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Using Portfolio Theory in Crop Selection to Ensure the Sustainable Economic Success of New Cropping Enterprises

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Abstract

There are large and often worrisome risks when a country leaves one agricultural sector and invests in another. As the Windward Islands and the Caribbean countries diversify out of the banana and sugar sectors the question arises is how to reduce the risk and ensure returns to producers to successfully and sustainably establish other agricultural enterprises. When producers decide to diversify into a new crop such as maize, wheat, rice, or any crop with multiple cultivars they are faced with not only production decisions but which cultivars to sow. Producers often plant more than one cultivar each year in an attempt to diversify yield risk. However, producers typically select combinations based on cultivar descriptions, intuition, and average yields, potentially ignoring one of the most important pieces of information: the relationship between varieties. Extension agencies worldwide have programs that allow producers to select specific cultivars and receive recommendations on optimum seeding rates, seedbed preparation, seeding date range, and drill width. A critical gap in these recommendations concerns what is perhaps the most important recommendation of all: which varieties to plant for optimal diversification.

The selection of grain varieties through portfolio theory, offers producers the potential to increase yield or decrease yield variability. Producers in areas where a new crop is introduced often value yield stability as much as yield potential. Yield and thus revenue stability is crucial to establish a new agricultural crop in an area. The lack of revenue stability will lead producers to adapt another crop or fall back on other established more familiar crops, in this case bananas and sugar. Producers often have a choice of several varieties to sow and must evaluate the tradeoff between yield mean and variance. Relationships between cultivar attributes (e.g. yield potential, pest or disease resistance, and drought tolerance) increase the complexity of cultivar selection decisions, with gains in one attribute (yield potential) potentially associated with losses in another (yield stability). Using location-specific empirical data, portfolio theory can provide producers a tool that is able to recommend a bundle of varieties to meet specific objectives, either maximizing yield given variance or minimizing variance given yield.

This study applies the existing literature on portfolio theory to wheat varietal selection for the Yaqui Valley in Northwest Mexico. While this study takes place in Mexico the methodology can be used anywhere and for any crop as long as multiple cultivars are available for producers to chose from. Varietal diversification may be an immediately plausible management strategy for producers cultivating a new crop. In this study two scenarios are evaluated. The first scenario holds constant actual historical yield and develops a portfolio of CIMMYT wheat varieties to minimize the variance around that yield. This essentially provides producers a "security net" that provides a stated level of revenue and maximizes the probability that they achieve that level by selecting a portfolio of wheat cultivars. This is important for the adoption of a new crop in that it provides producers a method that provides recommendations on how to ensure themselves some sort of revenue based on growing conditions in that area.

This method could also be implemented for producers developing alternative agricultural enterprises. For producers entering new agricultural enterprises, varietal diversification could lead to both an increase in revenue, a reduction in yield variance, and thus contribute to the formation and success of a new cropping alternative. Portfolio theory provides producers in new cropping ventures somewhat of a

revenue safety net so that they are not tempted to fall back on well established crops which may not be as profitable or sustainable.

Keywords: Portfolio Theory; Risk Aversion; Adoption of Alternative Crops; Crop Revenue Assurance