

An Economic Assessment of the Impact of Mango Pulp Weevil on the Agricultural Sector of Palawan, Philippines

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Beginning in 1987, the export of Palawan mangoes was prohibited and the entire province placed under quarantine as a result of the mango pulp weevil (MPW). Since the ban, a number of significant trends in yield, production and area planted have emerged in Palawan's mango industry. This study evaluated trends in yield, production and area planted as well as differences in yield between Palawan and the national average. Using data for Palawan from 1990 to 2009, it was revealed that overall mango production declined by 30%, average yield per tree fell by more than 50%, while, perversely, the area planted to mango has nearly doubled. Although yield losses are not directly related to MPW damage, the decline in yields and production can be directly related to the policies, farm practices and economic conditions created by the MPW quarantine. Of particular relevance is loss of access to both the domestic and international markets. Trends in national mango production, yield and area planted were also identified for the Philippines. In Palawan, potential causes of yield reduction in mango were identified and policy recommendations were made. Furthermore, farm gate and retail prices adjusted for inflation were used to evaluate the potential economic losses to farmers and the retail economy as a result of yield decreases. Lastly, changes in crop diversity and specialization of the agricultural sector of Palawan were computed.

Key Words: export, mango, mango pulp weevil, Palawan, Propensity Score Matching, Relative Diversity Index, specialization index, yield gap

Abbreviations: MPW – mango pulp weevil, PSM – Propensity Score Matching, RDI – Relative Density Index

INTRODUCTION

Agriculture plays an important role in the economy of the Philippines. In 2010, agriculture accounted for an estimated 13.9% of the gross domestic product (GDP). More notable is the fact that agriculture represented 33% of the labor force (CIA 2010). Mango, mangosteen and guava play a vital role in the agricultural sector of the Philippines with a value of just over \$462 million in production for 2009. Not only are mango, mangosteen and guava important domestically, but internationally as well. In 2009, the Philippines ranked 10th globally in production value and production weight, 771,441 metric tons for these agricultural commodities (FAO 2011).

The province of Palawan is of particular interest for mango production in the Philippines. In the past 20 yr, the national production of mangoes had increased by nearly 70%, while in the same time period, mango production in Palawan had decreased by 30%. These stark differences can be attributed to *Sternochetus frigidus*, commonly known as the mango pulp weevil (MPW). In 1987, the Bureau of Plant Industry (BPI)

declared the MPW a dangerous and injurious pest and placed the Palawan Island Group under quarantine to prevent the spread of the pest through the declaration of BPI Administrative Order No. 20 (IPPC 2006). This administrative order effectively halted the growth of the Palawan mango industry by restricting the market to the island province of Palawan. Evidence of the MPW was first discovered in southern Palawan when a survey of 33 mango-producing Filipino provinces was administered (Cuevas 2004). Palawan is the only province in the Philippines under mango quarantine. This paper aimed to show the impact of MPW on the output and agricultural economy of Palawan.

The main objective of this study was to identify the impact of the mango pulp weevil on the agricultural sector of Palawan. This study approached this question in a number of ways. First, the study investigated if the level of specialization and diversity has changed in the agricultural sector of Palawan from 1990 to 2009. Specialization and diversity indices were used to calculate these factors. Second, a yield gap analysis was carried out between Palawan and the national average.

Lastly, potential production and concurrent potential economic losses were assessed for Palawan. Potential production was calculated by first using Propensity Score Matching (PSM) to match Palawan with the other provinces in the Philippines that were most similar based on a number of observable characteristics. The growth rate of mango production for the counterfactual provinces was then applied to Palawan in order to calculate potential losses.

MATERIALS AND METHODS

Data from a variety of sources were used in this study. Data on mango yield, area planted and production were all acquired from the Philippine Bureau of Agricultural Statistics (BAS). Additionally, price data at the farm gate and retail level were obtained through BAS. Data on population were obtained through the Philippine Bureau of Internal Revenue Allotment and data for land size of provinces were acquired through the National Statistics Office of the Philippines.

Daily weather data for the Philippines were extracted from two satellite-measured sources and averaged as monthly values across the portion of the study period for which data were available, 1998 to 2009. Daily rainfall amounts were obtained from the Tropical Rainfall Measuring Mission (TRMM) (Simpson et al. 1988) website at 0.25° by 0.25° gridded resolution from latitude 50°N to 50°S. Daily maximum and minimum temperatures were downloaded from the NASA Prediction Of Worldwide Energy Resources (NASA/POWER) (Stackhouse 2006) project website, which provides a daily global coverage of weather data on a 1° by 1° gridded geographic coordinate resolution. Due to the mismatch in resolution, the NASA/POWER weather data was downscaled to 0.25° by 0.25° using thin-plate-splining (TPS) in R (RCDT 2011).

One goal of this study was to investigate how the entire agricultural sector and the mango sector in particular have changed since the introduction of the mango quarantine. One way of addressing this goal was to look at the specialization index in the base year, 1990, and again in the final year of this study, 2009. The specialization index, outlined by McCann (2001), compared the relative size of a sector in a region to its relative size in the nation. In this study, the total value of commodities at the farm gate level was used. It is expressed as:

$$S_{i,s} = \frac{F_{i,s} / F_i}{F_s / F} \quad [1]$$

where $F_{i,s}$ is farm gate value in region i for commodity s , F_i is farm gate value in region i for all agricultural commodities, F_s is total farm gate value in the nation for

commodity s , and F is the total farm gate value of all commodities in the nation. In this application, the specialization index indicates how specialized a province is in the production of a specific crop, relative to a situation where the farm gate value is randomly distributed across the nation. When the specialization index is higher than 1, the region is more specialized and has a higher concentration in the farm gate value of a particular commodity than the nation. Conversely, values that are lower than 1 indicate a lower concentration than the nation (McCann 2001).

Another useful tool in assessing the physical make up of an agricultural sector is the Relative Diversity Index (RDI). A high value of RDI indicates that the diversity in a particular region more closely resembles that of the entire nation. A province with a higher RDI value has a more diverse agricultural sector (McCann 2001). RDI is expressed as:

$$RDI_i = \frac{1}{\sum_s \left| \frac{F_{i,s}}{F_i} - \frac{F_s}{F} \right|} \quad [2]$$

where all variables have the same definition as in equation (1).

PSM is generally used to account for selection and self-selection biases based on observable characteristics. In project evaluation, it is a way to match beneficiaries of a project with non-beneficiaries based on observable characteristics that make an individual more likely to participate in a project. Similarly, this study used the propensity score to match provinces based on their probability to produce above the median level of production. However, in this study, our treatment is the presence of a mango export ban and Palawan is the only province that is included in the treatment group. As such, Palawan is matched to counterfactuals that most similarly express the observable characteristics that were thought to impact the production of mango during the study period.

This study follows the procedure outlined by Caliendo and Kopeinig (2005) to determine the propensity score. Through the use of PSM, this study matches Palawan to five provinces that are most similar, but do not have a mango export ban, using 5-to-1 nearest neighbor matching. The propensity score is expressed as:

$$Y_{ps} = \beta_0 + \sum_{j=1}^6 \beta_j X_j + \varepsilon \quad [3]$$

where Y_{ps} is the probability that a province will produce above the median level of production in base year 1990, all of the β parameters are defined in Table 1, and ε is the error term. The β parameters are observable characteristics of provinces that would cause mango production to be similar. The six parameters chosen help match provinces based on climate, initial endowment in