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THE MAIZE PRODUCTION IN VIETNAM: SITUATION AND POLICY IMPLICATION

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Abstract:

This study analyzed the trend in maize production in Vietnam and estimated a production model while determining factors affecting change in output. Response coefficients were estimated from time-series data covering 1986 to 2011 using the double-logarithm model. Estimated parameters results in model indicated that the maize production also had positive response to the price of maize, the fertilizer per hectare, the maize area, irrigation, the trend variable, and the agricultural extension policy. Recommended policies include: issuing policies to support production; enhancing judicious use of fertilizers; increasing maize area; improving irrigation system; increasing government support for farmers; and improving the extension system with market information.

Keywords: *Production, Maize, Vietnam.*

INTRODUCTION

In Vietnam, maize is cultivated in the country during different seasons, depending on the land condition and climate in each region. More than 70 percent of the maize areas are upland and hill regions, and these completely depend on rainfall [1]. In fact, maize is consumed as food by the people and as feed for livestock, poultry, and fish. Maize is now an important crop for the feed industry in Vietnam. An agriculture development solutions became the important problems to ensure the production of a substitute for import commodities (e.g., maize) by making it self-sufficient for domestic demand. Such self-sufficiency in production should first be targeted before exporting the commodity to foreign markets. Hence, this study of the factors affecting production of maize was provided an understanding of the maize farmers to government intervention. This study specific objectives were to: (1) Analyze the trend in maize production, area planted, yield over time in Vietnam and review government policies effecting maize production; (2) Estimate a production model on maize and determine the factors effecting change in output; and (3) Recommend some developmental policies of the Vietnam maize sector.

SITUATION OF MAIZE RODUCTION IN VIETNAM

Maize Production

Growth Pattern

From 1986 to 2011, maize production in Vietnam grew by more than eight times and achieved a new high level of production of 4.836 million tons in 2011 compared to 0.57 million tons in 1986. During this period, the annual average growth rate was about 9.19 percent. In this period, maize production continuously increased because of higher yield and increased area of cultivation. Likewise, new technologies for cultivation, such as OPVs and hybrids as well as postharvest storage contributed to higher output (Table 1).

Table 1. *Estimated Maize Production, Product Utilization, Maize Area in Vietnam, 1986-2011*

YEAR	TOTAL UTILIZATION (Tons)					MAIZE AREA (million ha)	PRODUCTION (Tons)
	Food	Feeds	Seed	Waste	Total Use		
1986	434,069	80,000	10,140	22,912	547,121	0,40	569800
1987	377,155	95,000	12,763	25,092	510,009	0,41	561000
1988	561,416	164,950	12,735	32,865	771,966	0,51	814800
1989	483,649	165,000	10,795	33,756	693,200	0,51	837900
1990	458,791	140,000	11,190	26,920	636,901	0,43	671000
1991	362,570	210,000	11,950	29,212	613,732	0,45	672000

1992	406,449	229,500	12,413	30,216	678,577	0,48	747900
1993	570,885	229,500	13,368	37,448	851,200	0,50	882200
1994	599,504	400,000	13,920	45,976	1,059,400	0,53	1143900
1995	462,692	640,000	15,380	48,128	1,166,200	0,56	1177200
1996	295,740	970,000	16,573	62,888	1,345,200	0,62	1536700
1997	417,132	1,155,420	16,243	16,506	1,605,300	0,66	1650600
1998	543,685	1,128,400	17,295	16,120	1,705,500	0,65	1612000
1999	634,844	1,227,170	18,255	17,531	1,897,800	0,69	1753100
2000	631,736	1,524,484	18,238	20,059	2,194,516	0,73	2005900
2001	651,732	1,494,330	20,410	21,228	2,187,700	0,73	2161700
2002	671,161	2,000,000	22,818	112,448	2,806,426	0,82	2511200
2003	698,071	2,430,000	24,778	133,452	3,286,300	0,91	3136300
2004	775,308	2,700,000	26,315	149,236	3,650,859	0,99	3430900
2005	734,114	3,100,000	25,828	160,936	4,020,877	1,05	3787100
2006	702,632	3,400,100	27,403	172,129	4,302,263	1,03	3854600
2007	909,002	3,700,000	36,005	193,549	4,838,556	1,10	4303200
2008	993,371	4,000,000	27,230	209,706	5,230,307	1,14	4573100
2009	949,097	4,666,685	28,160	201,650	5,845,592	1,09	4371700
2010	957,057	5,038,555	29,134	241,128	6,265,874	1,13	4606800
2011	829,121	4,722,343	28,878	194,771	5,775,113	1,12	4835600

Source: General Statistical Office (GSO), 2012.

Use of Modern Maize Varieties

In the early 1980s, maize was a principal crop in extensive farming. However, local white corn had a low yield of only about 1 ton per hectare. Through collaboration with the International Maize and Wheat Improvement Center (CIMMYT), Vietnam selected and produced a series of open-pollinated (OP) varieties such as VM1, HSB1, TH2A, TSB1, TSB2, MSB49, Q2, CV1. Using these OP varieties resulted to an increase in average yield of 1.5 tons per hectare in 1990 [8].

During the period 1991 to 1995, Vietnam began breeding and selecting new maize varieties that were high yielding and with good quality. These varieties had different growth durations that were appropriate to the various planting seasons and ecological zones in the country. These could also withstand unfavorable conditions. Many of the hybrid maize varieties developed were early maturing varieties with a high yield of 3 to 7 tons per hectare (LS3, LS5, LS6, LS7, LS8). During this period, the farmers also began planting new varieties from foreign companies such as Bioseed and CPseed Companies.

In 1996 to 2000, an 'innovation policy' encouraged the public sector to focus on developing purely hybrid maize varieties. This intensified the program on developing hybrid maize in Vietnam. The area planted to hybrid maize (LVN4, LVN17, LVN20, LVN25, V98-1, T9, B9636, B9696) increased rapidly from 32 percent in 1996 to 65 percent in 2000. Such policy increased yield levels at 2.75 tons per hectare starting in year 2000 [8].

With the use of hybrid maize varieties in Vietnam, the farmers also had to change their farming practice and adopt new cultivation technologies. From 2001 to 2011, hybrid maize area continued to increase, covering 1,043 hectares in Vietnam. The increase in area was one of reasons for the increased production of maize by 4.8 million tons (Table 1).

Irrigation

In Vietnam, all maize areas are not yet irrigated because of the complex terrains from the delta to the highland regions. The soil along the deltas, in the uplands, and in sloping areas are not irrigated. These areas depend entirely on rainfall. During the period 1986 to 2011, the rainfall in Vietnam fluctuated around 2000 mm per year, with the highest at 2402 mm in 1999 and the lowest at 1559 mm in 1988 [4].

From 1986 to 2000, the irrigation and drainage systems for the maize areas covered only about 20 percent of the whole country [10]. The coverage increased to 40 percent in 2005 and to

around 51 percent in 2010. In both deltas, only the Mekong River Delta had irrigation for all maize areas in 2011, while only 84.63 percent equivalent to 82.6 thousand hectares were irrigated in the Red River Delta. In 2011, the total irrigation capacity of the whole country was about 3.45 million hectares of arable land with investment cost for the irrigation system at around VND 2.819 billion [1]. Because of the lack of data on irrigation for maize areas in Vietnam from 1986 to 2011, the semi-annual time-series data of the annual average rainfall were used in the models.

Fertilizer Consumption

The fertilizers for agricultural crop include all fertilizer types like urea, potash, phosphate, nitrogenous ones, and others. Results show that fertilizer usage increased from 1986 to 2011. In 1986, the total fertilizer use was about 1.18 million tons with about 325 thousand tons being urea. In 2011, total fertilizer usage was 8.96 million tons with 2.12 million tons being urea [4].

Fertilizers accounted for around 80 percent of total maize production cost in commercial production areas such as in Son La and Dak Lak [9]. Fertilizer use per hectare increased from 110 kg per hectare in 1999 to 140 kg per hectare in 2011 [1]. The increase use of fertilizer per hectare had positive effects on maize yield. However, because of the lack of data on fertilizer use per hectare of maize from 1986 to 2011, the volume of total urea per hectare was used in the models.

Consumption Patterns and Investment in Maize-Related Researches

Maize Consumption Patterns

In Vietnam, maize is consumed as food by the people and as feed for livestock, poultry, and fish. Maize is directly eaten in the form of boiled corn, baked corn, and popcorn, or as processed products such as candy, oil, and wine. In addition, young corn cob is used principally as vegetable.

The consumption of maize for food decreased in 1986, but it peaked in 1988 at 561,416 tons. Consumption increased to a second peak of 599,504 tons in 1994, then decreased to the lowest point of 295,740 tons in 1996. Consumption continued to rise to its highest peak of 993,371 tons in 2008 (Table 1).

The per capita maize consumption per year showed the same trend. It was lowest at 4 kg per capita in 1996 and highest at 11.7 kg per capita in 2008. From 1986 to 2011, the annual average growth rate of food maize consumption was about 3.5 percent, an increase of 91 percent compared to that of 1986. Food maize was highly dependent on the annual population growth rate and the growth of the food industry sector.

Maize is an important crop for the feed industry in Vietnam. It is the main ingredient of synthetic feed, and it provides about 70 percent of the starch production in the country. In addition, feeds account for 69.23 percent of the production cost of chicken and 63.9 percent of the production cost of swine [10]. This means that the development of the cattle and poultry industries is extremely important as these will affect the trend of maize production in the future.

In 1986, maize used as feed in Vietnam amounted to 80,000 tons or 14.62 percent of the total maize consumption. This increased to 4,722,343 tons or 81.77 percent of the total maize consumption in 2011. The share of feed in the total maize consumption was stable at around 70 percent from 1996 to 2011. The increase in feed use reflected the rising trend of total maize consumption from 1986 to 2011 (Table 1). Both total use and feed use showed the same trend. The growth of maize used for feed contributed mainly to the increase in total maize consumption.

Investment in Maize-Related Research

Vietnam started with a free market economy in December 1986 after renouncing a centrally administered socialist economic system. The economic structure was changed and adjusted to meet the rapid development of economic sectors, especially in the government's investment on R&D in the agricultural sector. In addition, the government encouraged both the public and private sectors to invest in corn-related research in the country.

Public expenditures showed a steady trend from 1986 (VND 14 million) to 1990, increasing by 620 percent in 1989. In 1990 the fund for corn-related research increased to around 2,457 billion VND, but this decreased to about 1,650 billion VND. The peak of public expenditures was in 2004 at 3,957 billion. The cost was stable at around 3 billion VND every year after that [8].

Two public research agencies carried out most of the maize seed research in Vietnam. (1) The research programs of National Maize Research Institutes (NMRI) emphasize the development of improved OP varieties with high yield, good grain quality, tolerance to adverse environmental conditions, and resistance or tolerance to major pests and diseases. The program also tries to develop hybrid maize varieties suitable to the production environment in Vietnam [8]. (2) The Institute for Agricultural Sciences (IAS) initiated

hybrid research in 1992 using inbred lines acquired from CIMMYT. In 1994, the IAS developed a single-cross maize hybrid. It is now attempting to breed double-cross and three-way-cross hybrids [2].

The private sectors in Vietnam such as Bioseed Genetics International (BGI Vietnam), CP Seeds (allied with DeKalb), Cargill Vietnam, Pioneer and Uniseeds, and Luong Nong Company import their seeds from Thailand or the Philippines. These companies also transact contracts with public agencies or farmer groups to produce seed locally, except the BGI Vietnam that has a breeding and seed production program in Vietnam. These companies are expected to benefit from the research on the production, import, and sale of their seeds in Vietnam [2].

From 1986 to 2011, the public and private sectors have developed more than a hundred maize varieties that are appropriate to the farmers' local conditions. In 1998, the NMRI developed the high-yielding variety, LVN10, which could produce from 8 to 12 tons per hectare. From 2000 to the present, both public and private sectors continue to breed for new maize varieties that are high-yielding, resistant to pests and diseases, and tolerant to adverse environmental conditions [4].

Policy Reforms and its Effect on Maize Production

National Agricultural Extension Policy

In 1993, the National Agricultural Extension System was established. The system trains farmers about agriculture production management, production and organization skills, and policy and legislation. Trainings include government policies, progress of science and technology, advanced models in production, and promotion and sales through multimedia (e.g., mass media, agricultural extension publications and collaterals, conferences, seminars, contests, fairs, exhibitions, forums, and others) [5]. Agricultural extension or technical services for production were also provided to farmers so they could adopt modern technologies. Through agricultural extension, farmers were encouraged to extend their areas cultivated to maize, especially using hybrids. Techno-demos enabled farmers to observe new technologies and apply these to their own farms. Further, international cooperation in the agricultural extension was pursued to enable the exchange of experiences between Vietnam and foreign organizations and individuals [5].

In 1993, the total investment for agricultural extension was VND 1,268 million increasing to about VND 186,800 million in 2011. The cost for maize extension was about VND 23 million in 1993, and this increased to VND 6,044 million in 2011, or 1.81 and 3.24 percent of the total agricultural extension cost, respectively. It is the government's policy to strengthen investments in agricultural and rural development aside from R&D for maize [7].

Trade Policy

Starting 1986, Vietnam had strongly deregulated its policies on maize export and import. The general tariff for maize grains of 10 percent was reduced to 7 percent in 1992. Since 1999, the general tariff increased to 7.5 percent as the government encouraged public and private organizations to import or export maize, animal feeds, and other related materials. From January 1, 2004, imported maize from ASEAN countries had a tariff of 5 percent, and this was also Vietnam's offer to the World Trade Organization's (WTO) accession negotiation. The tariff would be eliminated under AFTA/CEPT in 2006, and the WTO's tariff would be cut down from November 7, 2006 [9].

The general tariff decreased to 5 percent in 2004 and 0 percent starting 2006. The reduction affected imports and the efficiency of Vietnam's maize producers. It also directly influenced the profitability of local maize production for animal feed. The rapid increment in livestock growth increased the use of imported maize; the net import was around 1,659,074 tons in 2010 (Table 1). When the volume of imported maize increased, the domestic prices were directly affected by the world market price.

There had been changes in trade regulation for maize inputs since the mid-1980s in Vietnam. The import tariff for maize seed varieties had been set at zero. In addition, the government reduced import taxes for fertilizers (NPK) starting April 2000. From 2001, the import tax for NPK was reduced from 5 percent to 3 percent; the import tax on phosphate was reduced from 10 percent to 5 percent; and the import tariff on nitrogen-based fertilizers that were mostly imported was equal to zero. Moreover, all restrictions on imports of fertilizer were eliminated, no import quota and licenses, no designated importers [9].

These positive changes encouraged the maize farmers to intensify maize production. The farmers adopted the approach of using new hybrid maize varieties with highest yields. They also reduced their production cost with the lower price of fertilizers.

METHODS

Source of Data

The study used semi-annual time-series data from published sources covering the period 1986 to

2011 in Vietnam. There were 52 observations with each observation covering six months. Secondary data were collected from the General Statistical Offices (GSO), other publications, and legal documents.

Empirical Model

The production response function was first used by Shefrin (1983) and modified by Ghosh and Neogi (1995) [3]. This was adopted with modifications in the expected price of the substitute commodity. The output response function was given as:

$$Q_t = a_0 + a_1P_t + a_2F_t + a_3A_t + a_4R_t + a_5INV_t + a_6 D93 + U_{at} \quad (1)$$

Where: Q_t: Domestic maize production at the time t; P_t: Farm-gate price of maize at the time t; F_t: Volume of total fertilizer per hectare at the time t; A_t: Area of maize at the time t; R_t: Rainfall at the time t; INV_t: Investment cost for research and development at the time t; D93: Agricultural extension policy, this variable was represented by a dummy, 0, for period 1986-1992 and 1 for 1993-2011; α_0: The intercept of model; α_i: The coefficients of variables in the model (i =1, …, 6) and $U_{\alpha t}$: The error term in above models.

The production of maize is estimated in double-log form of all variables in the equation (1), except the dummy variable.

RESULT AND DISCUSSION

Table 2. *Results of the model estimation of the maize supply response in Vietnam, 2011*

VARIABLE	PRODCUTION		
	OLS	Prais-Winsten	Cochrane-Orcutt
Intercept	-5.2649***	-5.2437***	-5.2511***
	(0.2241)	(0.2335)	(0.2333)
Maize price	0.0739**	0.0729**	0.0851**
	(0.0295)	(0.0311)	(0.0329)
Fertilizer	0.1062***	0.1069***	0.1137***
	(0.0322)	(0.0334)	(0.0343)
Area	1.7833***	1.7823***	1.7680***
	(0.0420)	(0.0445)	(0.0463)
Rainfall	0.0695***	0.0670***	0.0641***
	(0.0169)	(0.0162)	(0.0164)
Maize R&D investment	0.0008	0.0014	0.0001
	(0.0157)	(0.0165)	(0.0166)
D93 (Extension)	0.1177***	0.1181***	0.1164***
	(0.0308)	(0.0324)	(0.0324)
N	52	52	51
F value	2487.35	2018.78	1987.68
R^2	0.9966	0.9958	0.9958
Durbin-Watson Statistic	1.7181	1.8636	1.7688

*Note: ***, **, * Statistically significant at 1%, 5% and 10% level, respectively.*
Figures in parenthesis are standard errors.

Parameters estimated results of model based on double-logarithm are showed in table 8. This model was statistically significant at 1 percent level from its F-value (1987.68 in Cochrane-Orcutt), and the adjusted R2 was high, hence ensuring that the chosen independent variable had high explanatory power. In addition, the Durbin-Watson (DW) statistical values were in an "absence of first-order serial correlation" area at the 1 percent level, and in an indeterminate area at the 5 percent level, thus confirming the dubiousness of non-correlation in the model.

The price of maize was significant in method, but the magnitude of this variable was from 0.07 to 0.08. This estimated coefficient was approximately 0.1 and was consistent with the results of Lubulwa et al.'s (1996) result. In Lubulwa's study, the farmgate prices for maize were obtained from CIMMYT

(1992), the maize price supply elasticity in Vietnam was 0.1.

The coefficient of fertilizer per hectare (0.11) indicates that an increase in urea per hectare positively affected the production of maize. This means that the farmers may continuously increase their production by increasing their use of fertilizer per hectare.

The area (1.7) variable gave the greatest contribution to production and significant at 1 percent level. In the agricultural sector, the area planted by farmers is completely dependent upon the derived economics benefits from the crop and farm size.

The estimated coefficient of rainfall was 0.06 and significant at 1 percent level. This means that rainfall had a positive impact on the supply of maize, especially in the upland and hilly regions where the irrigation system is not yet developed. The differences in irrigation systems contributed mainly to the differences in maize production in six areas in Vietnam.

The investment variable's coefficient (near 0.00) was not significant.

For the dummy representing extension, the estimated coefficient was 0.1 and significant at 1 percent level. This indicates that an appropriate extension policy will have positive effect in increasing maize production. In fact, an extension policy was promulgated in 1993 to enhance the production process. This included training and skills development as well as sharing of improved production technologies and improved market information to farmers.

CONCLUSION AND RECOMMENDATIONS

This estimated parameters results in model 1 indicated that the farmer's production of maize was positive to the price of maize, the fertilizer per hectare, the maize area, irrigation, and the agricultural extension policy (Table 2).

Results of this study have identified the influence of various factors on the supply response of maize at the national level. Hence, the policies forwarded seek to strengthen that the development of government policies and programs to positively impact on maize production in Vietnam. Recommendation to development in future include such as: issuing policies to support production; enhancing judicious use of fertilizers, because Fertilizer plays an important role in the growth and development of the maize industry because it is a major input to maize production. In this study, fertilizer has a positive effect on production; increasing maize area by changing the crop structure and multiple cropping with long-term industrial trees like perennials and fruit trees; improving irrigation system in two deltas and in concentrated production regions; increasing government support for farmers by the government can support maize production through a loan program to enable farmers to buy improved seeds and apply new technologies into their production; and improving the extension system with market information, because a good agricultural extension system must be able to provide or make accessible the needed and vital market and technological information to maize farmers. Such information will help shape their decisions in maize production.

References

[1]. Department of Crop Production. 2011. *Report Orientation and Developed Solutions of the Winter and Spring Maize Plant of Northern Provinces*. Son La Province, 24 August 2011.

[2]. Gerpacio Roberta V. and Nguyen Tri Khiem. 2001. *The Maize Industry in Vietnam*. In: Roberta V Gerpacio (ed). Impact of Public- and Private- Sector Maize Breeding Research in Asia, 1966-1997/98. CIMMYT, Mexico.

[3]. Ghosh, Nilabia and Chiranjib Neogi. 1995. *Supply Response of Foodgrains and Policy Actions: A Model with Rational Expecation Hypothesis*. Indian Journal of Agricultural Economics. 30 (3): 135-152.

[4]. General Statistics Office of Vietnam. 2012. *Statistical Data*. Vietnam.

[5]. Government of The Socialist Republic of Vietnam. 1993. *Decree 13/CP on the Establishment and Function the National Agricultural Extension System*, 2 March 1993.

[6]. Luckmann Jonas, Rico Ihle, Harald Grethe and Ulrich Kleinwechter. 2011. *Can Vietnamese Upland Farmers Profit from High World Market Prices? A Price Transmission Analysis*. Paper prepared for presentation at the EAAE 2011: Congress Change and Uncertainty Challenges for Agriculture, Food and Natural Resources. August 30 to September 2, 2011. ETH Zurich, Zurich, Switzerland.

[7]. National Agricultural and Fishery Extension Center. 1993-2011. *Annual Reports*. Vietnam.

[8]. National Maize Research Institute. 2011, 2012. *Annual Reports of the National Maize Research*

Institute. Hanoi. Vietnam.
[9]. Thanh Hoang Xuan and Koos Neefjes. 2005. *Economic Integration and Maize-Based Livelihoods of Poor Vietnamese.* Discussion Paper. Hanoi, May 2005.
[10]. Trieu Mai Xuan. 2002. *Orientations of Maize Development Program in Vietnam toward 2005*. Proceedings of the 8th Asian Regional Maize Workshop, Bangkok, Thailand: August 5-8, 2002