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ECONOMETRIC ANALYSIS OF THE IMPACT OF AGRICULTURAL INSURANCE ON FARMING SYSTEMS IN THE MIDDLE BELT, NIGERIA

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ABSTRACT

Agriculture continues to dominate economic development policy in many developing countries. This is hardly surprising given the high proportion of the population of such countries that derive their livelihood from agriculture and related activities. What is surprising in many of the countries is the failure of the policy to deliver the sustained supplies of food and industrial raw materials as intended. In part this may have occurred because they failed to address the inability of the peasant farmers to withstand the increased risks associated with the adoption of commercial farming practices. Agricultural insurance is seen as one of the best strategies to address farm risks and encourage farmers to embrace modern production practices with greater potential for better and quality yields. In Nigeria, the Government introduced agricultural insurance programme with the tripartite aim of broadening farmers' access to farm resources, positively changing farmers' attitude to risk in their choice of resource use and to achieve increased food supplies in the market. Different factors can be identified that influence farmers' behaviour especially making decisions that relate to farm production, vis-à-vis choice of enterprise, its combination, the type and level of resources used in a given farming season. This study was carried out to examine whether agricultural insurance exerted any significant influence on the farming practices in the country. This study tests the broad hypothesis that farmers who purchase insurance increase their exposure to risk by adopting modern farming practices and achieved increase in resource productivity. The study found that the sampled farmers differ in their use of farm resources and the level of output produced. A higher proportion of insured farmers applied improved farming practices and were more commercially oriented. The insured farmers ventured into more risky enterprises and released a greater proportion of their output to the market for sale. However, contrary to expectations, uninsured farmers were found to be more productive and efficient in their resource use than the insured farmers.

Key words: Insurance, NAIC, farming, resource use

INTRODUCTION

Peasant farmers are naturally keen to avoid taking risks which might threaten their livelihoods and this is often reflected in their farming practices. This behaviour influences the levels and types of inputs they use and the aggregate levels of output produced. They are often reluctant to adopt output-increasing practices if these increase their exposure to risk [1, 2]. At least notionally there is a trade-off between the levels of risk that farmers can withstand and the aggregate level of food production in a country. Recognition of this trade-off by policy makers has led to the introduction of programmes that attempt to address peasant farmers' aversion to risk. One such approach is to establish a scheme to offer insurance against agricultural risk. The introduction of agricultural insurance has continued to generate a keen interest among academics and politicians because of the volume of investment involved. There are many reports that have addressed the usefulness, implications and operational practices of agricultural insurance in different parts of the world [3, 4, 5, 6, 7].

Agricultural insurance has often been funded by Governments as doubts have been raised about its efficacy in the face of covariance of risks and the problems of asymmetry of information that are prevalent in developing agriculture [8, 9, 10, 11]. The doubts give rise to the twin problems of opportunistic behaviour, namely adverse selection and moral hazard in insurance that could be expensive to control [12, 13]. These twin problems have been identified as the bane of private sector investment in the business. Since the private sector has been reluctant to venture into agricultural insurance and the public are deprived of the associated benefits such as increased food supplies in the market, the onus has often been upon Governments to provide it. This government involvement is premised on the belief that it can readily absorb the possible consequences of information asymmetry. However, the level of involvement by various governments in the provision of agricultural insurance have been criticised on the ground that the benefits are not commensurate with the financial investment committed [7, 14]. Given the very low incomes, the small sizes of holdings aimed at subsistence production, large scale ignorance and poverty and the adverse view of other people's experiences with activities of insurance companies in other sectors, peasant farmers are generally reluctant to patronize the insurance market, let alone willingly forgo a small payment in the form of premiums in exchange for their farm risks. In order to mitigate the ill effects of risk on the economy and encourage both the private entrepreneurs and farmers to take advantage of the opportunities offered by agricultural insurance, various governments introduce incentives to ensure that agricultural insurance is patronized and that it is sustainable and beneficial to the insurer, farmers and the public. The insurer benefits from the returns on investment made from premium payments while farmers benefit from the peace of mind of not solely carrying the burdens of farm production eventualities and the public benefits from increased food supplies in the market.

This paper examines the effectiveness of government involvement in agricultural insurance from the perspective of farmers by comparing farming activities between

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farmers that insured their farms against those farmers that did not. The study tested the broad hypothesis that insured farmers can be differentiated from the uninsured farmers according to their response to risk, production practices used on the farm and farm output generated in the process. While it may not be possible to generate a full cost-benefit analysis of the insurance programme in the entire country, the analysis conducted in this study may identify and objectively comment on the operation of the insurance programme on farming systems in Nigeria.

THE NIGERIAN AGRICULTURAL INSURANCE SCHEME

The Federal Government of Nigeria introduced an agricultural insurance scheme in 1987. The broad aim of the scheme was to widen farmers' access to farm inputs, especially credit, and to encourage farmers to adopt modern farming practices [15, 16]. This aim was predicated on the belief that if the risks associated with the adoption of modern farming practices could be reduced, farmers could be encouraged to produce high value enterprises that had previously been abandoned and regarded as too risky to produce. The potential changes in farm practices would increase the quantity and quality of agricultural produce supplied to the market and subsequently improve the welfare of the people. The insurance scheme was operated as a commercial enterprise by The Nigerian Agricultural Insurance Company (NAIC) and offered a multi-peril insurance policy to cover any crop enterprise. The insurance is compulsory for farmers taking institutional credit for their farm business. It is expected that by linking the insurance with credit it will encourage more inflow of funds to the farm sector and safeguard repayment to the banks. As an additional incentive to farmers' patronage, the government provides a 50 per cent subsidy of the premium payable by farmers. However, before a farmer could be indemnified for any insured hazards he/she would prove that he/she followed the guidelines on production practices published by NAIC. Owing to the diverse geographical, cultural and ecological spread and for administrative convenience, the country was divided into five operational zones. This study focused on Minna zone that is referred to as the middle belt of the country. The zone produces various types of agricultural products that are peculiar to the extreme climatic conditions of the northern and southern part of the country. As a result of this geographical advantage, the zone has been named the food basket of the country. Therefore it has always been a focus of attention when natural disasters strike in the country. Agriculture in this region is mainly rain-fed, with limited irrigation facilities being restricted to government-controlled agro-service projects and some dry season vegetable gardens. In addition, the average farm holding is small scale and majority of the farming population are illiterate with little access to the formal credit market.

METHODOLOGY

The Minna Zone of NAIC frequently suffers from pest and disease invasion, inadequate rainfall that often leads to drought and increased incidence of fire outbreaks. These events have heightened the risky nature of agricultural production in the zone and further constrained farmers' access to credit. To enable an assessment of

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the operation of the insurance scheme, this study examined the broad hypothesis that there are significant differences in production practices between insured and uninsured farmers. As the study tried to examine both the impact and the performance of the agricultural insurance and the benefits to the public, different types of data were required.

Data Collection

In order to test the hypothesis and achieve the broad objectives of the study, two broad categories of respondents were surveyed to obtain the data required for the analysis. A sample of 87 insured and 95 uninsured farmers were randomly selected and interviewed using structured questionnaires. While the insured farmers were randomly selected from the insurance policy register, the uninsured farmers were selected using randomised linear stratified sampling, contingent to the selected insured farmers. Thus the respondents operate in a homogeneous and contiguous area. They operate under similar environmental factors and they have similar characteristics. The data collected centred on farm production characteristics, resource use and farmers' risk management strategies among others. The data collected were analysed to examine whether there were any significant differences between insured and uninsured farmers in terms of their resource use, levels of production achieved and income generated.

Methods of Data Analysis

Production functions have been widely used to compare the level of resource use between groups of farms. It shows a technical relationship between input and output in a production process. It can thus give an insight into structural differences between groups of farms. The production function estimates are used to reveal significant differences that exist between insured and uninsured farmers in terms of the characteristics of resource use, production and income. Different production functions can be specified as a basis to examine and compare production characteristics between farms. There is no hard rule that a given functional form is more appropriate than the other [17]. However, for this type of study the Cobb-Douglas production function has enjoyed wide application and is the functional form used in this comparative analysis. This choice was based on its advantages over other forms, and the ease with which the function can be handled mathematically [18].

This study used econometric analysis as a basis to compare production practices between insured and uninsured farmers in the study area. Production functions project a physical relationship between inputs or factors of production and the resulting farm output represented as the dependent variable. A typical production function can be implicitly represented as

$$Q = f(X) \qquad \text{-------------------}1$$

where Q is the homogeneous output representing the endogenous variable and X, the n-dimensional vector of homogeneous inputs represented as explanatory variables.

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For this study different functional forms were tested on the cross-sectional data collected, but the Cobb-Douglas function was chosen as the basis of result presentation because it enjoys a wider application in this type of study and because of the added information implied by its parameter estimates. It has been emphasised that linear and quadratic functions which were commonly used as alternatives are better suited to the analysis of experimental data than to the analysis of cross-sectional data [19]. The statistical estimates obtained are used to compare production performance between the identified groups of respondents. The function is thus used to examine production performance and resource productivity between insured and uninsured farmers.

The Cobb-Douglas function can be implicitly presented as

$$Q = AX^{b}X^{(1-b)} \qquad \text{-----------2}$$

where **A** is a positive constant term and *b* a positive fraction. **Q** and **X** are the variables, the relationship between which are examined by the equation. However, in order to specify the equation, the above implicit equation must be explicitly expressed by taking the log transformation of both sides as shown below;

$$\ln Q = \beta_0 + \beta_1 \ln X1 + \beta_2 \ln X2 + \text{----} + \beta_9 \ln X9 + u \qquad \text{-------------3}$$

where the respective variables in the equation are represented as follows:

Q, the dependent variable is the value of the farm output generated; value of planting seeds (local seed, ***X1*** and improved seed (***X2***), fertilizer ***(X3)*** and farm size ***(X4)*** and value of labour employed on the farm ***(X5)***. Other variables include expenditure on agro-chemicals such as herbicides and pesticides ***(X6)***, expenditure on value added ***(X7)***, value of farm assets ***(X8)*** and ***(X9)***, a dummy variable used to represent the holding of an insurance policy.

β_0, β_1 -- β_9 are the parameters (coefficients) to be estimated, that respectively measured the relationship between the inputs and output in the production process, for the ninth inputs.

u is the error term which is assumed to be normally distributed with mean zero and constant variance. ***ln*** is the natural logarithm of the respective variables included in the equation. The essence of the log transformation is in recognition of the existence of error in the included variables, by the transformation the error is made to be nearly and normally distributed without any pattern in its relationship.

F-ratio was used to test the joint hypothesis to show whether the included variables exert any significant influence on the dependent variable, the value of farm output. It tests the null hypothesis that all the estimated coefficients are zero. The tests of the hypotheses are explicitly represented as follows:

$$H_O : \beta_1 = \beta_2 = \text{-----} = \beta_8 = 0 \qquad \text{---------------- 4}$$

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as against the alternative hypothesis that at least one of the coefficients are not zero

$$\mathbf{H_1 : \beta_1 \neq \beta_2 \neq \text{-----} \neq \beta_8 \neq 0} \, . \qquad \text{----------------} \; \mathbf{5}$$

The results of the data analyses are presented in the following section.

RESULTS

Three equations were specified, one each for the insured and uninsured farmers and one for their pooled estimates. The criteria for comparison between them were based on the characteristics of the parameter estimates of the respective production functions. These estimates include the value and sign of the coefficients, the significance of the coefficients, the R^2 (and adjusted R^2), F-value and the result of other diagnostic tests such as multicollinearity and heteroscedacity. The respective equations are shown in Table 1.

Considering the equation obtained for the insured farmers, two of the parameter estimates were significant ($p<0.01$). These were the value of assets owned by the farmer and the labour utilized on the farm. It appears that both inputs exert great influence on the level of output obtained by the farmers. Also, the value of fertilizer used on the farm had a significant ($p<0.05$) influence on farm production among the insured farmers. All the included variables except the use of agro-chemicals are positively and correctly signed.

For the uninsured farmer, three of the included explanatory variables were significant at the $p<0.05$ level. These variables are the stock of assets owned, the value of local seeds and fertilizer used in production. The use of farm labour was found to be significant at $p<0.05$ level. As explained above, the high significance of the parameter estimates of these variables implies that they exert great influence on the level of production achieved by the uninsured farmers.

The pooled estimates revealed that labour, the value of the stock of assets owned by farmers and the use of local planting materials and holding of insurance policy were significant ($p<0.01$) and the use of fertilizer was significant ($p<0.05$). All the variables are positively signed implying that they are positively contributing to output but at different rates. Surprisingly, the use of modern planting materials and chemicals were not found to be significant in any of the specified equations.

The R^2 values indicated the proportion of the total variation in output that is accounted for by the included independent variables [20]. An R^2 value of 81.55 per cent was obtained for the specified function for the insured farmers as compared to 97.34 per cent for the uninsured farmers. While an R^2 value of 90.33 per cent was obtained for the pooled estimates of the two farm groups. The high percentage values show the equations to give good representation of the relationship between farm output and the included variables. The adjusted R^2 values allow a comparison of the

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R^2 between different equations even with differences in the number of included explanatory variables.

From the pooled equation, the efficiency of resource use among the farm groups can be compared. Efficiency is defined as the value of output that is generated per unit of input. The higher the value, the more efficient the farmer is. Different mathematical equations have been used to compare efficiency of resource use between farms [21, 22, 23]. This study used the sign of the parameter estimates of the dummy variable in the pooled equation as measure of the efficiency of resource use between the farm groups. The sign of the dummy variable reveals the direction of the efficiency of resource use between the insured and uninsured farms. A positive signed coefficient indicates the efficiency moves toward the larger integer of the coded variables, that is, the insured farmers. Whereas a negative coefficient suggests that the efficiency measure will tend to the lower integer representing the uninsured farmers. The sign of the coefficient obtained in this analysis is negative, thereby showing that the uninsured farmers were more efficient in the bundle of resource use than the insured farmers.

The F-values of 38.68 and 394.06 were obtained for the insured and uninsured farmers' production functions, respectively. Also, an F-value of 170.12 was obtained for the pooled farms. All the F-values were significant ($p<0.01$). This showed that the included independent variables jointly exert great influence on the level of farm output generated by the respective farm groups. The estimates of the diagnostic tests did not show any problem of serial correlation or multi-collinearity in the function, see footnote 2.

The high R^2 values estimated, the significance of the F-values and the result of the diagnostic tests confirmed the quality of the estimates and they suggest that the equations can be relied upon for discussion, forecasting and for policy recommendation.

DISCUSSION

A majority of farmers in developing countries rely on farming practices and choose enterprises and scale of operation that they know can enable them to produce enough food to meet their household requirements for food and a little for sale. The people of Minna zone of NAIC takes the issue of culture and tradition seriously. They believe it is a stigma and an act of irresponsibility for a man to be unable to provide food and shelter for his family. Culturally, the peasant farmers may not want to embrace practices that would heighten their exposure to any risk that would hinder their ability to meet their obligations at home. This belief has heightened farmers' pessimistic views on practices or innovations they are not sure will safeguard their immediate household food security. However, as more farmers are encouraged to embrace modern farming practices, it is expected that they would change from these narrow and limited goals to more commercial oriented ones. But peasant farmers are limited by the choice of modern practices to use on the farm since most modern practices

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often come in a package. Peasant farmers may not have the wherewithal to apply them as required to guarantee the expected result. A majority of the peasant farmers are illiterate and with large scale poverty they have little if any bargaining power both in the input and output markets. It is on the basis of this understanding that farmers are encouraged to patronize agricultural insurance and with the assurance that it will increase their accessibility to a range of farm inputs and a further help to share the burden of risks so that they would still meet their basic obligations even in the face of the occurrence of uninsured farm hazards.

The two groups of farmers sampled for this study operate in a similar and contiguous area and they displayed some striking differences in their farm operations. The insured farmers are more commercially oriented in the choice of their enterprise combinations and in the inputs they used on the farm. They used more modern farm inputs and choose enterprises that are more market oriented than the uninsured farmers. However, the uninsured farmers are found to be more productive and efficient in the use of their farm inputs. The impact of the agrochemical use is worthy of note. In the two farm groups it does not contribute substantially to farm output. Even among the insured farmers that used more of the input, it actually contributed negatively to farm output. There are some factors that can be identified to be responsible to this pattern of relationship. The input may not be applied as expected because of the high level of illiteracy among farmers in the study area and the recurrent problems of product adulteration that are prevalent in the country. This has forced the government to invest on programmes to rid the country of fake and adulterated products in the economy. There are times when many of the agrochemicals are scarce and difficult to obtain in the open market. As a result of these problems, it may be difficult for an average peasant farmer to safeguard the correct use of these inputs that are time and quality specific for best performance.

The findings from this study are surprising in the light of the rationale for initiating the insurance programme. Apart from the fact that insured farmers embraced modern farming practices, possibly because of their accessibility to farm credit, their farm output does not make them better farmers than the uninsured farmers. The operation of agricultural insurance should not be limited to climatic variability but the government should complement their operations by making farm inputs readily accessible to farmers and that farmers are enlightened about their use.

SUMMARY AND CONCLUSION

One of the underlying assumptions of the agricultural insurance scheme was that its introduction would encourage farmers to positively change their farming practices. Specifically NAIC was established for farmers to have more access to essential farm resources that would motivate them to embrace the use of modern farming practices with the assumption that such practices will lead to increase the quality and quantity of farm production and food supplies to the market. The study discovered that NAIC exerts influence on the range of inputs and production methods farmers used on the farm. However, NAIC has not made farmers better managers and organisers of available resources for increased productivity. Evidence from the operation of the agricultural insurance scheme in the study area suggests that whilst insurance resulted in changes in production practices, this did not lead to a statistically significant increase in output and did appear to be associated with inappropriate application of some inputs with adverse consequences for farm profitability. Despite the fact that more insured farmers adopted improved production practices, the level of production achieved did not justify the extra expense incurred. The analysis suggests that the insured farmer would generate more output and greater net profit by reducing their present level of resource use as compared to uninsured farmers. The latter still have the potential to generate more output than they are generating currently by increasing their use of resources.

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Table 1: Production Function Estimates for Surveyed Farmers[1]

Variables	Insured	Uninsured	Pooled estimates
Intercept	5.5652 (11.319)	4.6621 (14.456)	5.4776 (15.558)
Local seed (X1)	0.0878 (0.990)	0.22401*** (5.222)	0.14814*** (3.185)
Improved seed (X2)	0.0528 (0.738)	0.017495 (0.817)	0.037800 (1.228)
Fertlizer (X3)	0.19972** (1.978)	0.0688*** (2.938)	0.079551** (2.191)
Farm size (X4)	0.0737 (1.323)	0.0161 (0.566)	0.051574* (1.64)
Labour (X5)	0.16146*** (2.758)	0.0781** (2.624)	0.12733*** (3.861)
Agro-chemicals (X6)	-0.0875 (0.548)	0.0338 (0.309)	0.014558 (0.172)
Value added (X7)	0.05454 (0.888)	0.01928 (1.094)	0.03135 (.2594)
Value of farm asset (X8)	0.45751*** (4.101)	0.54242*** (4.572)	0.01456*** (6.830)
Dummy (X9)			-.41508 .(1.835)**
R^2	.81552	.97344	.90325
R^{-2} (adjusted)	.79444	.97097	.89794
F-value	38.680***	394.063***	170.1226***
DW-statistic	1.9661	2.1734	1.9591

Figures in parentheses are the t-ratios.

[1] Diagnostic Tests using LM Version

Test Statistics	Insured Farms	Uninsured Farms	Pooled estimates
Serial Correlation	CHSQ(1)= .014128[.905]	CHSQ(1)=.84578[.358]	CHSQ(1)= .065102[.799]
Functional Form	CHSQ(1)= 1.4974[.221]	CHSQ(1)= .32858[.566]	CHSQ(1)=2.3536[.125]
Normality	CHSQ(2)= 81.7809[.000]	CHSQ(2)= 105.1787[.000]	CHSQ(2)= 832.2722[.000]
Heteroscedasticity	CHSQ(1)= .053851[.816]	CHSQ(1)=.074127[.785]	CHSQ(1)= .68744[.407]

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REFERENCES

1. **Antle JM** Nonstructural Risk Attitude Estimation, *Amer. J. of Agric. Econs.* 1989; **71**: 774-784.

2. **Dercon S** Risk Crop Choice and Savings: Evidence from Tanzania. *J. of Econ. Devel. and Chan.* 1996; **44**: 485-414.

3. **Anderson JR and PBR Hazell** Risk Considerations in Agricultural Policy Making. **In**: R. B. M. Huirne; J. B. Hardaker and A. A Dijkhuizien (eds) Risk Management Strategies in Agriculture; state of the art and future, Mansholt studies No 7, WAU, Wageningen, 1997.

4. **Hardaker JB, Hurine RBM and JR Anderson** Coping with Risk in Agriculture, Wallingford, CAB International, 1997.

5. **Townsend RM** Risk and Insurance in Village India, *Econom.* 1994; **62**: 539-591.

6. **Vavrova E** The Czech Agricultural Insurance Market and a Prediction of its Development in the Context of the European Union. *Agric. Econ.*-Czech. 2005; 51: 531-538

7. **Wenner M** Agricultural Insurance Revisited: New Development and Perspective in Latin America and the Caribbean, World Bank, Washington DC, 2005; 1-77

8. **Binswanger H, McIntire J and C Udry** Production Relations in Semi-Arid African Agriculture. **In**: Bardhan, P (eds) The Economic Theory of Agrarian Institutions; Oxford, Clarendon Press, 1989.

9. **Venkatesh SG** Crop Insurance in India- A Study. *The Jour.* Mumbai, Jan – June 2008;15-17

10. **Hazell P, Pomareda C and A Valdes** Crop Insurance for Agricultural Development Issues and Experience; Baltimore, The Johns Hopkins University Press, 1986.

11. **Roumasset JA** The Case Against Crop Insurance in Developing Countries. *Philip. Rev. of Bus. and Econs.* 1978; 1-22.

12. **Arias D and K Covarrubias** Agricultural Insurance in Mesoamerica: An Opportunity to Deepen Rural Financial Markets. Economic and Sector Study Series, Environmentat Division, InterAmerica Development Bank, RE2-06-006, Washington DC, 2006; 1-68

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13. **Goodwin B K** An Empirical Analysis of the Demand for Multiple Peril Crop Insurance *Amer. J. of Agric. Econs.*1993; **75**: 425-34

14. **Siamwalla A and A Valdes** Should Crop Insurance Be Subsidised? **In**: Hazell, PC. Pomareda Valdes A. (eds), Crop Insurance for Agricultural Development: Issues and Experience, Baltimore, MD; John Hopkins University Press, 1986.

15. **Evbuomwan GO, Okeke EU and FA Afelumo** Review of Policy and Developmental Objectives in Agricultural and Agro-based Industrial Financing in Nigeria. *Bull.*1993; **17**: 41-56.

16. **NAIS.** Operational Guidelines for the Nigerian Agricultural Insurance Scheme, Lagos, 1989.

17. **Maddala G S** Limited Dependent and Quantitative Variables in Econometrics, Cambridge University Press, 1992.

18. **Koutsoyiannis A** Modern Microeconomics, 2nd Edition, Macmillan Press Ltd, 1987.

19. **Upton M** The Economics of Tropical Farming System, Cambridge University Press, 1996.

20. **Gujarati D** Essentials of econometrics. McGraw-Hill International Editions, 1992.

21. **Antle JM** Risk Efficiency and the Adoption of Modern Crop Varieties: Evidence from the Philippines; *Econ. Devel. and Cultu. Chan.*1990; **38**: 417-437.

22. **Low ARC** Decision Taking Under Uncertainty: A Linear Programming Model of Peasant Farmers Behaviours. *J. of Agric. Econ.* 1974; **25**: 311-322.

23. **Lau LT and PA Yotopoulus** Efficiency and Technology Change in Taiwan Agriculture. *Food Resear. Stud.* 1979; **27**:11-15.