From: Bill Rooney
To: "Will Rooney"
Subject: RE: World Food Prize Essay Editing for A friend
Date: Tuesday, September 01, 2009 7:44:00 AM
Attachments: National Responses to Food Insecurity Pratt Revisions.doc

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Will:

Some edits for Ryan's document.

Pretty good.

Hope school is going well..

bill

Dr. William L. Rooney
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-----Original Message-----
From: Will Rooney [mailto:turkeymanwill@gmail.com]
Sent: Monday, August 31, 2009 8:51 PM
To: Dad; Grandpa Rooney
Subject: FW: World Food Prize Essay Editing for A friend

Hey can each of you if you have time read over this and make corrections/ suggestions, a friend of mine is entering the contest that I was in last year and needed an editor. Thanks

Will

From: Ryan Pratt [mailto:dryanpratt@gmail.com]
Sent: Monday, August 31, 2009 3:52 PM
To: Michelle Jedlicka; Will Rooney; John Mayo
Subject: World Food Prize Essay

Here's my World Food Prize competition essay.

Will, if your father doesn't mind reading over it by Wednesday evening do you think that would be able to?

--Ryan Pratt

Ryan Pratt

A&M Consolidated High School

College Station, Texas

12 August 2009

The Plight of the Rural Thai Farmers

Commerical a~~A~~griculture is the ~~is a~~ fundamental basis of human civilization. ~~element of the sustainability of the human race, since the inception of civilization~~. Agriculture's importance is underlined throughout history as a massive force in the movement of people, the catalyst of wars, and the significance of international commerce. These forces however, are not held in check by the perception of stability; but rather, the forces are held by the continued perseverance of farmers to improve their crops, producing more out of the land they have. These improvements in agriculture are continuous and they ~~continued for millennium,~~ diversify~~ing~~ and enhanc~~e~~~~ing~~ what we consume; the earliest civilizations pioneered plant husbandry, crossing different crops to produce the desired outcomes. These methods continue today, providing the basis upon which many of the worlds agricultural modification is constructed. While the rapid advancements in technology have enabled developed countries to expand their repertoire of techniques to~~-~~ manipulate crops to manifest desired traits; other countries have not yet reached that level of scientific progress, but their populations still continue to grow at exponential rates.

This disparity between the agronomic level and the immensity of population is characterized in many of the nations of the Southeastern portion of Asia. Thailand is particularly afflicted by this conundrum; their burgeoning economy is struggling to find a medium between an industrialized and agrarian society. These differences in ideas have led to issues that threaten the national food security. Issues involving national food security are ~~not on the decline, rather, they are~~ increasing as industry enters into more direct conflict with the agrarian life style that is known to many Thai. These conflicts demand a more active measure be taken to ensure that the producers of Thailand can continue to provision its population amidst this diversifying time. The implementation of advanced biotechnologies can heighten the yields of the country's staples, and convey resistance to disease, as well as mitigate other adverse

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environmental afflictions, will bestow an increase in the well being and sustainability of the Thai's population.

Civilizations are built upon the hard work and dedication of a people that are driven by a desire succeed; their ingenuity provides successes in the face of hardships that surround them. Rural Thai farmers primarily live in the Northern provinces of the country, with the North-eastern province trailing the farthest behind in terms of agricultural productivity and socio-economic advancement (Gibson). Often, ~~times~~ these families suffer from a disjunction between the size of their families and the capabilities of their farm to produce adequate food for themselves. The typical farm size is approximately 4.04 hectares, or just under 10 acres, while the typical Northeastern family is 4.1 people (National Study: Thailand; Census 2000). With such small families the typical number of available laborers on the farm fluctuates between two and three able workers, the majority of whom are past their prime (Od-ompanich). While the ~~-~~average family size for the region is approximately 4 people, often the poorest of farmers will have larger families ~~in order~~ to ensure as much help as possible ~~on~~ for the farm ~~to obtain a secure income~~. But~~,~~ these large families bring a their own set of issues with the large number of dependents attached; the greater number of mouths to provide food for can place undue stress on the land. Many of these farming families grow two types ~~varieties~~ of crops: ~~cash~~ crops for commercial sale~~to sell to other areas, (~~particularly the lowland plains) and ~~; and~~ crops for on-farm consumption. ~~consumed as food.~~ In Thailand, r~~R~~ice is ~~most commonly grown as~~ the subsistence farmer's ~~main~~ staple followed by ~~, with~~ cassava~~-clocking in as the second most prevalent~~. To many farmers, rice provides nearly 100 percent of their families' carbohydrate intake~~, from one harvest until the harvest the following growing season~~ as they have almost nonexistent economic means through which to purchase ~~more~~other food products. Besides cereals grown for their own consumption, the farmers grow a variety of other plants to support themselves both economically and nutritiously. Corn is grown in many rural settings as fodder for animals, such as swine and poultry, that supplement their rice based diet and provide protein either through ingestion of the animal's meat, in the case of swine, or their products such as eggs in the case of poultry. Additionally,

some Thai farmers plant a variety of fruits and vegetables to increase meal variety, supply necessary nutrients and to sell the surplus in local markets and to Thailand's growing agribusiness. Many tropical fruits such as oranges, lychee, langgan, and papaya are grown to sell to the lower plains and urban areas that can't grow them in vast quantities. Despite the large percentage of agriculture in the national economy, the agricultural practices have not progressed as far among the rural farmers as they have among the agribusiness tenants. Many rural farmers require the use of their physical labor or draft animals to produce their crops. ~~Only small amounts of~~ Agricultural mechanization is limited for ~~have reached~~ rural Thai farmers; typically only ~~in terms of~~ small ~~walk~~ walk-behind tractors are available~~to help with crop planting~~. The manual labor ~~un-mechanized~~ practices typical of Northeastern Thailand, are a function of the small areas of land and low incomes of the many subsistence farmers. In addition to manual ~~un-mechanized~~ crop sowing, the post-harvest procedures often are completed by hand. The rice kernels are commonly extracted by hand thrashing, however sometimes the more profitable families of a village band together to rent a mechanical thrasher (Gibson). The methods of planting and harvesting prove to be some of the most insurmountable obstacles to the improvement of their farming abilities. Without a more mechanized approach the farmers are limited by the size of their family as to how much land they are able to farm during a season. Additionally, the lack of defined and well placed transportation routes decreases the availability of markets to which the rural farmers can sell their more perishable cash crops. These restrictions that are part of the rural Thai life prevent them from improving their situation through their own means, leaving it to the charge of others to provide them with the capabilities to enhance their lives.

While rice dominates crop distribution among rural Thai farmers, the choice of a rice variety plays a large role in their ability to produce adequate amounts of cash ~~to generate additional~~ income. Many of the rural subsistence farmers rely upon native varieties that they have collected seed from, and are opposed to the use of genetically engineered and/or Green Revolution varieties because of the additional requirements associated with the improved lines; many of the superior yield lines rely up on the addition of large amounts of inorganically synthesized fertilizers to the soils (Od-ompanich). These

accessory requirements dramatically increase the cost associated with cultivating a plot of land, which cannot always be reabsorbed at the time of excess crop sales. In order to combat this issue rice lines have to be developed to use nutrients more efficiently (AFP). Of the inorganic fertilizers needed to bolster plant varieties from the Green Revolution, nitrogen~~ous~~ fertilizers are most commonly applied, but they are either not readily available or their use is cost prohibitive.

~~yet they also can have terrible side effects on the environment. However, r~~Recent developments during the last few years have indicated that certain nitrogen fixing bacteria can be induced to colonize the inter-cellular space in the roots of rice plants and produce fixed nitrogen that rice plants can absorb into their cellular structure to use in lieu of artificial nitrogen additions (Cummings). These modified plants would create a more sustainable agricultural method through which farmers would be able to remain located on one plot of land for longer periods of time without having to resort to slash and burn clearing of to open additional land for farming. Additionally a symbiotic relationship would allow the farmer to plant the cereal crop more consistently with less time planted either fallow or with a rotated crop such as a legume to replenish the nitrogen in the soil.

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Rice typically falls under one of two cropping methods: upland dry rice farming and lowland wet farming. The rice species grown with dry land farming often encounters periods of ~~suffer from more extreme~~ drought stress as water becomes more scares due to increased competition from the industrial and industrial sectors (IFAD). In an effort to alleviate drought issues researchers have over-expressed the late embryogenesis abundant proteins in certain rice strains, displaying an increase in the relative yield of the modified plants (Xiao). This increased resistance to ~~-~~drought stress may enable~~s~~ ~~the~~ farmers to continually provide adequate amounts of nutrition to their families despite the growing farming difficulties in the mountainous regions.

~~Besides environmental hardships, f~~Farmers must also deal with viral and disease damages to their crops. The Rice Tungro Virus maintains its status as one of the most endemic diseases, causing great losses of rice crops when it strikes. In an effort to prevent the disastrous effects from occurring researchers have discovered that an overproduction of two of the rice's own transcription factors caused a

decrease in symptoms after exposure to the Rice Tungro Bacilliform Virus; additionally the stimulation of transcription factor production demonstrated no adverse effects on normal plant development (Dai)Tis resistance to viral infections allows the possibility of future eradiation of the source of despair in much of Thailand's rural farming scene~~.~~. In further effort to nutritionally enhance foods most commonly eaten by the world's poorest, researchers from the International Rice Research Institute biofortified a high producing *indica* rice line, to accumulate higher levels of both iron and zinc in the seed's germplasm (Vasconcelos). This is important because brown rice, unpolished rice grains, is rarely ingested by any of the Thai (Gibson). The method used to polish the grains remove the vast number of micronutrients stored in the outer layers as detrirus. The increased iron levels help to alleviate iron anemia deficiency, a condition which causes decreased erythrocyte size, as well as decreased saturation of iron binding to the glycoprotein transferrin (Vasconcelos; Internet). These conditions can lead to chronic illnesses, including but not limited to, autoimmune diseases, neoplasia resulting in uncoordinated new cell growth, and chronic inflammation (Internet). Thus the genetic biofortification of the crops that provide basic sustenance to a large percentage of the world's population improves their personal health. These improvements are often incorporated into high performance rice lines that make efficient use of soil nutrients to offset the rather low soil solubility of many of the metals, including zinc (Vasconcelos; Cakmak). Despite the fact that the majority of the rural farmers' caloritic intake comes from rice, and it provides many of the necessary nutrients, other crops must be enhanced to provide total nourishment as well as economic prosperity.

In order to provide economic prosperity to the rural mountainous farmers of Thailand, more has to be done than ~~straightforwardly~~ improve their basic nutrient subsistence. The farmers ~~have to have~~ need access to a variety of crops that will help to support them in all of their endeavors to better their economic position. This means the enhancement of fruits and vegetables as alternate sources of nutrition must be embraced. Papaya, *Carica papaya*, is one of the most nutritious fruits available to the subsistence farmers: one serving of papaya, about a quarter) provides 133% of a person's daily Vitamin C intake, and 33% of

their Vitamin A intake, both of which help with the uptake of iron, helping to mitigate two of the three largest micronutrient deficiency among the world's poor farmers (Davidson). In addition to the large health benefits, the papaya also provides economic vitality through the *papin* protein used in a variety of industrial products.

While many of the poorest subsistence families rely upon the papaya to provide supplemental nutrition to the carbohydrate intake received from rice, their reliance is shattered yearly by the Papaya Ringspot Virus (PRSV). PRSV adversely affects the photosynthetic capacity of the papaya trees, resulting in drastic damages ranging from blemished to inedible fruit, ultimately resulting in plant death. Despite the lack of any natural resistance, researchers using transgenic techniques conveyed resistance through viral coat proteins sans PRSV (ASBPII). Despite the success and praise it has garnered in locations such as Hawaii; governmental instability and activity of radical political groups in Thailand have prevented the testing and use of any new genetically engineered organisms for the past decade. The ban is still enacted despite genetically engineered papaya's needed presence, particularly since many areas have infection rates of 100%, yielding a dramatically reduced crop harvest (Davidson).

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In addition to papaya, Chinese cabbage, a subspecies of *Brassica rapa*, is one of many vegetables grown in Thailand that suffers from a constant assault by various bacterial diseases. Bacterial soft-rot caused by *Pectobacterium carotovorum* destructively damages the Chinese cabbages of many rural Thailand farmers, presenting them with un-edible food, and a loss on investment. However, by producing transgenic cabbage, researchers have shown an increased resistance to moderate exposure to the bacterial soft rot (Jung). In addition to having bacterial disease resistance conveyed, *B.~~rassica~~ rapa* has the potential to have an increased zinc accumulation that could then be absorbed by the malnourished. Zinc is highly important to human health since approximately 10% of all human proteins rely upon zinc binding sites, yet at least 68% of the populations of Southeast Asia, and possibly as high as 95% are at risk for zinc deficiencies. However, compared to many of the bioengineered plants that are currently being developed, modification of the mineral uptake systems of the *B. rapa* requires a much more subtle and intricate level of work. Many of the mineral uptake proteins ~~that are~~ present in the cells uptake more than

one mineral apiece, leading to a potential over-accumulation of toxic minerals such as cadmium, in addition to the minerals that are beneficial to human health. Furthermore, genetic analysis demonstrates that the processes of metal accumulation and tolerance are controlled by separate genes, indicating that more manipulation must be done than simply activating a promoter sequence or the demethylation of another sequence. The research completed thus far indicates that there is potential for the modification of the homeotic processes in B. rapa to allow for the increased tolerance and accumulation of minerals. (Wu). These vegetable and fruit enhancements provide a basis for the correction of micronutrient deficiencies, as well as the production of a sustainable agricultural system in which produce can be grown without the addition of chemical fertilizers.

Comment [MSOffice1]: I don't know what this is supposed to mean. It is confusing.

In addition to the correction and enhancement of individual problems that afflict certain plant species, a broader look must be taken to see the ways that crop biology can develop a sustainable agricultural system. This is critical to the improvement of Thailand's position to become a leader in productivity to the status of developed country. Currently much of Thailand's success and self-sufficiency has come not from increased productivity based on either crop biology enhancements or chemical fertilizers, but instead from putting more land under cultivation. However, much of the land that is being forced into production is marginal land at best, and is not prepared for the demands that are made by the rapid use and double cropping techniques that are common Thailand's more rural areas. Even more so the marginal land is prone to soil erosion that causes detrimental effects to the more productive areas along the river basins (Roonnaphai). For many of these marginal farms, the impoverished farmers have no other place to grow their crops, and so they proceed to use what land they have available without regard for proper techniques to prevent soil erosion and increase nutrient availability. In order to grow rice, paddy fields are flooded to soak the ground and provide water for the fast maturing rice crops; but then the water is drained off and not used again. This method of paddy flooding wastes much of the water that could otherwise be utilized in a system of irrigation that results in the application of the remaining water to a more diverse range of crops (Khan).

Many of the farmers in addition to growing cereals and fruits as the majority of their diet raise livestock to supplement their protein needs. Animals, however, consume far more biomass than they produce in the form of edible protein. This leads to a controversy of whether to raise animals or to put that land that would be used to graze them into production with other plant crops that provide a greater direct nutrition. As a compromise, recent studies have demonstrated that unconventional plants, such as cassava can provide protein supplements for livestock. The cassava's foliage has been shown to replace other protein supplements in cattle, goat and swine diets due to its equivalent of 4 tonnes of protein a hectare when it is managed as a perennial forage, with the leaves harvested every eight to ten weeks. This is an important addition to a sustainable agricultural system because the manure produced by the livestock can then be recycled back to the cassava plant, mitigating the nutrient draw from the surrounding soils (Preston). By not harvesting the tubers, the plant can sustain the cropping as forage for approximately three years, then after that the tubers can be extracted and sold either to commercial industries for conversion into cassava chips and pellets for export or processed into a tapioca flour to be used in the home (Preston; Roonnaphai). The planting of the cassava also acts a soil cover that holds down the soil and prevents erosion that detracts from the already marginal nutrient value of the land on which it is grown. Cassava is able to provide this necessary function due to the large drought resistant properties present in many of the varieties, enabling it to survive when many other soil covers would perish (Zhang).

In addition to the including novel crops to improve the sustainability of an agricultural system, occasionally, entirely new approaches must be taken to produce sustainable environments that can continue to produce the necessary crops in the coming decades. TIn order to preserve the nutrients that are left in the soil after harvests, and not be removed by erosion, soil cover must be left on the field. In addition to providing cover to the already present nutrients, the cover contributes greater nutrients as the microbes in the soil break down matter, releasing nutrients by the next planting season. Soil cover is either implemented by leaving crop residue such as stalks on the land or by rotating crops and planting a green manure between seasons of the crops grown for consumption. Often times legumes are grown as a cover crop to fix nitrogen in the soil, and then the plant is killed to allow it time to be reabsorbed into the

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grown cover before the next cropping season (Hobbs). Through these methods a sustainable system can be achieved by which food production can be sustained for the coming decades.

The advancement of agronomic techniques will lead to the improvement of many living conditions and lifestyles of many rural subsistence farmers in the poorest parts of Thailand. The development of genetically engineered strains of crops allows for the farmers to improve their lifestyle. The engineered crops allow the farmer to gain a superior yield through either the enhancement of the crop's grain yield, or through a resistance to disease or other pests. The control of pests that plague the crops through the use of the biological deterrents in the form of proteins gives the farmer a twofold enhancement; the lack of pesticides used on the field provides extra monetary value that he can invest in other areas in order to diversify his holdings as well as to provide an innate resistance to detrimental pests. Furthermore, the biofortification of various a species of crops provides a large basis of nutrient enhanced foods that allow farmers to gain all the necessary nutrients the body needs. The use of marginal crops to provide desertification prevention and feed stock represents and ingenuity for the adoption of radical techniques that in many ways defy the local traditions on crop and animal husbandry. The advances that are made in crop biology and agronomic techniques grant rural subsistence farmers the means by which they can become independent, The improvement of the farmers harvest capacity, allows the surplus food stores to improve the physical well being of the nations urban poor through the diffusion of excess products. Thailand is a burgeoning nation that through the use of advanced biotechnology applications can continue to support and stabilize its growing populations need for sustenance.

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