An Assessment of the India Soy Protein Market

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India, a country with a large population, is experiencing rapid income growth. In most developing countries, diets are based on cereals, but as incomes increase, consumption shifts to other products. Previous studies on diet trends with respect to income show that as per capita income increases, consumption of protein in the format of meat also increases for low income countries. Since approximately two-thirds of India's population is vegetarian, much of the increase in protein consumption is expected to come from a non-meat source.

Over 80% of India's population is Hindu with Muslims (13%) being the next largest religious group. Hinduism encourages being vegetarian and avoiding the eating of any animal meat or flesh. However, not all Hindus choose to practice vegetarianism, and they may follow the religion's dietary codes in varying degrees of strictness. Some Hindus refrain from eating beef and pork, which are strictly prohibited in the Hindu diet code, but do eat other meats (ElGindy, 2005). Muslims are restricted from consuming pork of any form. The consumption of meat products from goat, sheep, poultry, and cattle is allowed granted the animal was slaughtered by a Muslim according to Islamic rules.

The first objective of this research is to determine India's protein demand over the next ten years. Soy protein is becoming more prevalent in the world marketplace. Major crop and oilseed processors are recognizing this demand and developing products accordingly. Market indicators show that soy protein products are in a position to fill this niche. The second objective of the research is to determine the economic feasibility of exporting value-added soy products to India from the U.S., a major oilseed producer, to fill the growing protein demand.

A political, economic, social, and technological (PEST) analysis was conducted to summarize the future potential of exporting U.S. soy to India. The analysis showed that although there will be obstacles, most macroeconomic variables show strong potential for the venture. One setback is that India lacks efficient contract enforcement regulations. This could shy potential U.S. exporting companies away from India due to the increased risk of Indian companies not paying specified prices, etc. Or, US sellers will want cash transactions. Also, the Indian rupee has been declining in value to the U.S. dollar for the last several years. However, the shear magnitude of the population and income growth rates show India to have a food demand surpassing that of nearly all other countries.

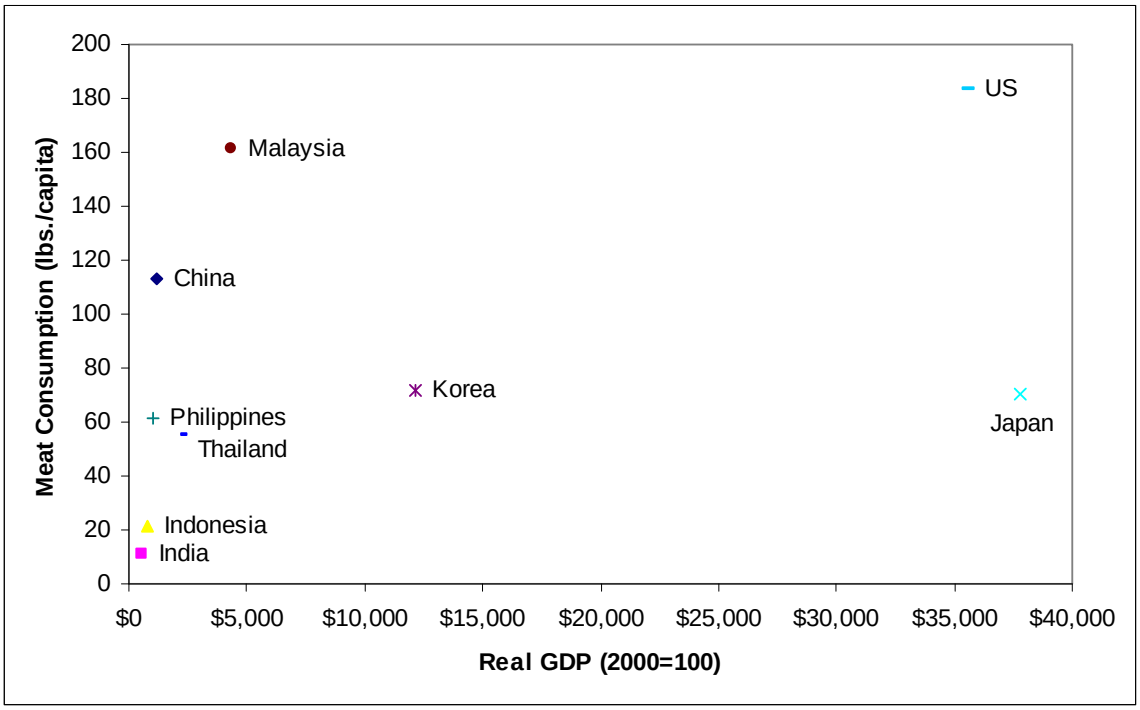
India's current and projected population levels and the state of the economy show the country is poised for a transition of diets that are higher in protein content. The vegetarian complex of the country has caused protein demand be derived from products such as soy. The Indian government, in response to WTO rulings, has been slowly moving towards more liberal trade agreements by reducing quotas and making restrictions tariff-based. This has allowed countries such as the U.S. to begin exporting more soy products. India is also recognizing the increasing trend in soy protein consumption. The number of soy food processors and soy products has greatly increased over the last 5-10 years.

According to Landes (2004), the India agricultural sector has outgrown the policies that contributed to past success. India's economy has grown at an annual rate of 5.7 percent since 1980, ranking the country among the fastest growing economies. India is now facing new pressures as consumer incomes rise. The middle class of the world's second most populous nation is becoming wealthier and seeks greater diversity in food products. Average India

households spend over half of their incomes on food. This, coupled with changing trade policies, is even changing food demand patterns. Many Indian consumers are spending more of their income on diversifying and upgrading their diets.

This research uses meat price, along with income, population, and dietary trend data, to determine future India per capita protein consumption. Evidence of the per capita income to meat consumption is illustrated in Figure 1, the U.S. is included for comparison purposes. There was a strong positive correlation between per capita meat consumption and per capita GDP over the 1990-2005 time period. India is currently in a position to have a major shift in dietary patterns through increasing per capita income levels. This change in food demand is further magnified by the shear population size and demographics of the country.

Figure 1. Per Capita Real GDP and Meat Consumption by Country, 2003 (Source: USDA ERS and FAO Stat)



Previous Literature

The majority of previous research completed concerning food demand show that per capita income level is the most important factor affecting food consumption patterns. Studies concerning protein demand have focused on animal-source protein, relating meat consumption with income growth. Animal meat the most common source of protein around the world.

Schroeder, Barkley, and Schroeder (1995) evaluated international meat consumption to explain meat consumption by quantifying the relationship between income growth and meat consumption. Looking at beef, pork, poultry, and lamb consumption data from 32 countries, the study found that meat consumption is particularly responsive to increases in income. Results showed that high income countries have experienced relatively constant per capita meat consumption while low income countries with growing income have experienced increasing meat consumption. A strong positive relationship existed between per capita meat consumption and per capita gross domestic product (GDP). In low income countries, the four meat categories were found to be normal goods, but as income levels increase, income elasticities were found to decrease. This shows that per capita meat demand does not grow as fast as income as countries become more developed. At higher income levels, lamb and poultry products appeared to become inferior goods. Also, high income countries typically did not increase per capita consumption with income growth; the high income countries are already at full consumption levels of meat products.

Gehlhar and Coyle (2001) stated that changes in consumption patterns are driven primarily by per capita income growth. Additionally, income growth on import demand differed from developed to developing countries. Developing countries showed a shift from basic staples

to higher value meat products while developed countries shifted toward further processed and non-bulk commodities. These shifts may also be induces by diversification of consumption rather than increased per capita consumption alone. It is also stated that although, in the case of China, rapid economic growth has not greatly changed import demand for meat, the country domestically increased production to cover most demand needs.

China has been in the spotlight in the last decade in the area of food demand. Shono et al. (2000) researched China's diet patterns. FAOSTAT data from 1992-94 was compiled on per capita daily supply of grain, vegetables, meat, dairy, and seafood products for over 120 countries. The goal of the study was to determine how China's dietary pattern was changing. Results concluded that Chinese diets were moving from the developing country group to the developed country group. However, the transition is not mimicking that of the U.S. and other Western countries. Rather, China is moving towards the dietary patterns of other developed Asian countries such as those in Japan and Hong Kong. In these developed Asian countries, diets depend on more seafood as a protein source than places like the U.S. In this case, fish consumption partially replaces meat consumption.

Sarma and Yeung (1985) determined that consumption of livestock products is claiming increased shares of disposable incomes in developing countries as per capita income rises. The study covered 104 developing countries in Asia, Africa, and Latin America from 1961-65 and 1973-77. Between the two time periods, meat imports for the developing countries increased by 80%. Meat products are a high-quality protein source, therefore, meat consumption increases the quality of a diet. At the time of the study, meat consumption was four to five time greater in developed countries compared to developing countries. Additionally, countries having income

growth of greater than 5% annually showed annual meat demand growth at more than double than that of countries with income growth of less than 1% per year.

Mintert, Schroeder, and Marsh (2002) reaffirm the notion of increasing disposable incomes increases meat demand in their study on beef. The study finds that U.S. consumer expenditures rose from less than 90% of disposable income in the early 1980s to near 98% by 1999. Additionally, it was discovered that beef demand increases by 0.90% for a 1% increase in total per capita expenditures.

In Growing Demand for Animal-Protein-Source Products in Indonesia: Trade Implications by Fabiosa (2005), elasticities were estimated from Indonesia's 1996, 1999, and 2002 National Socio-Economic Survey, or SUSENAS, data using a double-hurdle demand specification. The study suggests that Indonesian household diets are expected to undergo major changes as income growth levels are sustained. Most countries with growing incomes experience a diet "trading-up" effect in which low quality diets are replaced or partially replaced by animal-source protein. In the case of Indonesia, diets of cereal grains such as rice were shown to be replaced by diets of wheat based products along with animal based sources of protein.

All eyes have been on China over the last few decades concerning dietary patterns and therefore trade opportunities (Cai et. al., 1998). An LA-AIDS model was used to determine price and income elasticities for different income classes of Chinese consumers. This study analyzed data composed of 11 annual observations from 1985-1995 from three income groups. Over the last two decades, Chinese per capita disposable income have shown extreme growth rates in urban households. The low income households were first concerned with consuming

enough calories from the least cost source, usually rice in the case of China. As incomes rose, more variety and quality was added to their diets. Direct human consumption of cereal grains fell and meat consumption rose rapidly. Total meat expenditures to total food expenditures increased from 14% in 1990 to 24% in 1994 showing this change.

Industry Background

Worldwide, 10,256 million bushels of soybeans are consumed. After the crush, over 167 million tons of SBM and 39 million tons of soy oil are consumed (FAPRI, 2006). This is equivalent to approximately12 pounds of soy being consumed per capita for the entire world population.

In the U.S., nearly all soybeans are crushed to extract the oil from the resulting meal. According to the USDA, most soybean meal (SBM) goes to livestock feed. FAPRI reports 2,521 million bushels of soybeans are currently consumed annually in the U.S. From this, nearly 10 million tons of soy oil and over 33 million tons of SBM can be made which is further processed into more higher-value products. The most common of the soy protein products include soy flour, soy protein concentrates, and soy protein isolates.

The U.S. currently leads the world in soybean production. A record U.S. soybean production in 2006/07 raised world output by 4%. World production is expected to decline drastically in 2007/08 due to U.S. soybean planted acres down 15% from the previous year's record highs. This acreage reduction was due to a 19% increase in corn planted acres fueled by increased corn prices due to ethanol demand.

Although the U.S. is currently the largest soybean exporter, Brazil is expected to surpass U.S. levels with the 2008/09 crop and double U.S. exports by 2016 (USDA, ERS). The U.S.

export reduction is largely due to increased domestic use indicated by FAPRI. Some of the increases in domestic use could be from the increased consumption in soy protein categories. The United States, Brazil, and Argentina collectively account for more than 90 percent of world exports of soybeans, soybean meal, and soybean oil. Most of the projected growth in global soybean exports is expected to be satisfied from Brazil alone. The USDA states that Argentina continues to dominate world exports of soybean meal and soybean oil, as the country's modest domestic use and differential export taxes make it the most competitive place to process soybeans. Argentina taxes soybean exports at a higher rate than the exports of soybean meal and soybean oil, which favors demand by domestic processors.

USDA estimates show China as the leading importer of soybeans. China's projected import growth accounts for more than three-fourths of the projected gain in world trade by 2016/17. In many aspects, such as income and population growth, India is following in China's footsteps only lagged by 10-20 years. Thus, India could become a major importer in the years to come only in soy protein products instead of raw soybeans. Just as Shono, Suzuki, and Kaiser (2000) reported China as not following traditional dietary adjustments with increased income, India may very well begin to balance diets with soy protein.

As mentioned previous, soybeans are processed into two main types of products during the crush process: soybean oil and soybean meal. From one bushel of soybeans (60 pounds), about 11.5 pounds of oil and 47.6 pounds of meal can be processed. This is equivalent to approximately 19% and 79% respectively. According to the USDA, soybean oil is the number one vegetable oil, accounting for two-thirds of all vegetable oils used for cooking and industrial applications. Soybean meal (SBM) accounts for 50-75% of the value of soybeans and is the

most important protein feed in the world. Livestock feed is the greatest use of SBM, accounting for 98% of SBM consumption. Human consumption makes up much of the remainder of SBM use with applications in bakery, meat substitute, and other categories. After oil is removed, the remaining product can be further processed to other value-added products such as soy flour, soy protein concentrate, and soy protein isolate.

Soy protein is an inexpensive source of non-animal protein. Various methods exist to measure protein quality in regards to human consumption. The Biological Value (BV) score, on a scale of 0-100 is a common measure. Although products such as eggs have a larger biological value (BV), a measure of protein quality (encyclopedia.com) as shown in Table 1, cost makes soy protein the least expensive source of digestible protein on a per gram basis (Jolliet, 1998; McGilvery, 1970; McNamara, 2004; and Smith and Circle, 1972). The Indian population currently consumes predominantly poor quality protein; approximately 75% of Indian protein consumption is from cereals (Itapu, 2007).

Table 1. Protein Products and Biological Value

Product	BV
White Flour	41
Corn	60
Full-fat Soy Flour	64
Soybean Curd (Tofu)	64
Whole Wheat	64
Beef	74
Soy Protein Isolate	74
Fish	76
Defatted Soy Flour	81
Rice	83
Cheese	84
Cow Milk	90
Soybean Milk	91
Chicken Egg	94

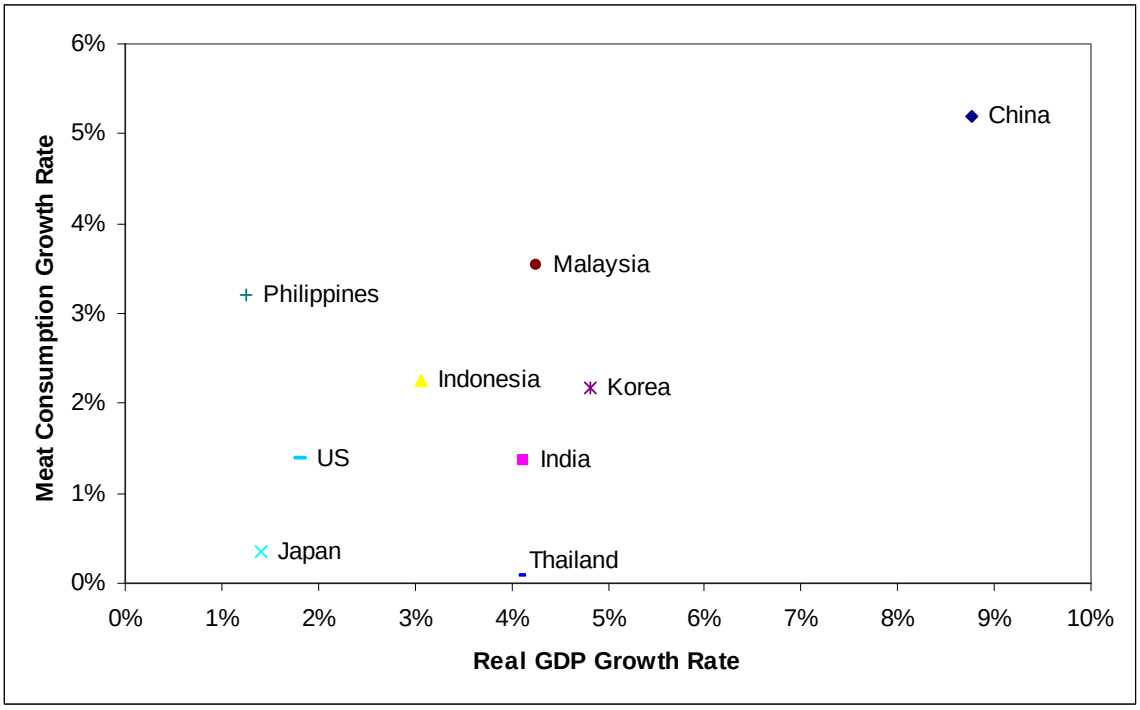
Note: The Biological Value (BV) score is on a scale of 0-100 with zero being the lowest quality protein to the human body and 100 being the highest.

India's per capita GDP and population levels growth rates have been similar to those of China. In today's globalized economy, many industry players watch China in an effort to adjust accordingly to the activities of the world giant. India is currently at population and per capita GDP levels China was at 10-15 years ago (USDA ERS).

Modeling India Protein Demand

Numerous studies have shown that increased per capita meat consumption is largely driven by increased per capita incomes (see Figure 2). This study developed a model to estimate future protein demand in India. The model uses a weighed average meat price of beef, pork, poultry, and sheep along with consumption data from FAO Stat data for select Asian countries. Population and per capita GDP data were collected from the U.S. Department of Agriculture. Per capita GDP was used as a proxy for per capita income. Quantity data was converted to short tons for all estimation measures. Additionally, per capita meat consumption was obtained by dividing meat consumption by total population for each country to determine pounds per capita. All data was collected for the selected countries from 1990-2005 while the meat price data was only available from 1991 to 2003. Thus, 1991-2003 was the estimation period utilized in this study.

Figure 2. Per Capita Real GDP and Meat Consumption Growth Rates by Country, 1990-2005 (Source: USDA ERS and FAO Stat)



The model used to estimate per capita protein consumption utilized the log of a weighted average meat price of beef, pork, poultry, and sheep for the selected Asian countries, along with a trend variable and the log of per capita income and per capita income squared as shown in Equation 1. Meat consumption is converted to a pounds of digestible protein equivalent.

(Equation 1) $\ln Q_{ijt} = \beta_0 + \beta_i \ln P_{ijt} + \beta_{y1} \ln INC_{jt} + \beta_{y2} [\ln INC_{jt}]^2 + \beta_t TREND$

where i refers to the meat commodities combined, j refers to country, t refers to country, Q is per capita consumption as pounds of protein, P is the weighted average meat price in US $/lb., INC is per capita GDP in US $/capita, and TREND is a simple linear trend where year one =1, year

two = 2, etc. The parameters $\beta_{0,...}$ β_{y2} are elasticities to be estimated. This equation utilizes the squared lnINC variable to allow income elasticity to vary by income level.

Linear regression was used in the estimation of protein consumption for seven Asian countries. Results from the analysis will show how meat price, income, and time have an effect on protein consumption per capita. The protein consumption equation performed well, having a R-square of 0.99. As expected, income had the most influential coefficient and significant. Income elasticity of protein demand for the sample of selected Asian countries was found to be 0.80. Thus, for a 1.0% increase in per capita income, per capita protein consumption increases by 0.80%.

Per capita income growth estimates published by USDA ERS from the International Macroeconomic Data Set were used to forecast annual per capita protein consumption rate increases to 2017. Results show India's per capita protein consumption increasing at an average rate of 4.51% per year for 2007-2017 as reported in Table 2.

The annual protein consumption growth rates in Table 2 can be used to estimate total pounds per capita protein consumption. It is unknown exactly how accepting the Indian population will be of soy protein products. As mentioned previously, 60-70% of India's population is vegetarian. Some of these residents are vegetarian due to income restraints. Additionally, even non-vegetarian India persons may consumer twice per week (personal source). This indicates that non-vegetarians will utilize some soy products as a protein source. Table 3 shows the scenario of using 50, 60, 70, and 80% soy protein to fulfill that amount of protein consumption.

According to Maier et al. (1998), raw soybeans yield approximately 35% protein. The standard USDA measure for one bushel of soybeans is 60 pounds. Therefore approximately 21 pounds of every soybean bushel is protein. Looking at the ratio alternatively, one pound of protein is equal to 2.857 pounds of raw soybeans. In terms of soy protein isolate, one bushel of soybeans yields 21-23 pounds depending on protein content. Approximately 21 pounds of 100% protein is contained in one bushel of soybeans.

Returns to Exporting Soy Protein into India

Further processing soybeans into more concentrated protein products adds value. Soybeans are assumed to be valued at $5.50-$8.50 per bushel. This chart is somewhat misleading in the fact that as these products are prepared, other co-products are also produced and sold off along the way. Table 4 summarizes average price of selected soybean products along with their value per bushel.

Table 4. Average price per pound and per bushel of selected soy products

Product	$/lb	$/bu
Soybeans	$0.12	$7.00
Soy Flour	$0.21	$8.51
Soybean Meal	$0.13	$6.12
Soy Oil	$0.28	$3.03
Soy Protein Concentrates	$1.45	$47.13
Soy Protein Isolates	$1.92	$42.53

Table 2. Current and Estimated Protein Consumption Growth in India

	2005	2010	2015	Average, 2007-2017
Increase in Per Capita Protein Demand (%)	5.53	4.43	4.53	4.51

Table 3. Current and Estimated Per Capita Protein Consumption in India

	2005	2010	2015	Percent Increase (2007-2017)
Per Capita Consumption (lb./capita)				
Protein	11.24	14.12	17.58	55.21%
Soy Protein				
Assuming 50% soy diets	-	7.06	8.79	-
Assuming 60% soy diets	-	8.47	10.55	-
Assuming 70% soy diets	-	9.88	12.31	-
Assuming 80% soy diets	-	11.29	14.07	-

U.S. processors will ship largely the higher value soy products to India, such as Soy protein concentrates and isolates. These products are valued in the U.S. at approximately $1.45-$1.92/lb. Transportation costs are estimated at $1,557 per container or about $0.03 per pound to ship containers from Western U.S. ports to Asia.[1] After duties and taxes are applied, breakeven prices for soy protein concentrates and isolates are $2.00 and $2.24, respectively as shown in Table 5. Import duties could be reduced to the U.S. processors by exporting through a country of lower tariffs, which the country has a free trade agreement with India.

Table 5. Breakeven soy product prices to U.S. processors from western ports, 2007

	$/lb	
	Soy Protein Concentrate	Soy Protein Isolate
Soy Product Value (U.S.)	$1.45	$1.92
Transportation	$0.03	$0.03
Import Duties and Taxes	$0.52	$0.29
Breakeven Price to U.S. Processor	$2.00	$2.24

Conclusion

Developing countries have been shown to change their dietary patterns as disposable income increases. The change is usually a transition from low quality to higher quality foods. Most countries experiencing increased per capita incomes also see increased meat consumption. This shift is more generally viewed as a shift to increased protein consumption. A shift in global dietary patterns is taking place, resulting in the world now eating more meat than ever before. The growing middle class worldwide is adopting diets including much more protein (Holmes, 2001). In the case of Japan, which has recently climbed out of developing country status,

[1] Based on personal interviews with India buyers, rarely will a U.S. based seller be able to market an entire container to one India buyer due to capital constraints. Either the seller will need to have multiple buyers – increasing search cost – or go through a broker – get a lower wholesale price because broker will require a return on investment.

showed meat consumption increase 360% from 1960-1990. Globally, meat consumption doubled over the same time period. Much of the growth in meat demand in developing countries is taking place in a few large nations, especially China and Brazil, which have accounted for more than half the increase in per capita meat consumption in developing nations over the last two decades.

A SWOT analysis, highlighting the strengths, weaknesses, opportunities, and threats for exporting soy products to India was conducted. Results show that with relationships and experience, there is great opportunity. India is now moving towards more trade with other countries, offering much opportunity to this market.

In the case of India, a primarily vegetarian country, increasing per capita incomes point towards an increase in protein demand from a non-meat source. Although Indian incomes are on an increasing trend, India is still a poor country. Soy protein has been found to be the least cost source of digestible protein on a per gram basis. Thus, it makes sense that India will utilize soy as a source of protein in the wake of shifting dietary patterns.

Food consumption of soy protein products has been on the rise in many Asian countries, especially China, Vietnam, and India. India is poised to further increase their per capita consumption of soy proteins more so than other countries because of their diets. Additionally, India's extremely large population coupled with a fairly aggressive growth rate show total soy demand growing at significant rates, another great opportunity for exporting soy products to India.

This research is a first step in determining India's future need for soy-based protein products. The objective of this study is to determine India's protein demand over the next ten years. Then, using the per capita protein demand derived from this study, along with income,

population, and dietary information, per capita soy protein consumption was estimated for the same time period. It was found that income growth has a large positive affect on protein consumption.

The findings from this study show that by the year 2017, India will be utilizing approximately twice the amount of soybeans currently consumed. Resource limitations show India will struggle to domestically meet these demand levels. U.S. business organizations, with the technology and resources needed, are positioned to be forerunners in exporting identity-preserved (IP) soy to India to fulfill the protein demand.

This study used the assumptions of the Indian population using 60-70% soy protein products to fill future protein needs. Currently, approximately 60-70% of the Indian population is considered vegetarian, mostly due to religious belief. Some vegetarians, however, refrain from meat consumption due to income restraints. The percent of the Indian population that will continue the vegetarian diet after increases in incomes are experienced is difficult to measure.

Results show that India will be increasing soy protein consumption over the next decade. Based on estimates from this study, Indian soy consumption could nearly double over the next 10 years. This consumption is equal to 10-20% of U.S. soybean production levels. The U.S. is in a position to fill India's protein demand. Market research shows that U.S. companies, would be a forerunners in logistical issues around moving the desired products to India.

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