Can Trade Policies Soften the Economic Impacts of an Avian Influenza Outbreak? Simulations From a CGE Model of the Philippines

U-Primo E. Rodríguez
UP Los Baños, Philippines
Email: uprime@gmail.com

Yolanda T. Garcia
UP Los Baños, Philippines
Email: Garcia.yt@gmail.com

Arnulfo G. Garcia
Southeast Asian Regional Center for Graduate Studies and Research in Agriculture, Philippines
Email: agg@agri.searca.org

Reynaldo L. Tan
UP Los Baños, Philippines
Email: reyltan@yahoo.com

ABSTRACT

The paper examines the possibilities of using trade policy to address the adverse economic effects of an avian influenza outbreak in the Philippines. In particular, it employs a computable general equilibrium (CGE) model for analyzing the likely effects of two options; namely, a) a ban on imported poultry, and b) the removal of tariffs on non-poultry meat products.

Using six model scenarios (i.e., production shocks, consumption shocks, ban on poultry imports, removal of tariff on non-poultry imports, and selected combinations of these shocks), the simulation results reveal that (a) the consumption and production shocks are expected to have a contractionary effect on real GDP; (b) the expected fall in the output of poultry products explains most of the decline in real GDP; (c) the production shock appears to have a larger impact since this explains most of the decline in real GDP as well as the increase in the general price level; (d) while the consumption shock tends to have a larger impact on the poultry products, the production shock dominates the aggregate responses because of its effects on other industries, and (e) avian influenza is likely to have far-reaching effects on the economy, way beyond the poultry sector.

Based on these results, this paper supports the use of an import ban as a preventive measure against the occurrence of an avian influenza attack. This is based on the finding that the economic costs from such a measure appear to be lower than the costs associated with the disease. In contrast, the study finds that there is a weak case for removing tariffs on non-poultry meat products as a means to soften the harmful impacts of an avian influenza outbreak.

INTRODUCTION

Avian influenza[1] is a serious threat to the world's economies. Thailand, for example, lost 14.5% of its poultry population during the 2003-2004 outbreak (McLeod et al. 2005). Apart from the expected losses of the poultry sector, the adverse effects of this disease on related industries are also worth noting (see Brahmbhatt 2005; Verbiest and Castillo 2004). This raises the potential for avian influenza to have widespread effects on the economy.

The possibility that the virus can mutate into a strain that can be transmitted from one human being to another makes avian influenza an even more serious concern. This is because if the outbreak develops into a global pandemic, it introduces costs associated with the loss of human life and reduced labor productivity. Initial estimates indicate that such losses can be staggering. McKibbin and Sidorenko (2006), for example, estimated that a pandemic can cause a 0.80 to 12.6% decline in global GDP.

Trade policy can be used to address avian influenza in two ways. First, it can serve as a preventive measure against the possible occurrence of the disease. Countries that are free from avian influenza can use trade instruments to prevent the entry of infected birds. The Philippines, for example, has imposed occasional bans on poultry imports for such a purpose. Second, the efficiency effects arising from trade policy can also be used to soften the impact of an outbreak. For example, the literature is replete with evidence of how changes in trade barriers affect economic output. The extent to which such changes cause an increase in aggregate output can then be weighed against the contractionary impacts of an outbreak.

This paper illustrates the possibilities for trade policy in addressing the adverse economic effects of an avian influenza outbreak. In particular, it uses the CGE model for analyzing the potential of employing bans on imported poultry and removing tariffs on selected commodities, to avoid and redress, respectively, the harmful impacts of an outbreak.

Such an analysis is relevant for the following reasons. First, the Philippines is one of the countries that are still free from avian influenza. Moreover, it has also used selective import bans as a means to prevent the entry of the disease. This paper, therefore, provides the Philippine authorities with a glimpse on how the different production sectors of the economy might respond to an outbreak, and the possible courses of action that may be taken to mitigate the situation. Second, this paper shows how a general equilibrium model can be used to evaluate selected policy instruments against the negative effects of an avian influenza outbreak. It offers a framework for which other courses of action, even those beyond trade policy, can be analyzed.

At this point, it is important to make three clarifications. First, this paper does not intend to address the efficacy of import bans in preventing avian influenza. Rather, it attempts to compare the costs of such a measure relative to an outbreak. Second, for obvious reasons, this paper does not attempt to examine the entire menu of trade policy instruments which are at the disposal of the government. As mentioned earlier, it only illustrates how general equilibrium models can be used to address well-defined questions regarding trade measures, in particular, and policy instruments, in general. Third, the current analysis is confined exclusively to an outbreak among birds. While the approach to evaluating such an event among humans may very well be the same, the potentially larger menu of policy choices is perhaps best left for a separate investigation.

THE TARFCOM MODEL

The tool that is used in the analysis is the TARFCOM model. This is a highly disaggregated CGE model of the Philippines. Patterned after the ORANI-G model of Australia, it has been used for the analysis of macroeconomic and sectoral shocks addressing competition and trade policies.[2]

The TARFCOM is useful in the analysis for the following reasons. First, the model accounts for three industries within the poultry sub-sector. These are chicken (*21Chicken*), eggs (*22HensEggs*),

and other poultry products (*23OthPoultry*).[3] This allows the direct implementation of production and consumption shocks in the analysis. Second, like any other CGE model, it contains equations that explicitly link poultry sales, production and trade to other industries in the economy. Finally, the model computes macroeconomic variables (e.g., GNP, imports and exports, among others) that allow an overall assessment of the impacts.

The model is composed of 229 industries/commodities.[4] Having the most disaggregated production side among existing CGE models of the Philippines, 28 of its industries belong to the Agriculture, Fishery & Forestry sector. On the other hand, the Industry sector accounts for 145 industries/commodities. The rest of the industries/commodities belong to the Services sector.

The model has four economic agents, namely, households, firms, government and foreign agents. Households act as consumers of goods and services. Firms use primary and intermediate inputs in the production of goods and services. Government collects taxes, buys goods and services, and provides government services. Finally, foreign agents transact with local agents through exports and imports.

The key relationships in the model are represented by (a) input demand equations, (b) commodity supply equations, (c) household demand equations, (d) government demand equations, (e) market-clearing conditions for commodities and primary factors, (f) macroeconomic relationships, and (g) other identity equations.

The input demand equations are drawn from a multi-stage optimization framework. In the first stage, a representative firm produces output by combining intermediate inputs and a primary factor composite using fixed proportions technology. This generates equations in which changes in the demand for the intermediate inputs and the primary factor composite are proportional to changes in output.

The second stage involves the formulation of the specific equations for the primary factors; namely, land, labor and capital. These equations are generated by assuming that a firm seeks to find the combination of inputs that will minimize the costs of purchasing a given level of the primary factor composite. As the technology is represented by a Constant Elasticity of Substitution (CES) function, the resulting factor demand equations are functions of relative prices and the quantity of the primary factor composite.

Each industry is assumed to produce more than one commodity. Commodity supply equations are generated though a mechanism in which the industry seeks to find the quantities of the commodities that maximize revenues, given a pre-determined level of its output. Since the commodities and industry output are related through a Constant Elasticity of Transformation (CET) function, the commodity supplies per industry are determined by commodity prices and the industry output. The aggregate supply of the commodity is then determined by taking the sum of the commodity supplies from each industry.

There is an additional stage in the model,which determines the destination of commodities. This generates the commodity supply equations for domestic use and export. However, this mechanism is currently inactive in the model. Taking its place is a series of demand equations in which the quantity of exports is a function of relative prices.

As consumers of goods and services, households are assumed to maximize their utility subject to a budget constraint. This generates household demand equations, which are functions of relative prices and total expenditure.

The TARFCOM differentiates the demand for commodities by source. In other words, a commodity sourced from a domestic firm is perceived to be different from its imported counterpart. The equations for domestic demand and imports are determined through another optimization process. In the case of households, for example, it assumed that upon the determination of the demand for a commodity, the next problem is to ascertain how much of this commodity is sourced domestically or from abroad. The model assumes that the household seeks to find the combination of

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[3] Items in the parentheses are product codes used in the TARFCOM model.

[4] For expositional convenience, the simulation results for the industries are aggregated into seven sub-sectors only. These are Poultry, Other Meat, Other Agriculture and Fishery, Meat Preparations, Other Food Processing, Other Industry, and Services.

[5] It is of course possible that the consumption shock occurs in the absence of a production shock. For example, it is not difficult to imagine a situation in which consumers shy away from poultry products because of a falsely reported outbreak.

domestic and foreign goods that will minimize the cost of acquiring the commodity.

The data for the TARFCOM are based primarily on the 1994 Input-Output Table of the Philippines. Elasticities and other data used in the model were also obtained from the Global Trade Assistance and Protection (GTAP) database (McDougall et. al. 1998), other Australian CGE models, the National Statistics Coordination Board, and the Tariff Commission of the Philippines.

DESCRIPTION OF THE MODEL EXPERIMENTS

Six model experiments were implemented in the analysis (Table 1). The first is a production shock in which the outputs of the three poultry industries are reduced by a pre-determined percentage. This attempts to capture the deaths of birds through disease and/or culling that accompanies an avian influenza outbreak. The second experiment is a consumption shock in which the household consumption of poultry products is reduced by a predetermined percentage. This is based on the observation that an outbreak or news thereof alters consumer preferences away from poultry products. Experiment 3 is a combination of the first two scenarios. Since production and consumption shocks are likely to occur at the same time, this experiment serves as a useful benchmark for evaluating the policy initiatives.[5]

The next two experiments attempt to evaluate the impacts of the policy initiatives in isolation, i.e., in the absence of an outbreak. Experiment 4 analyzes the consequences of an import ban. This is implemented by setting all imports of poultry products to zero. On the other hand, Experiment 5 removes all tariffs on non-poultry fresh meat products.[6] The idea in this experiment is to check if the entry of other meat imports, which is likely to follow after the removal of tariffs, can compensate for the losses arising from an outbreak.

A critical issue in implementing Experiments 1 and 2 is the magnitude of the possible production and consumption changes associated with an outbreak. The production shock depends on, among others, the extent of the outbreak, and the speed with which the authorities respond to the event. On the other hand, the magnitude of the consumption shock depends on consumer preferences and the availability of substitutes for poultry products. While a thorough evaluation of these factors is undoubtedly important, it unduly complicates the analysis in this paper. Hence, the strategy adopted was to base the magnitudes of the shocks on the evidence from countries that had experienced avian influenza.

Table 2 shows the impacts of an avian influenza outbreak on the poultry output of nine countries in Asia. It indicates a contraction ranging from 0.09% (Japan) to 14.96% (Viet Nam). It also shows that the average decline in poultry output was 3.86%. Experiment 1 in this paper assumes that the decline in the output of the poultry sector follows the average for the nine countries in the sample.[7]

Table 3 shows the changes in poultry demand for seven countries in Europe and Asia brought about by an avian influenza scare. It indicates that news of an outbreak has led to a decline of 20% (France, Germany, Hungary) to 80% (Greece).

Table 1. Experiments.

Experiment	Description
1	Production shock: 3.86% decline in poultry output
2	Consumption shock: 42.41% decline in poultry consumption
3	Production and consumption shocks
4	Ban on poultry imports
5	Removal of tariffs on non-poultry meat imports
6	Combination of Experiments 1, 2, 4 and 5

[6]   These are imports of fresh fish, hogs, cattle, and other livestock.
[7]   See Rodriguez et al. (2006) for experiments involving an alternative set of values.

Notwithstanding differences in the behavior of Filipino consumers, Experiment 2 uses the average decline in the demand of the countries in the sample. Taking the lead from the said data, the experiment assumes a 42.41% fall in poultry consumption.[8]

There are a number of closure rules that can be used in solving the model. One rule allows the real wage rate to adjust to an exogenously determined level of aggregate employment. This represents a long-run scenario in which an economy is assumed to operate under full employment. Another closure rule imposes an exogenously determined real wage rate accompanied by an endogenous level of aggregate employment. This is a short-run setting which effectively assumes the existence of unemployed resources. The second closure rule was used in all the experiments of the study. Hence, all results should be treated as representative of the short-run impacts of an avian influenza outbreak.

SIMULATION RESULTS

This section presents the results from the six model simulations. It begins by describing the likely production and consumption impacts from an avian influenza outbreak. This is followed by a discussion of the effects of the two trade policy options in isolation of an outbreak. The analysis concludes with a comparison of the impacts of the trade policies vis-à-vis an outbreak. All the relevant simulation results are presented in Table 4.

Table 2. Decline in poultry output due to the avian flu, January-June 2004.

Country	Estimated Losses	
	Head	Share of total population (percent)
Cambodia	36,495	0.15
China (Mainland)	9,127,600	0.19
Indonesia	7,000,000	0.52
Japan	270,473	0.09
Korea	405,968	0.39
Laos	150,092	0.65
Thailand	27,554,689	13.90
Vietnam	38,000,000	14.96
Average		3.86
Average (excluding Thailand and Vietnam)		0.34

Source: EMPRES Transboundary Animal Diseases (2004).

Table 3. Decline in the demand for poultry due to avian flu, as of 2006.

Country	Decline (percent)
France	20.0
Germany	20.0
Greece	80.0
Hungary	20.0
India	25.0
Italy	70.0
Turkey	70.0
Average	42.4

Sources: Reuters, CNN.com, MeatProcess.com, FOODProductionDaily.com; all articles as of 2006.

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[8] See Rodriguez et al. (2006) for experiments involving an alternative set of values.

Impacts of an Avian Influenza Outbreak

Table 4 indicates that an avian influenza outbreak unambiguously reduces aggregate output. This can be seen from the 0.29% and 0.19% projected decline in real GDP accompanying the production (Experiment 1) and consumption (Experiment 2) shocks, respectively. Together (Experiment 3), these shocks are expected to cause a 0.42% decline in real GDP.[9]

The production shock is expected to raise the general price level, as measured by the consumer price index, by 1.56%. In contrast, the consumption shock is projected to lower aggregate prices by 0.10%. These results reflect the impacts on poultry prices and are in fact consistent with a priori expectations. The production shock effectively causes a leftward shift in the supply curve. *Ceteris paribus*, this tends to raise prices and reduce output. On the other hand, the consumption shock represents a leftward shift in the demand curve. This is likely to reduce output and prices. The results from a combination of the shocks indicate a 1.15% increase in the consumer price index. This suggests that the production shock is likely to have a stronger impact on aggregate prices than the consumption shock.

The disaggregated analysis of the shocks reveals the following. First, an avian influenza outbreak is expected to cause a contraction in the output of the Agriculture, Fishery and Forestry sector. This result is not surprising since poultry belongs to this sector. Second, the shocks affect the outputs of the Industry and Services sectors in opposite directions. That is, the production shock has negative effects while the consumption shock has positive impacts. Third, while the output of the Agriculture, Fishery and Forestry sector declines from an experiment that combines both shocks, the effects on the Industry and Services sector essentially cancel each other out. For example, the results for Experiment 3 indicate that the aggregate output of the Industry sector increases by only about 0.01%.

A more detailed disaggregation of the results reveals a similar pattern. The production shock projects a decline not only in the outputs of the poultry sector (as assumed in the simulation run) but also in most of the other sub-sectors of the economy. In contrast, the consumption shock causes a 19.72%

Table 4. Simulation results, in percent deviation from the base.

Item	\ Experiment					
	1	**2**	**3**	**4**	**5**	**6**
Real GDP at factor cost	-0.29	-0.19	-0.42	0.00	-0.01	-0.42
Aggregate employment	-0.72	-0.57	-1.25	0.00	-0.02	-1.26
Consumer price index	1.56	-0.10	1.15	0.05	-0.27	0.88
Components of GDP						
Agriculture Fishery & Forestry	-0.54	-1.58	-2.02	0.02	-0.17	-2.18
Industry	-0.28	0.24	0.01	-0.01	0.04	0.05
Services	-0.18	0.12	-0.02	-0.01	0.03	0.01
Components of GDP – detailed*						
Poultry	-3.86	-19.72	-22.80	0.34	0.09	-22.63
Other Meat	-0.04	0.19	0.16	-0.01	-0.56	-0.40
Other Agri. & Forestry	-0.33	0.10	-0.17	0.00	0.00	-0.17
Meat Preparations	-0.94	1.34	0.59	-0.02	0.20	0.78
Other Food Processing	-0.30	0.44	0.21	-0.01	0.02	0.22
Other Industry	-0.23	0.09	-0.09	-0.01	0.04	-0.05
Services	-0.18	0.12	-0.02	-0.01	0.03	0.01
No. of industries with lower outputs	218.00	39.00	153.00	212.00	14.00	164.00

* See Rodriguez (2006) for the responses of the individual industries.

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[9] The results for each of the 229 industries in the model are available from the senior author upon request.

reduction in the output of poultry but raises the outputs of the other sub-sectors. The combined effects of these shocks suggest a 22.80% decline in the total production of poultry. Similar results are observed for Other Agriculture and Forestry, Other Industry, and Services. In contrast, a combination of the shocks generates a net increase in the outputs of Other Meat, Meat Preparations and Other Food Processing.

In examining all the industries in the model, one of the most important results is that the production shock is likely to cause a decline in the outputs of 218 out of 229 industries. Since the consumption shock has adverse effects on fewer activities, the combined impacts indicate a fall in the outputs of only 153 industries.

The results above suggest the following. First, the decline in poultry output is likely to be the largest source of the fall in real GDP. With poultry accounting for close to 2% of total output in the base data set, the 22.80% decline in poultry on its own explains a 0.46 (= 22.80 x 0.02) percentage point contraction in real GDP. Since this variable falls by "only" 0.42 percent in the experiment, there must have been a relatively small net increase in the output of all other industries in the economy.

Second, with the values used in the current experiments, it appears that the production shocks tend to dominate the aggregate effects. This is supported by a larger decline in real GDP in Experiment 1 and the net increase in the consumer price index.

Third, unlike the findings for the aggregate variables, the projected change in the output of the poultry sector is dominated by the consumption shock. This is so because the fall in output from the consumption shock is roughly five times larger than the production shock. However, this result must be treated cautiously because the magnitude of the consumption shock (42.41% decline) is more than 10 times larger than its counterpart for the production shock (3.84%).

Finally, an avian influenza outbreak has potentially far-reaching effects on the economy. The reason is that almost 66% (or 153 out of 229) of the industries in the model are expected to decline. While the detailed results are not presented in this paper, among the most adversely affected are those

which supply inputs to poultry, namely, the corn and the animal feed industries (see Rodriguez et al. 2006).

Effects of Trade Policies

Table 4 shows that banning imports of poultry products (Experiment 4) has negligible effects on real GDP and aggregate employment.[10] However, relative to previous experiments, it causes a small increase in the consumer price index.

The disaggregated analysis shows that the ban on poultry imports causes a 0.02% increase in the output of the Agriculture, Fishery and Forestry sector. This, however, is offset by contractions in the Industry and Services sectors of the economy.

A finer disaggregation of the results indicates that the expansion of the Agriculture, Fishery and Forestry sector is due mainly to poultry. In the experiment, the output of this sub-sector is expected to expand by 0.34% while those of Other Meat and Other Agriculture and & Forestry sectors are virtually unaffected. The higher output of poultry in this experiment is not surprising in the sense that an import ban essentially insulates domestic producers from foreign competition. The absence of imports, in turn, raises poultry prices which serve as an incentive to increase domestic production.

On the other hand, the removal of tariffs on non-poultry meat products (Experiment 5) is expected to reduce real GDP and aggregate employment by 0.01 and 0.02%, respectively. It is also expected to lower the general price level by 0.27%.

The decline in aggregate output is mostly due to the 0.17% contraction of the Agriculture, Fishery and Forestry sector. This is supported by the finding that the outputs of Industry and Services are expected to expand in the experiment.

On closer inspection, the response of the Agriculture, Fishery and Forestry sector is due to the 0.56% decline in the output of Other Meat. The finding that there is only a small increase in the output of poultry and negligible effects on Other Agriculture and Forestry further supports this

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[10] While it is not indicated in the table, the import ban causes a 0.0003% decline in real GDP.

claim. This result is expected because the removal of tariffs for non-poultry meat products exposes the industries in this sub-sector to lower domestic prices of imports. This creates pressure to reduce domestic prices as a whole, and weakens the incentive to produce the affected commodities.

The most important finding from Experiments 3 and 4 is the relatively small impact of the individual policy initiatives on aggregate output. This suggests two points. First, it lends support to the use of import quotas as a means of preventing the entry of infected birds. Ignoring issues of its effectiveness in achieving such an objective, it shows that the costs of such a measure, in the aggregate, are lower than an outbreak. Second, removing tariffs on non-poultry meat products may be of limited use as a measure to address an outbreak. While it could be argued that the increase in the output of the Poultry sector benefits farmers in this sub-sector, it is weakened by the potential harm that the measure brings to industries which supply other meat products.

Trade Policies in the Context of an Outbreak

The assertions made in the previous paragraph are strengthened by the findings from an experiment that simultaneously implements the production shock, consumption shock, import quota and tariff removal (Experiment 6). Table 4 shows that in such a simulation, real GDP and aggregate employment are expected to fall by 0.42 and 1.26%, respectively.

The disaggregated analysis of the results shows that the output of Agriculture, Fishery and Forestry is expected to decline while those of Industry and Services are likely to move in the opposite direction. Moreover, the response of Agriculture, Fishery and Forestry is explained mostly by the decline in the Poultry sub-sector. This contractionary impact is further strengthened by the lower outputs in the Other Meat and Other Agriculture and Fishery sectors.

The relatively small costs of implementing an import ban on poultry products and the removal of tariffs on non-poultry meat products can be seen by comparing the aggregate results in Experiments 3 and 6. In both simulations, the decline in real GDP is the same. This clearly suggests that the impacts of an outbreak dominate the results.

The disaggregated analysis also shows that the removal of tariffs on non-poultry meat products, and the import ban, to a much smaller degree, may actually do more harm than good. First, the output of the Agriculture, Fishery and Forestry sector is expected to contract more in Experiment 6 compared to Experiment 3. Second, while the output of Other Meat is expected to expand in Experiment 3, the opposite is true for Experiment 6.

The findings above suggest two important points. First, it echoes the call for more aggressive measures to prevent an outbreak of avian influenza. This follows from the relatively small impacts of the policies considered here. Second, the results strengthen the need to explore other measures which could mitigate the harmful economic effects of an outbreak. The reason is that the removal of tariffs on non-poultry meat products does not appear to be effective in achieving such an objective.

CONCLUSIONS AND RECOMMENDATIONS

The paper examined the possible roles for trade policy in addressing the occurrence of an avian influenza outbreak. In particular, it used a CGE model of the Philippines to analyze the potential of employing bans on imported poultry, and removing tariffs on non-poultry meat products, as coping mechanisms in the event of an outbreak. In setting a benchmark for the evaluation of such policies, this paper also evaluated the potential impacts of the production and consumption shocks that might result from an avian influenza outbreak.

The major findings of this study were as follows: First, the simulation results indicated that the consumption and production shocks were expected to have a contractionary effect on real GDP. Second, the expected fall in the output of poultry products explained most of the decline in real GDP. Third, the production shock appeared to have a larger impact in the aggregate since this explained most of the decline in real GDP as well as the increase in the general price level. Fourth, while the consumption shock tended to have a larger impact on the poultry products, the production shock dominated the aggregate responses because of its effects on other industries. Finally, avian influenza was likely to have far-reaching effects on the economy, way beyond the poultry sector. The

simulation results indicated that it would cause a decline in almost two-thirds of all the industries in the model.

The trade policies examined in this paper are projected to have relatively small impacts on real GDP. While both policies tend to benefit poultry producers, these tend to hurt the other producers of meat products. These findings suggest the following. First, the economic costs of an import ban on poultry are, at least in the aggregate, smaller than those of an outbreak. Although this finding is silent on this measure's efficacy in preventing an outbreak, it nonetheless supports the use of this measure as a precaution against the possible entry of the disease in the country.

Second, the removal of tariffs on non-poultry meat products appears to be ineffective as a means to mitigate the harmful economic effects of an avian influenza outbreak. This suggests the need for the authorities to explore other measures to address such an event. Consistent with the finding that an outbreak could have widespread effects on the economy, this study suggests that any alternative course(s) of action that will be taken in the future, either as a preventive or corrective measure, should look beyond the confines of the poultry sector.

NOTE ON THE AUTHORS

U-Primo E. Rodriguez and Yolanda T. Garcia are Associate Professors of Economics at the University of the Philippines Los Baños (UPLB); Arnulfo G. Garcia is Manager of the Research and Development Department of the Southeast Asian Regional Center for Graduate Studies and Research in Agriculture (SEARCA); and Reynaldo L. Tan is Associate Professor of Agribusiness Management at UPLB.

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