unique forms of technology - appropriate technology - in most cases by having access to the body of useful knowledge which has made it possible for the advanced countries themselves to produce their own input factors.

In the field of agriculture, four major production resources are identified viz., land, labour, capital and entrepreneurship. Among these, land and labour are regarded as the two primary resources that are most critical in determining a viable pattern of technical change in agriculture. Consequently agricultural growth may be viewed as a process of easing production constraints imposed by inelastic supplies of land and labour, thus giving rise to the imperatives of agricultural technology, which can be broadly classified as labour-saving or land-saving. This must be complemented by investments, production education for farmers (appropriate man power development) and by efforts to bring institutional development into conformity with the new growth potentials. Without this the full productive dynamism of the newly acquired knowledge and inputs may not be realised.

One hypothesis of the theory of agricultural development, the "Induced Development" Model proposed by Hyami and Ruttan described interactions between technical changes and institutional and economic development. It highlighted the development of response to constraints imposed by inelastic factors of production, such as the production of mechanical, biological and chemical technologies as substitutes for labour and land. It argued that institutional changes (subsidy, for example) are induced by changes in technology in response to the need to take full advantage of the latter.⁶

Identification of Technology Types

It is already established that agricultural technology could either be labour-saving or land-saving, embracing mechanical, biological and chemical innovations. These broad categories can be further broken down as follows:

Mechanical Technology: These cover all equipment used in agricultural production, viz. tractors; automatic seeders; tractor-mounted planters; tractor-mounted fertilizer hoppers, agitators; knapsack sprayers; mechanical harvestors, combines; grading, packaging devices, processing and transport equipment; milking machines; automatic feeders and waterers etc. They also include equipment for agro-industry (processing), e.g. cold storage equipment etc. Mechanical technology is geared mainly to compensate for scarce labour and thus increases labour productivity. In other words, one man could produce several times more the amount that he would have

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Yufiro Hyami and Vernon W. Ruttan (1971): *Agricultural Development: An International Perspective*. Baltimore & London: John Hopkins Press. Ch.5.

produced manually. It is to some extent also land-saving.

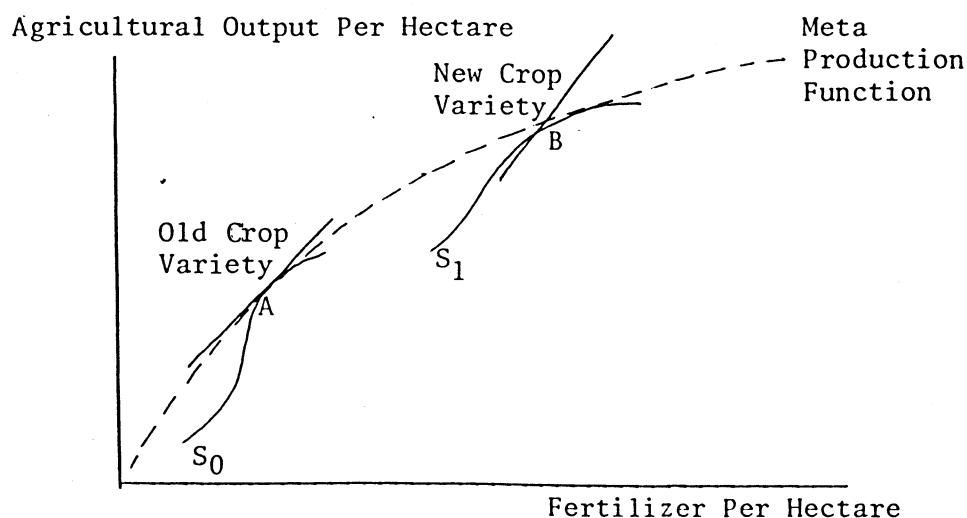
Chemical Technology: These include fertilizers, herbicides, insecticides, fungicides and other pesticides. These are geared mainly to maximizing the productivity of land. That is, where land as a resource endowment is scarce (inelastic) the development of means of increasing the output per unit area becomes imperative. Fertilizers, for example, have direct effect on yields. Herbicides and other pesticides would affect yields indirectly by preventing the destruction of crops or livestock, or eliminating measures that would depress yields.

Biological Technology: These cover improved varieties of plants such as those with disease resistance characteristics, high yielding potential, appropriate growth habits say for mechanical harvesting etc. New technologies such as tissue culture and genetic engineering also fall into this category. Biological technology is mainly land-saving in that the production per unit area of land (land productivity) is increased considerably.

THE EFFECTS OF TECHNOLOGY ON AGRICULTURAL OUTPUT

The well known meta production function (Figure 2) can be used to explain these effects. Suppose, for example, land is fixed and one is

FIGURE 2: EFFECT OF NEW TECHNOLOGY ON PRODUCTIVITY



using a traditional crop variety. In an attempt to increase output per hectare one would add fertilizer in increasing proportions. There is a point, however, all things being equal, when further additions of fertilizer would be detrimental to the crop and would result in absolute decline of output (through chlorosis or burning). In order to increase output, one requires a new crop variety (new technology) that is high yielding and very responsive to fertilizer use. When this is done, there is a shift in function (a new supply response curve). For any particular crop or livestock, one may have several supply response curves created as a result of changes in technology. This is in effect

"stretching" land. The meta production function is the theoretical envelope of all these supply response curves. One can similarly have meta production functions when labour is fixed, that is, with the use of mechanical technology, for example. One school of thought is that in the course of agricultural development one should strive to move along the meta production function. Therefore one cannot deny the invaluable contribution that technology can make to increased productivity in agriculture.

THE RATIONALE FOR SUBSIDIZATION OF TECHNOLOGY

Technical change in agriculture (the ultimate effect of technological adoption) has certain unique characteristics. It is usually associated with: (i) a long gestation period; and (ii) relatively capital intensive outlays, among others.

Thus it tends to be very difficult for potential users in newly developing countries to take full advantage of available technologies. Since it is reasonable to assume that factor prices must reflect the true value of the society in terms of social price, institutional changes would have to be made so as to create incentive policies governing the diffusion and overall adoption of agricultural technology.

Moreover, a large number of farmers face inelastic supply and demand of major inputs and outputs as well as natural hazards, which can result in the reduction of farm investment and use of farm inputs, and the application of new farm technologies, among other effects.

One general argument for agricultural subsidy policies, the "infant-industry argument", which suggests "that an industry cannot compete sufficiently if it is too small", may be applied to the agricultural sector in many developing countries. In particular it bears great relevance to the adoption of technology, owing to the substantial initial costs of technological development.

EVIDENCE OF SUBSIDIES FOR TECHNOLOGY ADOPTION IN THE SUBSIDY SCHEME OF TRINIDAD AND TOBAGO

Farm Income Subsidy

The tax exemption on income derived from farms less than 50 acres (1972) and up to 100 acres (1977) is difficult to assess as having any impact on technology adoption.

Farm Output Subsidies

The agricultural price support programme has a greater potential for promoting technology adoption. The minimum guaranteed price system administered by CMA, may not have had much influence on technology adoption, since it was aimed at a break-even income position. Deficiency payments on copra, citrus and milk, while having potentially greater influence on technology adoption, still do not guarantee (despite ensuring a stable income to the farmer) that the farmer would in fact invest in farm technology. The University of the West Indies study on the impact of the subsidy programme revealed that the guaranteed price system had little or no effect on changes in farming practices. Only a few farmers had improved their farming

practice (technology adoption included) over the ten-year period.⁷

Perhaps the most spectacular evidence of impact on agricultural production by a subsidy measure is that of import restrictions on competing agricultural outputs. Owing to restrictions placed on poultry meat in 1964, Trinidad and Tobago became self-sufficient in poultry production a few years later. The same is the case with cabbage and tomatoes prohibited from importation since 1982. These measures had the effect of rapidly increasing domestic production of the respective commodity. This in turn implied the application of various forms of technology so as to increase output to satisfy the import substitution gap thus created. Automatic waterers and feeders for poultry and large scale technology for the mechanization of tomato and cabbage production, were more than likely direct investment responses to the need to increase domestic output supply.

Farm Input Subsidies

Farm input subsidies would have had a much more direct effect on technology adoption. In particular, the National Fertilizer Scheme, which was aimed at encouraging the use of fertilizer by all farmers, must have been influential in the increased adoption of this technology. The same can be said of subsidies on herbicides and mechanical land preparation. This argument is again supported by the UWI study.

The subsidy on soil conservation is also one that was geared towards adopting improved practices (more strictly speaking, techniques instead of technologies) on the hillsides in order to conserve soil. Pasture establishment subsidy was intended to promote the adoption of new improved grasses such as pangola, paragrass as well as tropical legumes - biological technology.

Subsidies on spraying equipment, equipment and machinery for agriculture (which are provided for in the 1985/86 subsidy programme) seem to be the most relevant to the adoption of mechanical technology. The benefits gained in purchasing these items have been substantial and since their introduction in the mid-seventies, many farmers (exact statistics not available) have increased their use of these technologies.

Overall Impact on Production - Possible Reasons for Failure

According to the Prime Minister in his 1985 Budget Speech, in spite of a broadening of the agricultural incentives "to include nearly every aspect of farm practices at tremendous cost to the country ... however, the desired impact on production has not materialized."⁸ This was confirmed by the UWI study of the same year.⁹

It is a fact that the subsidy scheme evolved over time, being influenced primarily by very liberal fiscal policies, owing to the economic boom experienced in the mid and late 1970's. Initially there was no documented economic policy for agricultural subsidies. Policy documentation was attempted several years after the introduction of

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Roland A. Bosch et al (1985): Report No.1, p.4.

8

Ministry of Finance and Planning: Budget Speech 1985.

9

Roland A. Bosch: p.4.

the subsidy scheme.¹⁰ As such, there were no established criteria for periodic evaluation, neither were there specific and detailed objectives with which to work. Moreover, the great conglomeration of subsidies that were being administered simultaneously, as well as the varied influences of factor/product markets, weather, diseases, human capital, access roads etc. on farm output, did not allow for accurate and continuous assessment of the impact of agricultural subsidies individually or collectively.

One of the basic principles governing input subsidies is that inputs should be subsidized with the objective of encouraging their use beyond sub-optimal levels, as long as they have a high elasticity with output. In the case of Trinidad and Tobago, there was little evidence that such a principle was adhered to, in that subsidies were administered to all farmers; both efficient and non-efficient alike; those who were making full use of the various subsidized inputs and those who were not. There were several farmers whose financial status was as such that they could have purchased all their inputs without the help of subsidies. However, the scheme was not so structured as to identify and screen such applicants, and consequently curtail subsidization to them.

One must also be apprehensive about the fact that when input subsidies are not associated with improved or appropriate farm technology, the resultant technical efficiency of the operations remains parallel. That is, while the farmer may be encouraged to use more fertilizer, he may not be employing better fertilizing practices or may not be encouraged to use the best type of fertilizer. The subsidy should be so administered that he is not only encouraged to use more seeds, for example, but also higher yielding varieties. In addition, the UWI study revealed that the operational efficiency of the production subsidies was seriously undermined by:

- delays in subsidy payments
- levels of subsidy payments
- complicated administrative procedures
- distortions in the labour input market.¹¹

FUTURE CONSIDERATIONS

Any future agricultural subsidization policy must guard against the above pitfalls. Subsidies, in spite of their limitations and their probability of being strong political tools, if applied skillfully and in an organized, objective-oriented manner, can go a long way to foster not only increased agricultural production but also the efficiency of such production. It will be strategic to focus attention on clearly identifiable production functions in such a way that the impact of subsidies can be easily measured. Additionally, the areas of focus should not be merely beneficial to the economy, but should also have undisputed potential for opening up new levels of efficiency and promoting economic growth.

The field of technology is outstanding in this respect and where

10

Ibid. p.31.

11

Ibid, pp.8 & 9.

ever subsidies are to be granted this has to be a priority area.

The emphasis on subsidies for vehicles for agriculture, equipment and machinery for agriculture, agricultural spraying equipment and wheel tractors for agriculture, as well as locally manufactured agricultural chemicals in the 1985/86 subsidy scheme, is certainly a step in the right direction. My opinion, however, is that they are too broad-based. The ideal situation would be to relate these measures to the question of appropriate technologies among other criteria. That is, subsidy should not be paid merely for any agricultural equipment but for those that are relevant (via applied research etc.) to agricultural operations in Trinidad and Tobago. Still further, certain subsidies do not necessarily have to be paid to every farmer, but should be aimed to those farmers who are still using traditional methods and are being encouraged to adopt improved technologies. Some farmers can operate efficiently and will utilize the best technology in doing so, without the need for subsidies. Careful investigations would have to be made in order to identify such persons. The main objective of a future subsidy programme for the adoption of technology should be to make subsidies cost-effective. That is, there must be clear potential for increase in the efficiency of production by the use of the technology before payment is considered.

Special focus should be placed on post-harvest technology, for example, as a means of encouraging the development of cottage industries (agro-industries) - an essential facet of our future agricultural development. For example, a subsidy on a pigeon pea shelling machine for farmers and non-farmers alike should be strategic, since this is one of the crops that the government is now promoting. Another on an appropriate citrus-juicing system would be advisable in the light of the abundance of fresh citrus now on the open market. The potential for a widespread income substitution effect is real for citrus. Both farmers and non-farmers should be paid this subsidy. Other similar areas may crop up in the future.

Other potential areas of subsidization are:

- animal production in controlled environments owing to the decrease in availability of high potential land, and the consequent need to improve and utilize low quality roughages. Subsidies could be possibly based on the number of heads of cattle being reared under this system;
- the use of high density planting in combination with growth regulators and other chemicals, pruning, training and mechanical harvesting. Subsidies here would be applied to the system as a whole;
- many new technologies as may become essential or others that may come into existence in the process of time.

CONCLUSION

The path to technology adoption in agriculture is no doubt enhanced by the application of agricultural subsidies. Their effectiveness, however, depends on proper planning and streamlining of subsidy measures so as to ensure the realization of increased production efficiency. Across-the-board subsidies on technology do not seem to be purposeful enough to judge the impact of specific technology adoption. A great amount of our financial outlay in agriculture can be

saved, or efficaciously utilized, if adequate attention is paid to the cost-effectiveness of subsidies applied. One would hope that much research could be undertaken in this light in future.