

**Effectiveness of Bimodel Agricultural Development
Strategy: An Experience of Saudi Arabia from 1970 to 1985**

Dave Y. C. Hsu*

徐育珠

I. Introduction

In their well known book Agricultural and Structural Transformation, Economic Strategy in Late Developing Countries, Bruce F. Johnston and Peter Kilby made a distinction between a unimodal and a bimodal strategy of agricultural development.¹ The unimodal strategy relies on widespread application of improved technologies by numerous small-scale farms. Through a combination of agricultural research, land distribution, the provision of rural infrastructure, the growth of rural institutions and other government support measures, agricultural development under this strategy is spread evenly over the mass of the population. On the other hand, the bimodal strategy is based on the promotion of large-scale commercial farms using relatively capital-intensive technology to spur agricultural production. Under this type of strategy, commercialized capitalist farming exists side by side with traditional farming and the bulk of agricultural output is increasingly realized in the modern capitalist farming sector. A well illustration of a bimodal strategy is the pattern of agricultural development experienced in Saudi Arabia from 1970 to 1985².

Before 1970, agriculture in the kingdom has long been characterized by numerous subsistence farms of small size. In the traditionally cultivated area in the southwest and the oases, Three Quarters of the holdings are smaller than three

* Professor, Southern Connecticut State University, U.S.A.

hectares and over half are smaller than one hectare. The fragmentation of holdings was mainly due to Islamic Law under which the inheritance of property is shared by all heirs, leading to the division of agricultural land into small plots. Under the subsistence farming system, the immediate goal of farmers engaged in agricultural production is to achieve self-sufficiency of food for their families and most of the farm work is usually done by family members. The use of non-farm inputs such as improved seeds, machinery, chemical fertilizer and insecticides is in general extremely limited. As a result of implementation of the bimodal strategy, large commercial farms has increasingly emerged since 1970. These farms are mostly found beyond the old oases and previously cultivated valley bottoms. In contrast to traditional subsistence farms, the primary goal of these commercial farms is maximization of profits and the technologies used by these farms are much more capital intensive. The use of farm machinery, including electrical and diesel water pumps which can lift water from wells hundreds of meters deep is a commonplace in this modern subsector of farming.

In the kingdom, agriculture has been receiving unproportionally attention from the government in recent years and hence become one of the fastest growing sectors in the economy. The public opinions regarding the success of agricultural development during the period being investigated, however, were widely divided. Some people consider it a great success while others view it a failure. The primary objective of this study is to analyze the extent to which agricultural development through a bimodal strategy in the kingdom has met with success or failure in terms of its impact on such policy objectives as expansion of agricultural output, attainment of self-sufficiency in agricultural products, promotion of structural change toward more balanced

and diversified agriculture, improvement of income distribution between the farm and non-farm sector and among the population within agricultural sector and more efficient use of scarce agricultural resources. Organizationally, this study will be divided into four major parts. The first part discusses the policy measures used by the government to affect the pattern of agricultural development. The second part is a statistical analysis of the major accomplishments of agriculture between 1970 and 1985. The third part is to examine the undesirable effects generated in the process of implementation of the bimodel strategy to spur agricultural production. The last part is to propose a shift of strategy necessary to further achieve the goals of agricultural development in the future.

II. Policy Measures Affecting the Pattern of Agricultural Development

Since the early 1970's, the government of Saudi Arabia embarked upon a variety of programs to modernize and diversify its agricultural sector. Those which appear to have had the most important impact on the major policy objectives of agricultural development include the following:

1. Grant of Land: Under this program, what was once uncultivated desert land is surveyed, divided up and distributed free in tracts of up to 400 hectares per person with the condition that it be brought into production within five years. According to the government statistics³, between 1970 and 1985, 559,000 hectares of land were distributed. Of which 154,000 hectares went to ten large agricultural share companies, 175,000 hectares went to 1,456 agricultural projects and 106,000 hectares went to 18,621 individual farmers.

2. Interest-free loans: Any agricultural projects approved by the government in the Kingdom are eligible for interest free loans through Saudi Arabian Agricultural Bank (SAAB). The loan could finance up to 100 percent of the cost of project if it was less than 500,000 riyals, For a project with cost greater than 500,000 riyals the loan could finance up to 80 percent of the first 3 million riyals and 60 percent of the remaining balance up to 20 million riyals. The loans have a maximum maturity of ten years. Over the past 20 years, the loan granted by SAAB increased sharply from 4.4 million riyals in 1964/65 to 4.2 billion riyals in 1982/83 before declining to 3.5 billion riyals in 1983/84 and 2.3 billion riyals in 1984/85. The total amount of loans granted during this period was estimated at 16.6 billion riyals of which 82 percent was made between 1980/81 to 1983/84⁴.

3. Agricultural input and output subsidies. Starting in 1973, farmers in the kingdom have been receiving a variety of input and output subsidies from government. Items eligible for input subsidy ranged from animal feed to air transportation of imported cows and the coverage of outputs for subsidy included wheat, rice, corn, barley and date. The total subsidies on agricultural inputs and outputs granted by government in 1982/83 were estimated at 1,390 million riyals and 2,460 million riyals respectively.⁵

4. Water resource development. Since 1970, the Saudi government had spent billions of riyal in development of water resources. As a result, more than 20 new aquifers were found, of which 9 are being exploited⁶. In addition, some 174 dams were constructed for flood protection, aquifer recharge and the storage of run-off surface water while some 2500 wells were dug, drilled or repaired for the purpose of water supply, aquifer testing and the observation of water levels.⁷

III. Statistical Analysis of Major Performances of Agriculture

During the period under investigation, agriculture in the kingdom has made significant progress which can be summarized as follows:

1. The available statistics indicate that from 1970 to 1984, agriculture's contribution to GDP expressed at prices of 1969/70 increased from 1 billion to 2.3 billion riyals, a rise of 130 percent (Table 1). During the same period of time, agricultural employment rose from 445,800 to 617,400 or 38 percent.⁸ As a result, the productivity of labor (agricultural GDP agricultural employment) rose by approximately 86 percent over this period.

The output performance can also be estimated in terms of the quantity index of agricultural production which rose from 100 in 1970/71 to 179 in 1982/83. (Table 2) This index shows changes in value of a set of agricultural outputs when prices are held constant. From table 2, we can also see that the quantity index of livestock production increased at a much faster rate than that of crop production. The former was estimated at 448 percent while the latter was estimated at 52 percent.

It is interesting to note that from 1970/71 to 1982/83 there was only 8 percent increase in the planted areas of crops. During the same period of time, the total output of crop production was increased by 52 percent.⁹ It implies that only 16 percent of output gain was attributed to an increase in the use of land. The remaining 84 percent of output gain was a result of increase in yield per unit of land.

2. Until 1980, more than 50 percent of total consumption of wheat, the most important basic food in the kingdom had relied on import. Since then the domestic production of wheat jumped from 164,482 tons to 1.3 million tons in 1984 while the consumption of wheat increased to around 900,000

tons. Consequently, 400,000 tons of surplus of wheat were suddenly generated. Over the same period of time, the self-sufficiency rate of chicken, the most popular meat in the kingdom, increased from 24 percent to 55 percent and egg output also rose from 0.9 billion to 1.91 billion¹⁰. Since 1983/84, the kingdom has become a net exporter of eggs. Liquid milk production was 231 thousand tons in 1980/81, compared with total consumption of 633 thousand tons. By 1982/83 its production had increased to 320 thousand tons while domestic consumption increased to 786 thousand tons. Based on these figures the kingdom had achieved 41 percent self-sufficiency in liquid milk. Self-sufficiency in tomatoes and whatermelons has also nearly been achieved¹¹.

3. An important shift in composition of agricultural products was observed from 1970/71 to 1982/83. This shift was reflected by an increase in diversity index from 3.15 to 6.20¹². This increase in diversity index is remarkable as compared with other developing countries. For example, Taiwan is considered as the model of agricultural development for developing countries. From 1953 to 1967 when the island underwent a significant agricultural structural change, its diversity index rose from 3.18 to about 6.2¹³. Another indicator for structural change toward greater diversification of agricultural production in the kingdom was a substantial decline of its reliance on date palms and melons from 77 percent in 1970/71 to 41 percent in 1982/83.¹⁴

4. Ever since the first development plan being implemented in 1970. The government in the kingdom has made clear its desire to share the wealth derived from oil among the Saudi people. Through extensive support programs provided by the government, billions of riyal were channeled into the agricultural sector over the past 15 years. Take 1983/84 for example, the total amount of money

spent by government on major agricultural support programs including interest-free loans, input subsidies and a supported price for wheat was estimated at 5.2 billion riyals which accounted for 60 percent of the total value-added produced by the agricultural sector (Table 3). We have reason to believe that heavy involvement in agricultural development by government should have some contribution to the improvement in income distribution between the farm and non-farm sector.

IV. Undesirable Effect of Agricultural Development through Bimodal Strategy

As we mentioned previously, Saudi agriculture has received a wide range of supports from the government since the early 1970's. Among them the most important ones are interest-free loans, input subsidies and supported price for wheat. The total costs of government for these agricultural support programs between 1975/76 and 1983/84 were estimated at about 18 billion riyals (Table 3). If these implicit costs were taken into account, the contribution of agriculture to GDP would be much less than is shown in the National Income Accounts. It is commonly believed that some of government's supports were too generous. For example, in 1984 the cost of farmers to produce one ton of wheat on the average was estimated at U.S. \$430 while government supported price for wheat was fixed at U.S. \$1000 (or SR 3,500). The profit made by farmers for each ton of wheat produced was as high as U. S. \$570¹⁵. Another estimation, based on the data collected in Al-Hasa Oasis for 1977/78, shows that the variable cost per ton of wheat was 672 riyals with government supported price fixed at 3,500 riyals per ton, the return over variable costs for each ton of wheat produced by farmers on the average was 2,828 riyals -

4.2 times as much as the variable costs¹⁶. Even after the government's supported price was reduced to U.S. \$570 a ton (from 3,500 riyals to 2000 riyals a ton as effective of 1985/86), the farmers can still easily make U. S. \$340 of profit for each ton of wheat produced provided that the yield per hectare is 5 tons or higher.

Generous government support made agricultural investors to reap windfall profits simply by skillfully taking advantage of the government subsidy programs, not by making a correct assessment of the market. Furthermore, since other cereals are not subsidized as much as wheat, farmers were induced to switch from the production of those less-subsidized cereal crops such as barley, sorghum, maize to wheat and thus caused a distortion of resource allocation. Because of heavy subsidy, the production of wheat increased from 140,767 tons to 600,019 tons from 1978/79 to 1982/83. On the other hand, the production of sorghum, maize and barley, during the same period of time, dropped from 167,130 tons, 3,798 tons and 13,122 tons to 47,088 tons, 672 tons and 1,851 tons respectively.¹⁷

One of the purposes of agricultural subsidies is to encourage the import substitution of domestic food production. The realization of this purpose, however, was at least partially offset by the conflicting subsidy measures provided for imported agricultural products. It was often heard that many dairy farmers used imported wheat flour for animal feed to supplement locally produced feed grains and fodders simply because subsidies on imported wheat flour are so high. Another criticism regarding the agricultural subsidies which was also often heard was that they encouraged the excessive use of new machinery and acted as a disincentive to the maintenance of existing equipment thus favoring further imports of machinery at the expense of local repair and

maintenance activity.

Because of excessive use of water resulting from rapid agricultural expansion, the ecological environment in the kingdom has been deteriorating. According to the estimate of the Ministry of Agriculture and Water, from 1980 to 1985 agricultural demand for water had increased from 1860 million cubic meters to 7,430 million cubic meters.¹⁸ Our calculation, however, shows that the total consumption of water for agricultural production already exceeded 10,000 million cubic meters in 1982/83. Even though the inadequate information does not allow us to estimate exactly how much the irrigated groundwater remains, the concensus among hydrologists is that the majority of this non-renewable groundwater is being depleted at a very rapid rate.

While the kingdom has decreased its dependence on import of certain agricultural products such as wheat, poultry meat, eggs, liquid milk and some vegetables and fruits its overall dependence on imported agricultural products has been actually on the rise. The available statistics indicate that from 1970 to 1985, the total value of the agricultural products imported from overseas had increased from 1 billion riyals to 18.7 billion riyals, a rise of 25 percent per year¹⁹. Because of rapid agricultural modernization, Saudi Arabia also increased its long-term dependence on imported agricultural inputs such as machinery, equipment, insecticides, water pumps, farm laborers and managers.

In spite of its wide application and non-discriminative nature, the benefits of agricultural support programs seemed not to have been spread evenly over the mass of population in rural areas. Take land distribution for example, between 1970 and 1984, of 559,000 hectares of land areas being distributed, only 20 percent went to peasant farmers. The remaining 80 percent all went to big agricultural companies

and large-scale commercial farms. Geographically, over 90 percent of the land being distributed was concentrated in the central, northern and eastern regions.²⁰ Similarly, one third of the interest-free loans granted by SAAB over the period from 1980/81 to 1983/84 were for the development poultry production, followed by 21 percent for water development and 16 percent for tractors and agricultural machinery²¹. Again, the large-scale commercial farms, especially those engaged in the production of wheat and poultry, benefitted most from this agricultural supported program.

V. Need for Shift of Agricultural Development Strategy

Our previous discussion indicates that agricultural development in the Kingdom over the period under investigation has met with considerable success in terms of its impact on attainment of self-sufficiency in selected items of food, improvement of income distribution between farm and non-farm sector, expansion of agricultural output and an increase in production diversification. On the other hand, agricultural development might have also caused an increase in technical and economic gap between traditional subsistence farming and modern capitalist farming; rapid depletion of fossil water resources; deterioration of ecological environment, increased reliance on imports of agricultural inputs and a distortion of resource allocation. If the undesirable trends are to be checked and corrected, the future agricultural programs should be designed in such a way that the wide application of modern technology would receive greater encouragement and the benefits of government support measures would spread more evenly over the mass of agricultural population. Toward this end, infrastructure and institutional development as well as credit provision should be geared more closely to the need of small farmers and the introduction of new

technology should be based not only on its economic effect but also on its welfare effect.

There is no doubt that it is much easier to introduce modern methods of production to the commercial capitalist sector than to peasant farmers. From a purely economic viewpoint, concentrating investment in commercial capitalist sector will also generate larger short-term dividends. On the other hand, it is more likely that the overall level of saving and investment will be higher if agricultural production is increased by the widespread adoption of new technology on a large number of peasant farms. Secondly, modernization of the traditional sector increases the productivity and buying capacity of a large section of the rural population and thereby creates a greater market for local industrial products. Consequently, it will facilitate import substitution and hence accelerate economic diversification. Thirdly, modernization of agriculture through the widespread adoption of new technology by the mass of the rural population will reduce the regional socio-economic disparity and thereby help maintain economic and political stability.

Shortage of labor plus fragmentation for farm holdings have constituted a binding constraint to modernization of traditional subsistence farming in the kingdom. To cope with this problem, the following institutional innovations may prove to be helpful:

1. Introduction of joint decision making in certain operations such as land preparation, irrigation and drainage, spraying of insecticides and harvesting to enable the farmers to use jointly the expensive machinery;

2. Introduction of joint management and contract farming which entails joint responsibility for crop growing or livestock raising between farmers and an agro-industrial

company.

3. Establishment of cooperatives or farmer associations to perform such functions as buying & selling agricultural input and output on behalf of farmers.

4. Establishment of specialized production areas in accordance with underlying resource endowment.

Since the key factor to sustain long-run agricultural growth in the kingdom is water, efficient use of this scarce resource is of the utmost importance. The government's effort to deal with water problems so far has been concentrated on increasing water supply by digging wells, constructing dams and building desalination plants. Recently, various steps aimed at conserving water resources have been taken by government. They include selective bans on drilling agricultural wells in certain areas, monitoring water use by individual farmers and increases in heavy-subsidized urban water tariffs. These measures should be carried out more vigorously and extensively.

Because of lack of rainfall, Saudi agriculture has traditionally been dependent upon groundwater, most of which is non-renewable. Future agricultural growth is limited by the availability of water. More comprehensive studies are required to collect data concerning the detailed property of underground and surface water resources in different localities. This data would provide a basis for estimating the amount of water that could be drawn from different aquifers without causing damage to quality of water. Based on these estimations, a more realistic evaluation of the limited potential for further growth in agricultural output should be made.

Since early 1970's, government's agricultural credit policy has been increasingly oriented toward long-term investment loans. The share of short-term loans in total

credit provided by government in recent years has never exceeded 1 percent. In a situation where the supply of credit is rationed like what has prevailed in the kingdom, this policy should cause a shortage of working capital and thus would have adverse effects on agricultural expansion. To correct this situation, provisions of agricultural credit in the future should be geared more closely to the working capital used.

As mentioned previously, an increase in agricultural diversification and self-sufficiency in food was brought about in recent years mainly through rapid expansion of wheat and livestock resulting from promotion of forage crops. The achievement of these two goals was largely obtained at the expense of depletion of water resource and deterioration of ecological environment. It would be better off to further achieve these two goals through encouragement of greenhouse production of fruits and vegetables that requires much less water than open field cultivation. The result of an experiment carried out in Southern Israel showed that 0.2 hectares of greenhouse cultivation required about 1,500 cubic meters of water annually as compared with 15,000 cubic meters of water required by open field cultivation²². This is largely because most progressive greenhouse operations use water conserving devices such as drop or trickle irrigation through which plant nutrients are also applied. Because of its intensive use of land, the greenhouse cultivation also requires less soil resource. Furthermore, sand land that is not fit for open field cultivation could be used productively under greenhouse cultivation.

Until 1985 the government's effort to support agricultural production has been concentrated in building infrastructure, developing land and water resources and providing material incentives. The major problems facing agriculture

in the kingdom from now on is how to increase the efficient use of whatever facilities and infrastructure which have already been made available. Because of high complementarity of agricultural inputs, a minimum number of these factors must be applied simultaneously if they are to have an appreciable impact on agricultural production. For instance, an irrigation project cannot be fully productive if there is a lack of coordinated plans such as conservation of the watershed, the provision of drainage as well as the inputs required for the effective use of the water. Complaints were often heard that investment in dairy, fruits and vegetable production had been held back by lack of processing, storage, marketing and distribution facilities. People also complained that the extension services were not addressing the real problems confronting agriculture such as mis-management of limited water supplies, introduction of inappropriate farming technology and that coordination between researchers and extension agents, both in defining the research program and in transmitting research results to the farmers was almost non-existent. All of the above mentioned jobs remained to be strengthened are of an institutional nature and must be done by government. They are more difficult to provide but extremely important to sustain future agricultural growth indeed.



FOOTNOTES

This study was mainly conducted at the National Center for Financial and Economic Information, Ministry of Finance and National Economy, Kingdom of Saudi Arabia where I served as a senior economist in 1985-86. I am greatly thankful to the Center. Without its support, this study would not be completed. The views expressed here however are mine and not necessarily those of the Center.

1. Bruce F. Johnston and Peter Kilby, Agricultural and Structural Transformation: Economic Strategies in Late-Developing Countries (New York: Oxford University Press, 1975) pp. 127-181.
2. The best contemporary example of a developing country that followed a unimodal strategy with considerable success is Taiwan. For details regarding the pattern of Taiwan's agricultural development, see Erik Thorbecke "Agricultural Development" in Economic Growth and Structural Change in Taiwan, edited by Walter Galenson (Ithaca and London: Cornell University Press, 1970) pp. 132-205.
3. Fourth Development Plan (1985-1990), Ministry of Planning, the Kingdom of Saudi Arabia.
4. Saudi Arabian Agricultural Bank, Twentieth Annual Report, 1403/04 A.H., p. 23.
5. American Embassy in Saudi Arabia, "Agricultural Development in Saudi Arabia, 1975-1985" (unpublished manuscript) p. 8.
6. Saudi Arabian Agriculture Guide 1985, (Dar Al Watan/Beacon Publishing, First Edition) p. 13.
7. Development Plan, various issues.

8. Second Development Plan, p. 19, and Fourth Development Plan, p. 32.
9. Production of fodder crops is not taken into consideration. In 1982/83, the total planted areas of crops were 681,471 hectares, of which 264,371 hectares were used for production of fodder crops. See Bulletin of Agricultural Sample Survey, Ministry of Agriculture and Water 1982/83.
10. Saudi Arabia: A Reappraisal, Business International S. A. Switzerland, September 1985.
11. American Embassy, p. 12.
12. The diversity index is defined as the reciprocal of the sum of the squares of the ratio of the value of each product to the total value of agricultural output. The greater the value of this index, the higher is the production diversification.
13. Erik Thorbecke, p. 179.
14. These estimates are based on the sources of information given at the bottom of table 2.
15. Saudi Arabia: A Reappraisal
16. Humaidan, Salek Halwan, Policies and Management Guidelines for Optimum Resource Utilization at Al-Hasa Irrigation and Drainage Project, Saudi Arabia, University Microfilms International, Ann Arbor, Michigan, U.S.A. p. 94.
17. Bulletin of Agricultural Current Sample Survey, various issues.
18. Fourth Development Plan, p. 134.
19. Foreign Trade Statistics, various years, CDS., Ministry of Finance and National Economy, The Kingdom of Saudi Arabia.
20. Fourth Development Plan.
21. SAAB, p. 23.

22. Amiran, D. H. K., “Arid Zone Development: A case of Limited Choice” in Arid Zone Development Potentialities and Problems, edited by Y. Mundlak and S. F. Singer (Cambridge, Mass: Ballinger Publishing Co., 1977).



National Chung Hsing University

TABLE 1

GROWTH OF AGRICULTURE'S CONTRIBUTION TO GDP

Fiscal Year	Amount (Billions of Riyal)	Annual Rate of Growth (%)
1970	1.0	—
71	1.0	0.00
72	1.1	10.00
73	1.1	0.00
74	1.1	0.00
75	1.2	9.09
76	1.3	8.33
77	1.5	15.38
78	1.5	0.00
79	1.5	0.00
80	1.6	6.67
81	1.7	5.88
82	1.8	5.88
83	2.0	11.11
84	2.3	15.00

Source: National Accounts of Saudi Arabia, Central Department of Statistics, Ministry of Finance and National Economy.



TABLE 2
QUANTITY INDICES OF PRODUCTION OF CROP, LIVESTOCK AND
AGRICULTURE IN SELECTED YEARS

Year	Crops (1)		Livestock		Agriculture (2)	
	Value of Output (^{'000} Riyals)	Quantity Index (%)	Value of Output (^{'000} Riyals)	Quantity Index (%)	Value of Output (^{'000} Riyals)	Quantity Index (%)
1970/77	6,656,617	100.00	500,409	100.00	7,157,026	100.00
1974/75	7,395,395	111.10	1,229,866	245.77	8,625,261	120.51
1980/81	7,428,903	111.60	1,646,439	329.02	9,075,342	126.80
1981/82	9,627,477	144.63	2,033,019	406.27	11,660,496	162.92
1982/83	10,091,504	151.60	2,744,625	548.48	12,836,129	179.35

* Sources: Statistical information on quantities of production for different crops are from Bulletin of Agricultural current Sample Survey, Ministry of Agriculture and Water, Various issues, Statistical information on Quantities of production for different livestock products are from Second Development Plan (for 1970/71 and 1974/75) and Saudi Arabia: A Reappraisal Business International S. A. Switzerland, September 1985 (for 1980/81, 1981/82, 1982/83). Statistical information on prices are from Cost of Living Index, CDS, October 1985, price averages, CDS, Safer 140 A. H. and Foreign Trade Statistics, CDS, 1984.

(1) Not including fodder crops.

(2) Includes livestock and crops.

TABLE 3
GOVERNMENT EXPENDITURES FOR MAJOR
AGRICULTURAL SUPPORT PROGRAMS
1975/76 to 1983/84

(SR Million)

Year	Input Subsidy	Interest Free Loan (1)	Government Buying Price for Wheat (2)	Total
1975/76	431	32	NA	463
1976/77	727	59	NA	786
1977/78	959	70	NA	1,029
1978/79	1,178	85	224	1,487
1979/80	776	135	361	1,272
1980/81	780	304	471	1,555
1981/82	1,550	352	959	2,861
1982/83	1,023	500	1,677	3,200
1983/84	1,378	420	3,439	5,237
TOTAL				17,890

(1) Imputed interest estimated at 12 percent per year.

(2) Derived by multiplying quantity of wheat produced by the difference between imported price and government buying price.