

AgriStats¹

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Abstract: The Potash & Phosphate Institute (PPI)/Potash & Phosphate Institute of Canada (PPIC) have developed AgriStats, a Microsoft Access database that tracks nutrient use data in the regions where PPI/PPIC have programs. ArcGIS software is used to support the interpretation and analysis of data contained in the AgriStats database. Maps generated show where nutrient use in crop production might be lacking, overall nutrient use within each region, and correlations between nutrient application rates and yields. This information helps PPI/PPIC regional directors focus their efforts in identifying potential nutrient use opportunities that will benefit crop production systems.

An Introduction to AgriStats and PPI/PPIC

AgriStats is a Microsoft Access computer database software system developed by PPI/PPIC and Agrisoft-Systems that is dedicated to storing and analyzing information concerning agricultural resources, crop production, fertilizer consumption, and fertilizer use on crops with significant market potential for mineral fertilizer use. The primary objective for AgriStats was to capture the Institute's expertise and knowledge concerning crop nutrient use in areas of the world where we have a presence. PPI/PPIC is a not-for-profit research and education organization that conducts market development programs for phosphorus (P) and potassium (K) fertilizers in North, Central, and South America, as well as China, India, Sri Lanka, and the ASEAN countries of East and Southeast Asia.

AgriStats is an agricultural statistics organizational tool that utilizes an Institute-wide system of data collection. Its main purpose is to supply PPI/PPIC staff with current and vital statistical information that is easily accessible and has not readily been found among current providers of agricultural data. The software is capable of displaying data in pre-programmed and user selected (i.e., filtered) views. The program includes built-in data analysis tools that can be used to calculate nutrient consumption ratios and compare nutrient consumption and removal data by crop and by geographic region.

A wide range of practical data export options are available to produce reports used as fertilizer market development and description tools for the Institute and its member companies. In addition to the desktop version, an active server page program has also been designed to provide some of the data contained in AgriStats 'on-line'. Users will have access the data using any web browser and extract data for further analysis or as printed reports.

The software was designed to filter for, and produce custom subsets of data specifically designed for use by ArcGIS. This ability to readily compile and link tabular data to GIS software is proving advantageous as we strive to analyze and interpret agricultural data which impacts fertilizer markets.

What data are we tracking?

The software is currently designed to track basic demographic measures, land use types, macro and secondary nutrient consumption, farm animal populations, and recoverable portions of nutrient from the animal manures. In addition crop-specific nutrient consumption data is recorded for a regional list of major crops. This information includes crop area and production, nutrient removal in harvested portions of major crops, estimates of actual and targeted crop-specific fertilizer and manure application, as well as estimates for actual and targeted crop area fertilized. These data fields are used as stand alone indicators, or are combined in pre-programmed (or manually) calculated field combinations to provide valuable market descriptors and comparisons.

What is the geographic scale of the data?

The current version of AgriStats operates at the PPI/PPIC Region and Country level of geographic detail. AgriStats is also designed to operate at much finer geographic scales (e.g., Country and State/Province, or State/Province and County/Municipality) if data is available. The quality of source data will be dependant upon the stage of regional development. The experience gained from the current version of AgriStats has been invaluable in terms of standardizing data collection, verification and entry procedures and this experience will be applied to future attempts to develop more detailed versions of the software.

The GIS component

The GIS component of AgriStats is a data exporting function designed to produce source data in ArcMAP-ready format. AgriStats currently exports two separate data tables based on sets of predefined fields and user selected filter settings.

Questions to answer?

PPI/PPIC is frequently called upon to provide estimates of fertilizer use and requirements for major crops in the countries where we work. In our role as a market development organization we are continually looking for effective means to describe regional nutrient balances, nutrient consumption patterns, and more specifically, potash and phosphate market priorities and opportunities. Examples of such questions include:

1. Where is nutrient use lacking or unbalanced?
2. Are trends comparing nutrient application rates and crop yield visible?
3. What is the relative rate at which specific regions/markets are developing?
4. Which cropping sectors are showing the best market potential?
5. What is the balance among actual nutrient consumption and nutrients removed by harvested portions of cereal crops and for the US and Canada?
6. What is India's P consumption for a range of years?
7. What is Ecuador's N: P₂O₅: K₂O ratio for a range of years?
8. What are the recommended nutrient application rates for rice in Thailand? What are the actual rates? What is the deficit or gap?

Mapping output from AgriStats

Map output can range from the most basic of data to specific indicators that provide market insights that are not readily available. The combined capabilities of AgriStats and ArcMAP, which allow us to map various combinations and permutations of data fields, provide a useful tool which adds a promising new flexibility to our market development efforts.

The demand side

Demographic indicators are a starting point for many attempting to characterize a particular region's present and future demand for food and fibre. Total *population* provides a measure of internal demand, which is particularly useful as we study the developing world. For example, population and the resulting demand in China and India is massive. The U.S., Indonesia, and Brazil are our next populous nations, but their stage of economic development places a varying degree of importance on this statistic. A region's dependence on agricultural activity is apparent by considering *percent Ag. Population* (**Figure 1**). A higher degree of dependence on agriculture normally equates to greater risks to food security - a situation common to most developing nations. *Cereal crop production* is another generalized way to track the supply of staple foods, but consideration must be given to the proportion destined for the export market. Along with basic food production, it is useful to compare basic physical resources (such as *arable*, *permanent*, and *irrigated lands*) used to produce that food - in order to measure a region's capacity for agricultural production.

The supply side

In fertilizer market development, a great deal of emphasis is given to the analysis of *regional nutrient balances* and *consumption patterns* (**Figure 2**). Along with adequate application rates, which consider local soil fertility, crop responses and production goals, we promote a 'balanced plant nutrition' strategy that produces the most economic yields and promotes efficient use of agricultural lands.

Identifying market priorities/opportunities: Regional examples

Southeast Asian market

Crop area, *production* and *yield* provide the starting point to analyze crop-specific trends concerning adopted levels of technology, market priority, and opportunity. A crop profile for East & Southeast Asia (ESEA) shows the majority of planted area belongs to cereal crops with rice as the dominant commodity. Next is the tree crop area, dominated by oil palm. A ranking of nutrient use by crop reveals that rice and oil palm are the two largest nutrient consumers in the region. Rice is and will continue to be the most important staple for the region while oil palm is a valuable commercial crop that continues to increase in economic importance.

Rice in Southeast Asia

Examining rice production in ESEA, approaches a nearest neighbor analysis (**Figure 3**). Here we see the influence of a number of socio-economic and physical factors including political priorities, domestic pressures and policies on agriculture and food production, and inherent resources. We can find regions with all combinations of yield levels and crop area. Of particular importance are regions with high yield and large area (Indonesia, Vietnam) and low yield and large area (Thailand).

Knowing the relationship between crop production and crop nutrient demand enables the analysis of the cropping system by estimating nutrient demand or *crop nutrient removal*. The highest yield/area combinations will have the greatest nutrient removals. Given crop demand, an indication of nutrient deficit can be provided through use of the *ratio of nutrient removal to fertilizer use*. This ratio illustrates national nutrient 'mining' intensities. In ESEA we see regions currently providing a better match between nutrient P demand and supply (Vietnam) and those that more heavily rely on soil depleting practices (Indonesia). Southeast Asia's rice soils are commonly 'mined' of its K reserves, which can also be mapped to provide evidence to support this fact.

Ratio of K removal and K fertilizer use in soybean: South America

Brazil and Argentina are the major soybean production centers in South America. In 2000, Brazil produced approximately 37 million tonnes (M t) while Argentina produced about 26 M t. A country-scale comparison of the ratio of K removal by harvested soybean to K fertilizer applied reveals a significant difference (i.e., Brazil ratio ≈ 1.3 ; Argentina ratio ≈ 975). This difference partially reflects a more mature soybean production sector in Brazil with more experienced farmers and, more importantly, a widespread soil K deficiency problem in established and newly planted regions in Brazil. By contrast, soils in Argentina's major crop producing region (Pampas) have soils with very high plant available K levels, which is evident from the high ratio indicating a heavy reliance on native K supplies.

Back to the P fertilizer market for Southeast Asian rice

Significant components of a fertilizer market include the proportion of area receiving product and the expectation for area growth. Based on local expertise, AgriStats estimates this by tracking *actual* versus *recommended fertilized area*. In staple food production, area is an especially important factor used when determining opportunity. Given our estimates, it is apparent that Indonesia, Thailand, and Vietnam have the greatest area and opportunity for the foreseeable future. Area is not always the dominant factor, as is the case in Myanmar, where potential growth in fertilized area is hampered by political difficulties.

With an appreciation of rice production and the resulting P demand, we can now turn to P supply. AgriStats tracks crop-specific estimates of *actual application rates* along with *minimal recommended rates*. Vietnam and Malaysia apply the highest P rates in rice, but the minimal P recommendations maybe of greater use. Countries like Indonesia require more P to balance large P exports from high yields, while countries like the Philippines, Thailand, and Laos require more P if most economic yields are the goal.

Like the removal to fertilizer use ratio, mathematical manipulation of the basic data fields allows for a wide range of other ratios and indicators. In a GIS, many of these indicators provide a powerful picture that elegantly describes market potential. Examples of this include:

- *Market size* = (actual rates x actual areas)
- *Market potential* = (recommended rates x recommended areas)
- *Market gap* = [(recommended rates - actual rates) x recommended area]

All of these examples highlight a single year's data, but it is also possible to filter for yearly data sets that provide visual time series and, as an example, depict *crop-specific market growth rates* (**Figure 4**). In ESEA, oil palm has been a rapidly growing crop and thus its is useful to closely monitor its fertilizer market potential.

The next level - State/Provincial detail

The Region and Country level of detail of AgriStats has proven a useful analytical tool, especially when applied to the developing world, but with the growing interest in site-specific nutrient management in the developed world, a within-country version (i.e. state/provincial detail) of the software is needed. Some success with a more detailed version has occurred internationally.

Recently, a version of the software tailored for use at the Indonesian Fertilizer Institute (IFI) was prepared to include basic data on 20 key crops as well as land use data for each province in Indonesia. This will then allow a thorough analysis of fertilizer markets for major crops in Indonesia's 29 provinces as well as estimates of nutrient removal in crop products and the nutrient balance for each crop in terms of nutrients added in mineral fertilizer and nutrients removed in crop products. Many similar data sets are envisioned given the proper data source.

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