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# Introducing Fortified Rice in Cambodia and Vietnam

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# I. INTRODUCTION

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Despite rice production surpluses and considerable improvements in overall nutritional status and living conditions over time, many Cambodians suffer from malnutrition and food insecurity. Insufficient micronutrient intake, especially of iron, Vitamin A, and iodine, is a contributing factor to high morbidity and mortality rates among Cambodia's women and children. According to the World Food Programme, almost 40% of children are chronically malnourished and maternal mortality is 472 per 100,000 live births.<sup>1</sup> Cambodia's maternal and children-under-five mortality rates are among the worst in Southeast Asia.

The most disturbing finding is that Cambodian women of reproductive age and children under five who are most in need of micronutrients are the least likely to receive them (Johnston and Conkle 2008). Micronutrient delivery interventions vary greatly by province and socio-economic status. The current Ministry of Health (MoH) goals for vitamin A and iron supplementation focus on overall coverage, a strategy which overlooks the individuals who need these interventions the most. This stems from the fact that the targeted populations are not easy to reach.

To address micronutrient malnutrition, PATH is interested in incorporating micronutrient-fortified manufactured rice grains into Cambodian and Vietnamese social sector programs. Both Cambodia and Vietnam have very high rice consumption. Current health systems mostly promote micronutrient supplementation but recently there has been an increased interest of fortified foods as a potentially effective avenue to reach the most vulnerable populations.

In order to help PATH assess the probability for success of a rice fortification project in Cambodia and Vietnam, a feasibility study was conducted by the author, a Yale School of Management intern.

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<sup>1</sup> "Cambodia Overview," World Food Programme website, accessed 2 August 2010, <http://www.wfp.org/countries/cambodia>. Data source: Ministry of Planning, Cambodia Demographic and Health Survey (2005) and Cambodia Anthropometric Survey (2008).

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## II. BACKGROUND

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### A. CURRENT MICRONUTRIENT DEFICIENCY STRATEGIES IN CAMBODIA

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#### Vitamin A Supplementation

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Preventive vitamin A supplementation began in Cambodia in the mid 1990s and since then, vitamin A supplementation for children and post-partum women have been integrated into routine outreach activities. Vitamin A is distributed through health centers, hospitals, and routine monthly immunization outreach.

Key Findings from Johnston and Conkle (2008):

- Children from households of the poorest wealth quintile and those whose mothers were uneducated to the least likely to ever receive any vitamin A supplementation. Women of the poorest wealth quintile and those who were not educated were the least likely to ever receive post-partum vitamin A supplementation.
- There is significant variation of vitamin A supplementation by province. Surprisingly, urban areas do not achieve high coverage rates. One conjecture is that caretakers in those areas have to work outside the home and may be too busy to prioritize vitamin A supplementation.
- There is a trend of declining interest and involvement with vitamin A supplementation after the child reaches one year of age.

Key Takeaways:

- Special efforts have to be made to reach the poorest and least educated.
- Distribution of supplements has to be more uniform across the country.

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#### Iron Supplementation

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There is currently no national policy or commonly implemented intervention to treat or prevent iron deficiency in infants and young children, despite anemia in children being a documented long-term severe public health problem in Cambodia. Iron/folic acid tablets were made available in 2007 through hospitals, health centers, and outreach activities (MoH 2007). Pilot projects have been conducted on fortifying fish sauce and providing supplements to secondary school girls, factory women and rural women of reproductive age, but neither are national programs.

Key Findings:

- Iron supplementation has had only limited success due to inadequate knowledge on the importance of iron among vulnerable populations and an irregular supply of iron tablets.

- Consumers have noticed that iron-fortified fish sauce leaves a thick residue if not used right away.<sup>2</sup> While wealthier Cambodians have the luxury of tossing out the product, poorer Cambodians do not and so they are wary of purchasing the item.
- The most popular fish sauce producer in Kampot province is Ngov Heng. Ngov Heng supplied the iron-fortified fish sauce in the pilot study as well as supplying the local market with unfortified fish sauce. However, iron-fortified fish sauce was priced at a much higher price than unfortified fish sauce, making it difficult for the truly needy to purchase the fortified product.<sup>3</sup>

#### Key Takeaways:

- Utilization of iron supplementation increased but poor compliance continues (Johnston and Conkle 2008).

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### Iodine Supplementation

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Fortification of salt is the only iodine intervention in Cambodia. Iodized salt production began in Cambodia in 1999 but universal salt iodization was not signed into law until 2003.

Salt was an easy food to choose for fortification because it satisfied two conditions: 1) consumption of salt is high in Cambodia, and 2) all salt in Cambodia comes from the Kampot region, making it logistically easy to fortify salt.

#### Key Findings:

- Iodized salt is available in markets, but its cost is prohibitive. In Svay Rieng and Prey Veng, non-iodized salt in the market costs about 150-200 riels/ kilogram (4-5 US cents). Iodized salt costs from 800-1,000 riels/ kilogram (20-25 US cents) (Johnston and Conkle 2008).
- The majority of salt comes from the region around Kampot yet Kampot was found to have the lowest levels of iodine deficiency in school children in 1997 (Johnston and Conkle 2008). Because salt is so plentiful and cheap in Kampot, Cambodians who live there have no incentive to purchase iodized salt.
- Provinces that border Vietnam also do not have full iodized salt coverage because unfortified salt can be smuggled into Cambodia from Vietnam.<sup>4</sup>
- In 2009, Cambodia suffered a salt shortage due to heavy rains and had to buy unfortified salt from Vietnam.<sup>5</sup>
- At first, Cambodians did not want to use iodized salt because they wanted to stay true to traditional recipes. Also, even though education campaigns were implemented, they were unsure about what to believe. Some thought that if you left the salt out without covering it, the iodine would disperse.<sup>6</sup>

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<sup>2</sup> Food Fortification Meeting held by the Ministry of Planning, translation by author, 9 June 2010, Phnom Penh, Cambodia.

<sup>3</sup> Srun Darith (CARD), interview with author, 20 July 2010, Phnom Penh, Cambodia.

<sup>4</sup> Srun Darith (CARD)

<sup>5</sup> Srun Darith (CARD)

<sup>6</sup> Food Fortification Meeting.



## Key Takeaways:

- There has been an increase in household use of iodized salt since 2003, but problems remain in border areas.

## B. CURRENT STATUS AND DEVELOPMENT OF RICE FORTIFICATION

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With the exception of salt fortified with iodine, there are currently no other government mandates for food fortification. However, since 2008 the Government has seriously started discussing a social protection strategy for the most vulnerable that would cover distribution of food to vulnerable groups such as school feeding programs, food-for-work, and food rations.<sup>7</sup> With help from the Emergency Flood Assistance Project (EFAP) of the Asian Development Bank (ADB), the Council for Agricultural and Rural Development (CARD) developed a social protection strategy that was finalized in June 2010 and is currently awaiting endorsement from the Council of Ministers.

The issue of food fortification is also addressed in the Strategic Framework for Food Security and Nutrition in Cambodia 2008-2012 (SFFSN) in Objective 3: Food insecure households improve the use and utilization of their food resulting in reduced malnutrition, morbidity and mortality, particularly among women and children.

CARD plans to conduct a mid-term review of the framework and review goals and objectives. They will use the outcome of the review to offer recommendations to update the strategy framework for the next time frame.<sup>8</sup> Now is an opportune time for health advocates to start building strong momentum around food fortification.

## C. FOOD DISTRIBUTION PLATFORMS

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### Government

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The Government of Cambodia does not have a public feeding program but with help from its development partners, Cambodia contributes to food aid distribution during times of crises, be it natural disasters or economic market forces. Green Trade Company (GTC), a state-run enterprise, is responsible for purchasing and storing the national rice reserves required under the ASEAN Food Security Reserve. In 2008, when rice prices reached an all-time high, the government released rice from its national reserve in order to stabilize prices. The Government appears to be working on strengthening the food reserve to meet any disaster needs.<sup>9</sup>

The Government also purchases domestic and imported milled rice for the army and police from one supplier, Men Sarun Import & Export Company, who in turn procures rice directly from other mills if they cannot meet the government's demand.

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<sup>7</sup> Biranchi Kumar Choudhury (EFAP), interview with author, 14 June 2010, Phnom Penh, Cambodia.

<sup>8</sup> Srun Darith (CARD).

<sup>9</sup> Biranchi Kumar Choudhury (EFAP).

The United Nations World Food Programme (WFP) operates in 78-80 countries and provides food aid and food assistance over 100 million people (figures as of August 2010). They have 14 country offices in Asia and procure a significant amount of food there. There are three different ways that WFP procures food: 1) locally, 2) regionally, and 3) internationally. In 2008, of 4.5 million metric tons of food, 1 million metric tons was procured in Asia; 400,000 metric tons of food was procured just in Bangkok.<sup>10</sup> Rice is procured from India, Pakistan, Vietnam, and Thailand and is WFP's largest procured item, representing 10% of all procured foods.<sup>11</sup>

In Cambodia in 2009, WFP purchased 14,000 metric tons of rice at a cost of \$5 million (typically WFP purchases between 20,000-25,000 metric tons of food at a cost of \$5.3 million). From January 2010 until June 2010, WFP purchased over 8,000 MT of rice and sugar at a cost of \$2.9 million. In the peak season, WFP typically pays approximately \$330 per ton, and in the off-season (August-November), WFP can pay as much as \$450 per ton of milled rice.<sup>12</sup>

Food items are procured through a bidding process:

1. WFP solicits procurement bids
2. WFP visits factories/sites to determine whether the vendors are reliable, able to follow all procurement rules, are reputable, etc.
3. WFP puts together a preselected roster of vendors that they use throughout the year(s)
4. Preselected vendors bid on a tender and whichever company comes in with the lowest bid gets the contract.

WFP has at present a roster of 19 preselected rice milling vendors and splits the tender among them.

WFP activities reach close to 1 million food-insecure people per year in rural Cambodia. The overall goal of WFP's assistance in Cambodia is to improve food security and nutrition for the hungry poor by building longer-term social capital and physical assets, but also by building models and strengthening capacities that promote the development of sustainable national food security systems. Under the Country Programme 2011-2016, resources are allocated to interventions in Education, Nutrition and Productive Assets/Livelihoods Support. Provision of time-critical food security information through Vulnerability Analysis and Mapping (VAM) is also a key activity.<sup>13</sup>

#### COMPETITIVE MARKET FOR RICE

WFP is concerned with managing donors' funds, being cost effective with the funds, and distributing the right items to the right beneficiaries. When purchasing rice, WFP looks at the cost, the nutritional value, quality, and if purchasing regionally or internationally, how similar the rice is to local rice in Cambodia (an example of an indirect cost).

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<sup>10</sup> Shane Prigge (WFP), in meeting with author, 9 July 2010, Hanoi, Vietnam.

<sup>11</sup> Chandan Shrestha and Lamine Phe (WFP), interview with author, 15 June 2010, Phnom Penh, Cambodia.

<sup>12</sup> Chandan Shrestha and Lamine Phe.

<sup>13</sup> WFP Cambodia Website: <http://www.wfp.org/countries/Cambodia/Operations>

In general the WFP tries to buy from the region in which the rice is needed. However, price is a major factor in WFP's decision. Because WFP purchases big quantities, it compares the price of rice in Cambodia with that of the international market. If the rice is expensive in Cambodia relative to other countries, WFP will purchase rice elsewhere.

In addition, WFP is funded by voluntary contributions from public and private donors, and contributions can be either cash or in-kind donations. Some countries, like the U.S. and Japan prefer to donate in-kind, but often WFP could get more value for their money by purchasing in-country mainly because transportation costs would be cheaper.

Through WFP's Internal Nutrition Improvement Approach, WFP now prioritizes purchasing fortified food commodities, e.g. fortified oil, flour, and salt when possible.

#### MOVING FROM FOOD AID TO FOOD ASSISTANCE

WFP's overall goal in Cambodia is to assist the government to reduce food insecurity among the poorest and most vulnerable. The government currently has a poverty reduction policy in place called the National Strategic Development Plan 2009-2013 as well as a Strategic Framework for Food Security and Nutrition 2008-2012. WFP is moving from food aid to food assistance, which, in addition to food, includes a broader range of transfers such as cash and vouchers. Along with food assistance, it is providing technical assistance to the government to take over operations and building the government's capacity to manage programs and logistics.

#### POTENTIAL CHALLENGES WITH FORTIFIED RICE

- Maintaining a competitive process: if WFP requires rice to be fortified, at least a minimum of 3 suppliers would need to have capacity to produce or blend fortified grains with traditional rice;
- Capital Expenditure: If blending were to be done at WFP's warehouse, financing for this equipment, as well as staffing would need to be addressed. Also, if their programs move away from rice distribution, the equipment could potentially lay idle. However, the ideal scenario would be for the Cambodian rice milling industry to take this on and invest in the necessary blending equipment to enhance (i.e. fortify) their products.
- Dietary diversification: For programs where food baskets are distributed, they often include rice and vegetable oil. It optimizes these meals based on calories and micronutrient content. It needs to be determined that fortified rice would be filling a gap in micronutrients that these meals do not provide and that its cost-effective. WFP's primary goal is to benefit the most number of people with its current resources.
- Irregular resource flows could result in a lag in procurement.
- In India, WFP's biggest challenge with fortified rice was monitoring whether the fortified rice grains were actually blended or sold in the black market.

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## E. RICE PRODUCTION & MILLING STRUCTURE

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### Paddy Rice Production in Cambodia

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Rice is Cambodia's main agricultural produce. According to Yu and Fan (2009) rice is cultivated primarily through traditional farming practice by over 80% of Cambodian farmers, of which 60% produce for subsistence needs.

The five main paddy producing provinces are Prey Veng, Takeo, Kampong Cham, Battambang and Banteay Meanchey (MAFF 2010, cited by ADI 2010). Together these provinces produce more than half of total paddy rice production in Cambodia. See Exhibit 1 for a further breakdown of rice production by region in 2008-2010.

For the 2009/10 crop year MAFF estimates a production of 7.25 million tons of paddy rice, of which 5 percent is reserved by farmers for seed, 3 percent for animal seed, and 7 percent lost to post-harvest losses. The remaining 6.1625 million tons of paddy is what is available for consumption. This available paddy is then routed through two parallel channels of distribution: subsistence production and commercially marketed production. It is estimated that approximately 50 percent (3.08 million tons) of available paddy is marketed commercially, which allows for 3.08 million tons to subsistence production (ADI 2010). See Exhibit 2 for a graphical representation of paddy rice distribution.

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### Subsistence Production

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Farmers bring subsistence paddy directly to either custom (village or home-based) mills or small commercial mills to be milled into white rice. The quantities milled by custom mills at any given time are small and frequent, depending on the farmer's consumption need. In return for free milling, the millers get to keep the bran (the layer in between the husk and the germ), which is used as animal feed. If the farmer wishes to keep the bran, they are assessed a fee of 500 Riel per 15 kg of rice (ADI 2010).

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### Commercially Marketed Production

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The marketed paddy channel starts with sales to either rice collectors (75% of farm sales) or directly to mills (25%) (ADI 2010). It is estimated that commercial mills only require 886,000 tons of paddy to meet per capita consumption requirements and the balance (2.19 million tons) is exported to Thailand or Vietnam (ADI 2010).

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### Rice Mill Industry

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The exact number of rice mills operating in Cambodia is hard to pinpoint because more than half (13,100) of the estimated 23,103 mills are not registered with the Ministry of Industry, Mines and Energy (ADB 2008). Due to registration barriers and little perceived benefit of joining the formal sector, many of Cambodia's enterprises, especially small rice mills, have remained informal.

There are two types of rice mills in Cambodia: custom mills and commercial mills. Custom mills, also known as village or home-based mills, are small operations that mill primarily for farmers' own consumption. Commercial mills produce rice primarily for the domestic and export market.<sup>14</sup>

A study by the Japanese International Cooperation Agency (JICA) found that almost 96% of surveyed mills were custom mills.<sup>15</sup> Prey Veng and Kampong Cham have the largest number of mills – well over 2,000 – while the majority of mills in Battambang province are commercial mills (JICA 2001, cited by ADI 2010).

#### CUSTOM MILLS

Custom mills are primarily used by subsistence level farmers. Each custom mill serves between 45-60 families. Two types of mills are used at the village level: a combined steel huller and polisher system that removes the husk and polishes the rice in a single operation; and a dual system that uses a rubber roller to remove the husk and steel polishers to remove the bran and polish the rice. See Exhibit 3 for technical characteristics of custom mills.

#### COMMERCIAL MILLS

There are four general classes of commercial millers: the very large and modern operators (only 3 - or 4 in Cambodia); large volume millers; medium size millers; and small millers. See Table 2 for milling capacities. See Exhibit 4 for technical characteristics of commercial mills.

Most commercial mills are small mills. One study found that in Battambang, of the 376 licensed commercial mills in 2001, almost half (184) were small, 105 were medium-sized, and 79 were considered large mills (ADI 2010). The same study found that in Takeo, of the 19 commercial mills in the province, most are medium and large mills, although maximum capacity is relatively small at 1.5 tons per hour. Only in Battambang province and Kompong Speu are there very large milling operations with hourly capacities of more than 5 tons (ADI 2010). See Exhibit 5 for rice mill capacities and Exhibit 6 for a breakdown of the number of rice mills by size and district.

### D. RICE AVAILABILITY AND DISTRIBUTION

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Most milled rice is consumed locally within the province it is produced, with medium and larger mills selling rice to traders with distribution networks outside the province, in Phnom Penh, and abroad.

Millers are often small wholesale traders. They will buy paddy, mill it, and then bag it in their privately labeled bags. They will then sell their products to wholesalers and traders, who then distribute milled rice to other wholesalers, retailers, institutions such as the Army/Police and WFP, and directly to end-users. Bulk rice is purchased by packers who then bag it for larger clients like supermarkets in the major cities (ADI 2010).

Imports of rice into Cambodia are small relative to domestic production and are procured primarily by development agencies. In addition, Cambodia annually imports an estimated 11,000 tons of

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<sup>14</sup> Currently, apart from one large commercial miller exporting aromatic rice to Malaysia, the EU, and the US, the rest of the milling sector caters almost exclusively to the domestic market, although there is definite investment and interest towards increasing exports.

<sup>15</sup> The JICA study identified 518 registered commercial mills and 12,198 custom mills in 2000.

high-quality milled rice from Thailand to meet the needs of high-income consumers in large cities such as Phnom Penh and Siem Reap (ADI 2010).

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## III. MARKET FEASIBILITY

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### A. CONSUMERS

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Consumers are more concerned with cost and quality rather than nutritional level, mainly because knowledge of nutrition in general is low. Consumers are particular about purity/color of rice and will pick out anomalies.

Cambodians first have to **UNDERSTAND** the benefits (with the help of advertisements and demonstrations, have to believe that it is **TRUE** (by taste testing it and seeing approval from the government), and **TRUST** your organization (team up with well-known and well-regarded NGOs) and safety of the product.

Key Takeaways:

- Need to educate consumers about general nutrition as well as benefits of fortified rice.
- It will take a long time for fortified rice to be incorporated into the fabric of Cambodia, but one way in which organizations can do that is by targeting young Cambodians. Through school feeding programs, education in schools, and advertisements, young Cambodians will recognize fortified rice as a brand and know about its benefit. When they start their own life, they will be more inclined to buy fortified rice.

### B. SELLERS

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Interviews with rice wholesalers in Phnom Penh revealed that some rice wholesalers and retailers would be interested in purchasing a small amount of fortified rice to test whether the product had any appeal with their customers.<sup>16</sup> One rice seller remarked that he would more likely to sell fortified rice if he saw ads for it on TV, radio, and other promotional materials. However, many people we spoke with firmly believed that the price of the fortified rice had to be on par with the price of traditional rice. If consumers become more familiar with the idea and the product, and if the product is endorsed by the Government, they will start to incorporate product gains familiarity and people start to like it, then sellers could slowly raise the price as consumers' willingness to pay increases.

Rice, like dairy, is a fast moving, consumer good. What turns a profit is high volume, low margin; however, Cambodians are looking for small volume, high margins. In the beginning, they might sell a small amount of the product at the suggested retail price. If many people purchase the product (let's say 50 items), they will think of capturing a higher profit by raising the price – but sales will decline.

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<sup>16</sup> Rice wholesalers/retailers, interviews with author, 8 June 2010, Phnom Penh, Cambodia.

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## C. FORTIFIED RICE AS A COMMERCIAL PRODUCT

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The population that needs fortified rice the most lives mostly in the rural areas but people who live there either get their rice from their own fields or from other rice producers in their community. On the other hand, the population that could afford fortified rice commercial product and would be interested in its health benefits live in the cities.

Looking purely at market forces and not at food subsidization, if a company or NGO wants to sell fortified rice to the poorest, most vulnerable populations the product has to be 1) affordable and 2) accessible (i.e. can they purchase it at a local market?). If a company wants to sell fortified rice as a premium product to urban consumers, the product 1) has to have a different appeal – a luxurious or trendy product<sup>17</sup> and 2) cannot be a product that consumers can produce themselves.

Fortified rice can be made into a premium product – the value added could come from higher quality packaging, having less sugar, or adding calcium.

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# IV. TECHNICAL FEASIBILITY

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## A. APPROPRIATENESS OF RICE FORTIFICATION TECHNOLOGY

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Please see Exhibit 7 for a chart detailing appropriate extrusion technologies considering production needs and consumer preferences.

## B. CAMBODIAN RICE MILLS

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The JICA study found that the majority of the mills are of Chinese, Vietnamese or Japanese manufacture, being imported from Vietnam (57 percent) and China (30 percent) with Japanese machinery imported via either Vietnam or China (JICA 2001, cited by ADI 2010).

In Cambodia, there is very little secondary rice processing except to make rice flour, which is used for hand-made noodles and rice cakes for the restaurant trade. With the exception of Men Sarun, no other rice miller that the author visited in Cambodia processed other foods, possibly because millers in Cambodia have not yet transitioned from thinking of oneself as a rice miller/trader to food processor,<sup>18</sup> whereas Thai and Vietnamese millers have already started to make noodles.

See Appendix 1 for information on the rice mills that the author visited and Appendix 2 for a descriptive photo album of the visits. See Exhibit 8 for profiles of rice mills with milling capacity over 9 tons/hr, Exhibit 9 for places in the production process in which blending can be added, and Exhibit 10 for a list of upcoming ventures that can potentially produce fortified rice kernels.

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<sup>17</sup> One example is the case study of Dannon yogurt in Bangladesh. Through the Grameen Foundation, Dannon put nutrients into yogurt for their Bangladeshi market. They then positioned the yogurt as a luxury brand.

<sup>18</sup> Sovithea Khun and Baz Rozemuller (IFC), interview with author, 10 June 2010, Phnom Penh, Cambodia.



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## V. OPERATING FEASIBILITY

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### A. REGULATORY CLEARANCE AND IMPORT LOGISTICS

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#### Import Licenses

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For most goods, no approval is required to import goods into Cambodia as long as the importer is registered with the Ministry of Commerce. However, because fortified rice contains vitamins, permission from the Ministry of Health (MoH) is necessary. Import licenses issued by the MoH are valid for six months and extendable upon request.

If fortified rice is categorized as a pharmaceutical product, the licenses will be issued free-of-charge. However, any pharmaceutical product registered with the MoH is subject to a one-time fee of USD \$200 and requires a Certificate of Good Manufacturing Practice in accordance with WHO Standard Guidelines (Doing Business in Cambodia 2008).

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#### Ministry of Health Requirements<sup>19</sup>

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#### PRODUCTION OF FORTIFIED RICE IN CAMBODIA

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1. Import licenses of raw materials (e.g. vitamins)
2. Certificate related to hygienic control at rice mill
3. Certificate of Analysis of finished product
4. Samples (3 units)

#### IMPORT OF FORTIFIED RICE

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1. Free Sale Certificate issued by government agency
2. Certificate related to hygiene condition of mill
3. Certificate of Analysis of finished product
4. Samples (3 units)

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### B. IMPORT DUTIES & FEES

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Importers have to pay three types of duties and taxes: custom duties, special tax for certain goods, and value-added tax (VAT).

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#### CUSTOMS IMPORT DUTY

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<sup>19</sup> Document from Ministry of Health, sent to author on 2 July 2010.



Import duties are levied on all imported goods, with the exception of goods that qualify for special privileges (see first bullet below).

There are five major duty rates for imported goods which are subject to the following rates:<sup>20</sup>

- 0% for exempt goods (agricultural equipment and inputs, school materials and equipment, pharmaceutical products, and sporting goods)
- 7% for primary products and raw materials
- 15% for capital goods, machinery and equipment, locally available raw materials
- 35% for finished products, alcohol, petroleum products, vehicles, precious metals and stones.

According to Noli Jocson of So! Nutritious (interview with author on 14 June 2010), if an organization or company receives a permit from both the Ministry of Health and the Council of Development of Cambodia (CDC), import duties will be waived.

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### TAXES AND SURCHARGES

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Camcontrol collects a fee of 0.1 percent on the value of all imported goods.

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### VALUE ADDED TAX (VAT)

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Cambodia applies a 10% flat rate of VAT on imports from all sources. The only exception is agricultural equipment and inputs which are subject to 0% VAT. A fee of 15,000 Riels (~\$4) is charged per import declaration (Doing Business in Cambodia 2008).

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### DECLARATIONS

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Cambodian customs requires importers to lodge declarations accompanied by the bill of lading/airway, commercial invoice, packing list, insurance, inspector report of finding where applicable, and other documents if required, e.g. licenses, certificate of origin, etc. Lodgment fees for imports or exports are \$40 (Doing Business in Cambodia 2008).

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### PRE-SHIPMENT INSPECTION PROGRAM

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A container worth a minimum of \$4,500 must undergo a pre-shipment inspection. Importers have to pay fees for this service. Regulation on the Implementation of PSI Services can be found at [www.customs.gov.kh/regulation.pdf](http://www.customs.gov.kh/regulation.pdf). Grants in-kind and goods shipped for government use under government order are exempt (Doing Business in Cambodia 2008).

Details on import and export clearance can be found at [www.customs.gov.kh](http://www.customs.gov.kh).

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<sup>20</sup> General Department of Customs and Excise of Cambodia website, accessed on 12 July 2010, <http://www.customs.gov.kh/>

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## VI. VIETNAM

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There are high malnutrition rates in the rural and mountainous provinces. People in the mountainous areas are iron-deficient. In the North, they are selenium-deficient. More generally, Vietnamese people suffer from zinc and vitamin A deficiency.<sup>21</sup>

Up until now, there has been no survey conducted to establish thiamin, folic acid, and niacin deficiency. International Relief and Development (IRD), in partnership with the Global Alliance for Improved Nutrition (GAIN), started conducting a micronutrient deficiency survey in July 2010. The first result of the survey is scheduled to be released in October 2010.<sup>22</sup>

### A. CURRENT MICRONUTRIENT DEFICIENCY STRATEGIES

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#### IRON SUPPLEMENTATION

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In the case of fish sauce fortified with iron, GAIN provided initial funding for equipment and the iron compound free of charge to the manufacturer and also provided technical support. Consumers were expected to pay for the product. The National Institute of Nutrition (NIN) established a wide-spread education campaign to communicate the benefit of this product. The incremental cost was 500 Dong / ml of fish sauce, which is approximately 10 cents / liter. Once producers were no longer given free fortificants, they stopped producing the iron-fortified fish sauce.<sup>23</sup>

#### IODINE SUPPLEMENTATION

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The iodine salt campaign was very successful prior to 2008, at which time the Vietnamese government ended its funding. Salt samples were tested at multiple levels – at the household level, in storage, and on the factory floor. Preventative medicine entities and health centers were very vigilant about checking for iron deficiency in their patients. In 2005, 100% of salt was iodine; in 2008, less than 40% of salt contained iodine.<sup>24</sup> Counterfeit products started to appear on the market and consumers became nervous about the quality and authenticity of the product.

#### FLOUR FORTIFICATION

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In the case of flour fortification in Vietnam, GAIN provided initial funding for equipment and the fortificants as well as technical support to manufacturers. Even though fortifying wheat flour cost less than 1 cent, producers were not willing to eat the cost. There was only one mill that produced fortified flour voluntarily for the export market but is not currently in production.

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<sup>21</sup> National Institute of Nutrition (NIN) Meeting, 7 July 2010, Hanoi, Vietnam.

<sup>22</sup> Dr. Frank Wieringa (IRD), interview with author, 7 July 2010, Hanoi, Vietnam.

<sup>23</sup> NIN Meeting.

<sup>24</sup> NIN Meeting.

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## OTHER FORTIFIED FOODS

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High-calorie biscuits for the extremely malnourished population are fortified with Vitamin A. Vina Milk, a fortified infant formula, has been passed out in 8-12 provinces. NIN's campaign to introduce multi-vitamins in flour fortification has only been targeted towards country women. Fortified flour which is turned into noodles include zinc, iron, B1, B6, and B12.<sup>25</sup>

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## B. CURRENT STATUS AND DEVELOPMENT OF RICE FORTIFICATION

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Vietnam is interested in food fortification in general, especially food with additives, such as micronutrients in wheat. For the last five years, NIN has been working on regulations for rice fortification through MoH. Mandatory food fortification is now articulated in the new food safety law with overall focus on public health. Three conditions must be satisfied before fortified foods can be introduced into Vietnam:

1. Evidence that there is a nutrient deficiency in the country
2. Evidence that the fortified food is an effective method to address nutrient deficiency
3. Availability of distribution vehicle

Currently, NIN is waiting for the legislation to be formally approved by the National Assembly. After it is approved, MoH will start to prepare regulations to guide implementation of mandating iodine salt and flour fortification.

Flour fortification is more logistically feasible than rice fortification because there are only twenty flour mills in Vietnam. The challenge with fortifying rice is that it is a decentralized industry of manufacturers as well as private households that produce for family consumption. However, the downside of flour fortification is that it will not reach the most vulnerable populations – 60% of the poorest people do not consume a lot of flour.<sup>26</sup> Flour is mostly used in the city.

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## C. FOOD DISTRIBUTION PLATFORMS

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There is no national food distribution program in Vietnam. The government will subsidize food during emergency situations using their extensive distribution networks and in the past has subsidized iodized salt for severely malnourished populations. Unlike in other countries like in Cambodia, Vietnam NGOs do not have the logistical system to deliver food on a national scale. USDA has a school feeding program which consists of soybean milk distribution in four poor provinces and USAID currently provides food as part of a package to those living with HIV. Hue, a city in central Vietnam, provides regional food aid.

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## D. DEVELOPMENT AGENCIES IN VIETNAM

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WFP<sup>27</sup>

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<sup>25</sup> NIN Meeting.

<sup>26</sup> NIN Meeting.

<sup>27</sup> Shane Prigge (WFP).

Since 2001, WFP has not operated any programs in Vietnam, but procures rice in big quantities from Vietnam. The purchased rice is distributed all over the world. Of 400,000 metric tons of rice procured last year, 30,000 metric tons were from Vietnam.

WFP's interest is identifying foods for nutrient delivery. Their corporate policy is to fortify at least 80% of the foods they distribute in an attempt to improve the quality of food in a cost-effective manner. The bulk of food commodities are cereals, vegetable oil, and the high-energy biscuits.

WFP's visit to Vietnam in July 2010 was a preliminary assessment of what opportunities exist in Vietnam for fortified rice production. Currently, WFP has only validated one exporter for fortified rice in Thailand. They are interested in the production aspect of fortified rice insofar as they want to develop a list of pre-approved fortified rice suppliers. While WFP's focus is to procure rice for export to programs in other countries, the building of capacity for production of fortified rice for other uses (like domestic programs) is a positive side effect.

The purpose of the visit was to get answers to the following questions:

- How do they bring vitamins and minerals into Vietnam, blend it with traditional rice, and then export it?
- Does the government-owned food processors (VF1 and VF2) have the facilities and the ability to get the inclusion rate correct? Is the company already mixing different grades of rice (broken rice) for export purposes?
- What documentation is required? What regulatory and mechanism barriers exist?

WFP is very committed to producing fortified rice and has been working with other entities to:

- Develop product specifications – this is an internal procedure to WFP, and should be finished in a few months. This will allow WFP to communicate their exact needs to fortified rice producers in terms of nutritional content needed, approved manufacturing protocol, hygiene, etc.
- Figure out how to get vitamins into Vietnam – how to import micronutrient kernels for blending into rice (regardless of how they were created) rather than just a vitamin and mineral premix
- Engage suppliers on blending, facilities, validating the process, and meeting product specifications, which includes
  - Ensuring the correct inclusion rate, and
  - Producing homogenous fortified rice kernels
- Streamline export process – work with different government entities<sup>28</sup>

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## UNICEF

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<sup>28</sup> The ideal situation is if rice suppliers import the vitamins but as food processors, rice suppliers do not usually deal with the Food & Drug Administration. This process will be different for each country. WFP will have to figure out how to register the product depending on its classification (as a food item, an ingredient, a pharmaceutical, etc.) and then determine the appropriate method for legally exporting the product.

UNICEF has advocated for a legal basis for salt to be mandatorily iodized (again) and for mandatory flour fortification. They have focused their support on vehicles where the technology is available for fortification at scale and foods that are centrally produced.<sup>29</sup>

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## E. FORTIFICATION TECHNOLOGY

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The following technologies are available in Vietnam: spraying salt with iodine, mixing nutrients into fish sauce, and iron tablets.

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### CURRENT PRICES

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Fortifying wheat flour costs \$5-6 per metric ton. Currently, estimates for fortifying rice are between \$10-\$40 per metric ton. Many stakeholder feel that the cost of fortifying rice should be below \$10 per metric ton in order to be competitive with other fortification approaches.

In addition, the price of fortified foods increases once it becomes a commercial product and it is difficult to get the price back down again. When a company is helped by the government and global organizations to fortify foods, it will be sell the product for \$1.20/ kg. The same company will sell the product commercially for \$3.50/ kg, which is pure profit.

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## E. FOOD PROCESSORS VISIT

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In Vietnam, the research team visited five food processors: Vietnam Northern Food Corporation (VF1), Vietnam Southern Food Corporation (VF2), Fudo Company, GreenFood Joint Stock Company, and Thien Huong Food Joint Stock Company.

Vinafood I and Vinafood II are government-owned enterprises with two main functions: 1) food security and 2) food trading. Having both food security and food trading goals means that both VF1 and VF2 not only has to worry about profit and loss, but they also have an objective to provide the people in Vietnam high quality and nutritious foods. Because of this objective, they are interested in fortified rice.

VF1 and VF2 have wide distribution channel that focuses on retailers. If living conditions improve in Vietnam, they will be able to sell fortified rice to the middle and upper classes.

Out of the privately owned companies visited, only Fudo expressed interest in fortified rice production. Please see Exhibit 11 for an analysis of each mill and Appendix 3 for a photo album of the visits.

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## F. OPERATING FEASIBILITY

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### REGULATIONS FOR PRODUCTION<sup>30</sup>

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VFA's processes for producing fortified and non-fortified foods are similar:

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<sup>29</sup> Roger Mathisen (UNICEF), in meeting with author, 8 July 2010, Hanoi, Vietnam.

<sup>30</sup> Le Van Giang (VFA).

	Fortified Foods	Non-Fortified Foods
Operating License	Obtain business license	Same
Government Approval	Get approval from MoH	Get local agency permit
Product Approval	Obtain Certificate of Product Analysis; send to authorities	Same
Quality Control	Inspection Cmte takes random sample; company pays for cost of lab test if anomaly is found in product	Same

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### IMPORTING LAWS<sup>31</sup>

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While there are restrictions on importing pharmaceuticals (due to pure rate of chemicals), there are currently no import barriers for vitamins (diluted rate of chemicals). To obtain approval for imported products, the importer must take random samples and test it, either in their own labs or externally. An official letter of the results then must be sent to the provincial office.

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## VII. ANALYSIS

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### A. CAMBODIA

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#### POLITICAL, ECONOMIC, SOCIO-CULTURAL, AND TECHNOLOGICAL (PEST) ANALYSIS

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##### POLITICAL

- *Corruption is the biggest deterrent to investment in Cambodia.* Institutionalized corruption makes Cambodia an extremely difficult country in which to do business. Importers frequently cite problems with undue processing delays, excessive paperwork, and formalities driven by excessive discretionary practices (D&B 2008).
- *Problem of coordination across ministries and government bodies.* Responsibilities for topic areas within the government often overlap.
- *Finances are dependent on international donors.* Donors have expressed concerns over governance procedures and the misuse of funds could lead to suspension of aid (D&B 2008).

##### ECONOMIC

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<sup>31</sup> Le Van Giang (VFA).

- *High operating costs.* Energy costs are higher in Cambodia than in Vietnam, especially those linked to generator-produced electricity, as are prices for diesel. A typical miller only uses diesel generators rather than electricity because the cost of electricity is almost double that of diesel, e.g. \$12.60/ ton of milled rice for diesel vs. \$23.80/ ton for electricity (ADI 2010). Therefore, the cost of milling rice in Cambodia is much higher than in neighboring countries.
- *High interest rates.* Most millers want to update and repair their machines to increase their profit margin but the high interest rates on bank loans prohibit them from borrowing capital. While interest rates in Cambodia are not that high compared to other developing countries, they are high compared with Vietnam and Thailand, Cambodia's major competitors. This means that, all other things equal, cost of production in Cambodia is relatively higher because of a greater cost of credit (ADI 2010).
- *Growing export market for Cambodian rice.* Rice exports rose to US \$21.1m in the year to June 2010, according to customs and excise results released by the Economic Institute of Cambodia (EIU 2010). Since November 2009, Cambodia has enjoyed duty-free trade to EU countries through the "Everything but Arms" agreement so there is definitely a big demand for Cambodian rice abroad. The government wants to encourage the export of milled rice overseas but Cambodia's legal framework has hindered this process and export shipping is expensive. The government is currently working on an export policy to make it easier to export goods. One example is reducing the time lag for certificate issuance.<sup>32</sup>

#### SOCIO-CULTURAL CONTEXT

- *Most Cambodian consumers are price sensitive.* Because 80% of Cambodians live in rural areas, and more than 30% live in poverty, price is the foremost concern. Unless the fortified rice is subsidized, many consumers will not purchase it. However, the middle class has expanded, especially in Phnom Penh, so there is opportunity for commercialization of fortified rice.
- *Majority of Cambodians lack knowledge about general nutrition.* They are mostly interested in eating enough to satisfy their hunger. Also, consumers are nervous about the thought of chemicals in food and will be afraid to eat the rice, unless a mass education campaign can dispel their doubts.
- *Preference for white rice grains.* Cambodians are particular about the color of rice. One worry is that Cambodians will pick out grains because it does not resemble traditional rice in color and feel. A majority of rice mills do not have color sorters so rice sellers will go through each bag of rice and pick out the bad grains. In addition, although some Cambodians know that brown rice is healthier, they do not choose to consume it because of its flavor and hard texture.
- *Habits are hard to change.* Changing behavior is difficult to do in Cambodia, especially for an unfamiliar product. Cambodians have a saying, "If they don't understand it, they won't believe you." Behavior modification can happen but it will take time to build awareness and confidence in fortified rice. Mass media is necessary to bring the message to consumers about the importance of both micronutrients and nutritious foods. When the salt iodization

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<sup>32</sup> Tes Ethda (Ministry of Commerce), interview with author, 15 June 2010, Phnom Penh, Cambodia.



campaign was first introduced in Cambodia, consumers would not consume iodized salt because they thought it was not tasty but they soon got accustomed to the taste.

- *Growing interest in organic rice.* According to Sahakreas CEDAC, the demand for organic rice is there but awareness about its benefits, price, and where to get it is not.
- *Easier for people to make choices about nutrition when their welfare improves.* For example, sanitation of water was a very recent phenomenon but with the rising middle class, it has become almost mainstream. When people don't have enough to eat, they don't have the luxury to make choices about what they eat.

#### TECHNOLOGICAL CONTEXT

- *Lack of processing capability.* Although Cambodia has more than 12,000 commercial rice mills, they are functioning at 60% capacity (ADI 2010).
- *Potential fortified rice producers limited.* Only one rice miller (Men Sarun) currently has the capability to produce fortified rice kernels.

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### SWOT ANALYSIS

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#### STRENGTHS

- *Development of social protection strategy.* CARD developed a social protection strategy that was finalized in June 2010 and is now awaiting endorsement. The strategy covers school feeding programs, food-for-work, food rations, cash-for-work, and public works.<sup>33</sup> Once a program is established, the government might negotiate with development partners like the UN, World Bank, ADB, European Commission, USAID, AusAid, and other bi- and multi-lateral entities to receive a program loan. In fact the World Bank has agreed to loan \$13 million to Cambodia for the purpose of continuing a social safety net program.<sup>34</sup>
- *Many commercial mills have blending capability.* Many commercial mills only require slight modifications to their milling system in order to blend fortified rice kernels with traditional rice grains.

#### WEAKNESSES

- *Food fortification not a priority.* Cambodia is much more focused on food security: 20% of Cambodians are food insecure even though there is approximately 3 million tons of paddy rice surplus.<sup>35</sup>
- *Reluctance to mandate rice fortification.* The government may be reluctant to enact legislation that mandates rice fortification because of its potential burden on the rice milling industry. In addition, rice millers can be a powerful lobbying force because many government officials own rice mills. It will also be difficult to convince the government to accept rice fortification with extruded kernels because the grains are artificial. Food security policies still have to take consumers' preference into consideration.

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<sup>33</sup> Srun Darith (CARD).

<sup>34</sup> Biranchi Kumar Choudhury (EFAP).

<sup>35</sup> Srun Darith (CARD).



- *No infrastructure or policies in place to enforce fortified rice standards.* There is currently no infrastructure or policies in place to ensure correct inclusion rate. Cambodia itself does not have established quality standards for rice.
- *Inefficient border administration.* Procedures to import are burdensome, numerous, and lengthy and high port costs
- *Limited logistics capabilities and transport infrastructure result in delays and high shipping costs.* Cambodia's overall infrastructure is poorly developed. Port facilities have been upgraded but are still inadequate while limited road and rail transportation networks suffer from a lack of investment (EIU 2008).
- *Structure of rice milling industry not cost-efficient.* Rice fortification would show better cost-efficiency if the rice industry were centralized and the mills involved had production capacities larger than 5 MT/hour (i.e., around 15,000 MT/year). Participation of small mills will not only introduce logistic difficulties but also will increase the cost of the program (ADI 2010).
- *Decentralized rice milling industry will hamper distribution.* In addition, rice milling machines have now become mobile in most provinces. Small machines are hitched onto moto-cycles and travel to different households. This will make it harder to guarantee that fortified rice will reach all consumers. Most rural consumers who grow their own rice find it cheaper to hull their own rice than to buy at the market. But in the lean season they face food shortages and will have to supplement their meals by buying rice from the market. Rice millers associations are often mentioned as an avenue for distribution but most of these associations exist for the export market, not for local consumption markets.
- *Rice is more difficult, and therefore more expensive, to produce than wheat or cassava.* In the old days, families used to make rice noodles for dishes like kuytiev (similar to pho) but once commercial production of rice noodles began, family production could not compete. The commercial products were often of lower quality and cheaper than hand-made noodles. Commercial producers were able to cut costs because of new technology and because they started using cassava as the base ingredient, which is much cheaper than rice.<sup>36</sup>
- *Some millers are reluctant to adapt to new technologies.* Transitioning from thinking of oneself as rice miller/trader to food producer is a novel phenomenon in Cambodia, whereas both Thai and Vietnamese millers have learned to use the rice to produce flour and noodles.

#### OPPORTUNITIES AND THREATS

- *Food distribution programs in Cambodia will be hard to fund in the future.* Cambodia is transitioning from a status of protracted relief and recovery operation (PRRO) to country program status. Opportunity: Cambodia will have access to more donations from development agencies to build their safety net programs. Threat: They will start to see a decline in the amount of donations they are able to secure. Food relief donors are more interested in funding acute emergencies because they can see immediate results.<sup>37</sup>

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<sup>36</sup> Srun Darith (CARD).

<sup>37</sup> Shane Prigge (WFP).

Many aid programs are slowly moving away from service delivery to capacity-building. As funding opportunities change for Cambodia (e.g. loans for safety net programs instead of grants), the government will seek public/private partnerships. Rice fortification is slowly being introduced into the policy conversations but the challenges of distribution and enforcement of standards will make it difficult to implement. As rice fortification becomes standard as a proven way to alleviate malnutrition and development agencies advocate for fortified rice, systems will be developed that will support its success. But in the meantime, educating stakeholders about rice fortification and keeping it on the government's agenda is still a valuable objective.

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## B. VIETNAM

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### SWOT ANALYSIS

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#### STRENGTHS

- *Ample processing capability.* Vietnam produces noodles for export so almost all of the manufacturers that the author visited would be able to produce fortified rice kernels and blend it with traditional rice.
- *VF1 and VF2 are very much interested in fortified rice.*

#### WEAKNESSES

- *Voluntary food fortification does not work.* In Vietnam, maintenance is very difficult for many social projects because of lack of money. The government and global funders will help set up markets, such as that for food fortification campaigns, but once the market is set up, relinquishes control over to the market players. Time and again, it has been shown that voluntary food fortification does not work.<sup>38</sup>
- *Quality control uncertain.* Vietnam at this stage does not have capacity to check quality of fortified rice although FAO has conducting a lot of food inspections for free. The government is committed to increasing the number of food inspectors, a little bit at a time, but it will take a while because the government is new to the food business (see first bullet in Opportunities section below).
- *Dependence on provincial health systems for monitoring purposes.* As an example, the provincial health staff in the north of Hanoi is well aware of iodine salt and has been proactive in developing a mechanism to monitor factories' production of iodine salt. Unfortunately, not all health systems in Vietnam are as diligent or have the capacity.

#### OPPORTUNITIES

- *New technology will help with inspection.* GAIN currently has a technique to check whether rice is fortified. It is small device with a cost of \$5,000 and will be available at the end of

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<sup>38</sup> NIN Meeting.

2010.<sup>39</sup> This will be extremely helpful as the government of Vietnam strengthens its food inspection task force.

Although Vietnam's processing capability for fortified rice exists, implementing a strategy for mandatory rice fortification will be a long-term goal because of the variety of micronutrient deficiencies being utilized and the necessity of securing government support.

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<sup>39</sup> Arnaud Lailou (GAIN), in World Health Organization meeting, 8 July 2010, Hanoi, Vietnam.

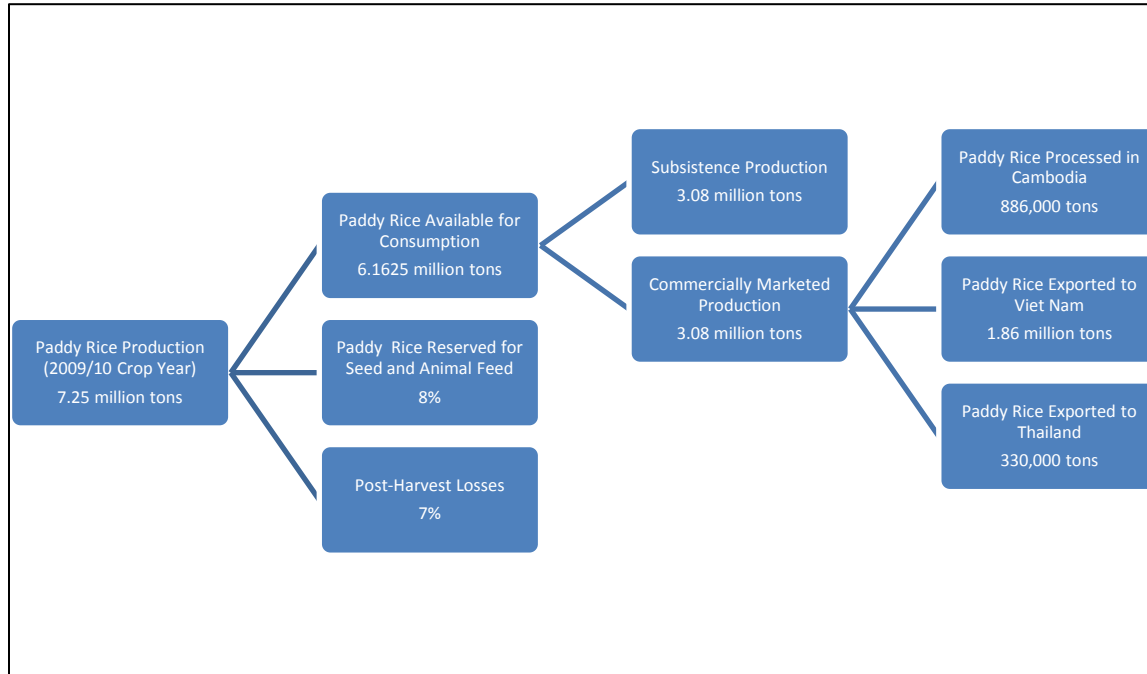
## X. EXHIBITS

### EXHIBIT 1. PROVINCIAL PRODUCTION OF RICE IN 2008-2010

Province	Total Production (Tons)	
	2008-2009	2009-2010
Banteay Meanchey	549,558	534,281
Battambang	672,669	703,331
Kep	7,833	9,179
Kompong Cham	700,593	759,528
Kompong Chhnang	359,678	378,495
Kompong Speu	245,950	272,669
Kompong Thom	435,818	488,832
Kampot	354,121	398,424
Kandal	364,350	384,812
Koh Kong	22,518	21,971
Kratie	112,062	112,425
Mondulkiri	29,932	33,166
Oudor Meanchey	104,526	110,323
Pailin	15,397	23,181
Phnom Penh	18,167	18,130
Preah Vihear	75,284	93,282
Prey Veng	994,495	989,566
Pursat	270,517	268,928
Rattanakiri	45,332	46,792
Siem Reap	413,124	473,812
Sihanoukville	31,380	38,050
Stoeng Treng	57,613	61,344
Svay Rieng	418,086	443,739
Takeo	875,965	921,588
<b>Total</b>	<b>7,175,449</b>	<b>7,585,850</b>

Source: MAFF 2008 and MAFF 2010, cited by ADI 2010

## EXHIBIT 2. PADDY RICE DISTRIBUTION



### EXHIBIT 3. TECHNICAL CHARACTERISTICS OF CUSTOM MILLS

Machine Type	Characteristics
Engerberg Compact Mill	<ul style="list-style-type: none"> <li>▪ Compact, low cost, easy to operate.</li> <li>▪ Made in China. Originally a coffee mil.</li> <li>▪ Processes paddy to white rice in one pass.</li> <li>▪ Processed husk sticks to white rice and increased production of broken rice.</li> <li>▪ Bran also contacts processed husk and quality of bran is low.</li> </ul>
Noda Compact Mill	<ul style="list-style-type: none"> <li>▪ Made in Vietnam. Husker is a copy of the Yanmar Model machine. Milling machine is a copy of Noda type.</li> </ul>
Satamar Compact Mill	<ul style="list-style-type: none"> <li>▪ Made in Vietnam. The milling section is equipped with an aspirator and a rubber roll type husking section is mounted.</li> </ul>
Rubber Roll Husker w/Engerberg Compact Mill	<ul style="list-style-type: none"> <li>▪ Rubber roll type husker above milling machine, compact with a common base.</li> <li>▪ Separates out husk from processing stage, but rubber roll becomes easily worn.</li> <li>▪ Friction type milling but one-pass milling so broken rice and whole grain not separated.</li> </ul>
Engerberg Compact Mill Husker w/Friction Mill	<ul style="list-style-type: none"> <li>▪ Uses Engerberg machine for husking rather than rubber roller and a Friction type mill for polishing.</li> <li>▪ Not compact, requires elevator for loading paddy.</li> </ul>
Rubber Roll Husker w/Friction Mill	<ul style="list-style-type: none"> <li>▪ Uses rubber roll husker and friction type mill.</li> </ul>

Source: JICA 2001, cited by ADI 2010

### EXHIBIT 4. TECHNICAL CHARACTERISTICS OF COMMERCIAL MILLS

Components	Characteristics
Pre-cleaner	<ul style="list-style-type: none"> <li>▪ Sifting type, air screen type not used. Cannot remove lighter paddy and reduces milling quality.</li> </ul>
Husker (stone type or rubber roller or both)	
Paddy separator	<ul style="list-style-type: none"> <li>▪ Table shifting machine type</li> </ul>
Milling machine (2-4 stage)	<ul style="list-style-type: none"> <li>▪ Vertical emery stone type. Number of milling machines increased as capacity of mill increases to obtain better recovery rates.</li> <li>▪ Vertical type more suitable for long grain rice, is durable and easy to operate.</li> <li>▪ Stone grinding, while removing the bran, damages the surface of the white rice and reduces the quality.</li> <li>▪</li> </ul>
Grader (sieve or indent type)	<ul style="list-style-type: none"> <li>▪ Some millers use length graders to meet demand for high quality rice.</li> <li>▪ Destoner or color sorter machine rarely installed.</li> </ul>
Scale	
Packing Machine	

Source: JICA 2001, cited by ADI 2010

### EXHIBIT 5. RICE MILL CAPACITIES

Size	Paddy Rice Processing Per Hour	Milled Rice Production Per Day
Custom Mill	< 500 kg <sup>40</sup>	< 1 metric ton
Small Commercial Mill	500 - 700 kg	4 - 5 metric tons
Medium Commercial Mill	700 kg - 1,200 kg	5 - 10 metric tons
Large Commercial Mill	> 1,200 kg	> 10 metric tons
Giant Commercial Mill	> 9 tons	---

Source: ACI 2002

### EXHIBIT 6. NUMBER OF RICE MILLS BY SIZE AND DISTRICT

Province	Mill Size				Total
	Village	Small	Medium	Large	
Banteay Meanchey	199	46	0	1	246
Battambang	328	23	0	0	351
Kep	121	0	0	0	121
Kompong Cham	2,429	1	0	0	2,430
Kompong Chhnang	823	0	0	0	823
Kompong Speu	2,306	1	1	0	2,308
Kompong Thom	4	3,787	2	1	3,794
Kampot	2,858	0	0	0	2,858
Kandal	1,550	0	1	1	1,552
Koh Kong	505	0	1	1	507
Mondulhiri	90	0	0	0	90
Oudor Meanchey	100	0	1	0	101
Pailin	1	0	0	0	1
Phnom Penh	17	0	0	1	18
Preah Vihear	3	0	0	0	3
Prey Veng	4,647	0	0	6	4,653
Pursat	1,685	0	0	0	1,685
Rattanakiri	2	0	0	0	2
Siem Reap	1,265	9	0	0	1,274
Stoeng Treng	5	46	129	3	183
Svay Rieng	908	0	0	1	909
Takeo	730	0	0	0	730
<b>Total</b>	<b>20,576</b>	<b>3,913</b>	<b>135</b>	<b>15</b>	<b>24,639</b>

Source: Stata output from ADI 2010 database, given to author by Tim Purcell of ADI, 30 July 2010.

<sup>40</sup> The JICA study found that the average capacity of village mills were 300 kilograms per hour (JICA 2001, cited by ADI 2010).

**EXHIBIT 7. APPROPRIATENESS OF EXTRUSION TECHNOLOGIES**

<b>Scenario</b>	<b>Coating</b>	<b>Cold Extrusion</b>	<b>Hot Extrusion</b>
Consumer Preferences	Will accept rice with color impurities and form inconsistencies  Will accept rice kernels that are different in appearance, with the knowledge that these kernels are the ones with additional nutritional value	Will accept rice with color impurities and form inconsistencies  Will accept rice kernels that are different in appearance, with the knowledge that these kernels are the ones with additional nutritional value	Will accept only rice with homogenous grains in form, size, consistency, flavor, and color  Will accept rice kernels that are different in appearance, with the knowledge that these kernels are the ones with additional nutritional value
Production Size	Small volumes	Small volumes	Large Volumes
Break-Even Demand of Rice Pre-Mix	> 300 MT/year (1 MT/day)	> 300 MT/year (1 MT/day)	> 1,500 MT/year (5 MT/day) Because investment is high
Production Capacity <sup>41</sup> MT/year	30,000-60,000	30,000-60,000	150,000-300,000
Investment Cost for Rice-Premix Factory	\$0.3 million	\$0.75 million	\$4.0 million

Source: AED 2008

<sup>41</sup> Production capacity is based on the size mentioned in the previous category and on a dilution factor of 1:100.



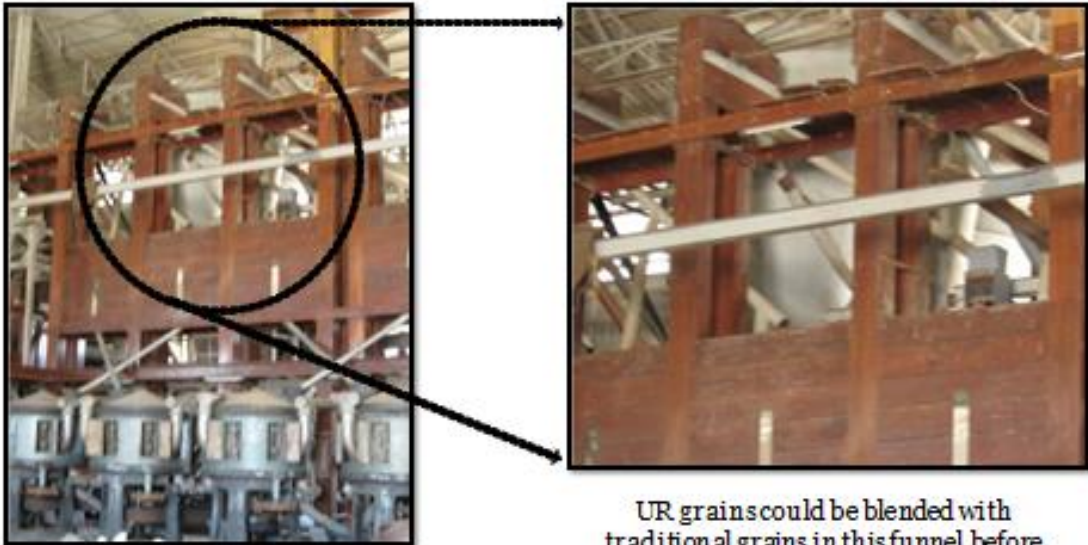
**EXHIBIT 8. CHARACTERISTICS OF RICE MILLS IN CAMBODIA WITH <9 TONS/HR CAPACITY**

<b>Company</b>	<b>Maximum Processing Capacity</b>	<b>Storage Capacity</b>	<b>Annual Production</b>	<b>Other</b>
Angkor Kasekam Roongroeung Co (Angkor Rice)	10 tons/hr (although only operating at 30% capacity)	30,000 tons of paddy	20,000 tons of paddy	
Golden Rice	10 tons/hr		12,000 tons of paddy (only de-husking – brown Jasmine rice is shipped to Reunion via containers where it will be milled and re-exported to the E.U.	
Green Trade Company	10 tons/hr (combined capacity of 6 rice mills, four of which are in PP) – operating at less than capacity, reported milling yields of 55-60%	56,000 tons (46 warehouses in 5 provinces)	5-10,000 tons	Highest quality is 10%
Lor Ngor Peng Rice Mill Co Ltd	12.5 tons/hr			
Loran Import-Export Co, Ltd	12.5 tons/hr (combined capacity of 4 mills)		20,000 tons of paddy	Produce 5% rice but most of their sales are under 15% under the “LH” brand)
Men Sarun Group	Largest mill: 24 tons/hr (operating 20 days each month) Other 39 mills: 1-2 tons/hr		Overall: 150,000 tons of paddy Main mill: 90,000 tons of paddy	
Phou Poy Rice Mills	9 tons/hr (combined capacity of 2 mills on the outskirts of Battambang City) – rice mills are operating only 7 days/month – can achieve milling outturn of 60-62%			

Source: ADI 2009

EXHIBIT 9. POTENTIAL POINTS FOR FORTIFIED RICE BLENDING

Lay Se Rice Mill




Polisher

UR grains could be blended with traditional grains in this funnel before the whitening stage

1

Lay Se Rice Mill



Color Sorter

It's hard to see but there is a bin to the left of the color sorter that can also be used to blend UR grains with the traditional rice.

27

## Loran Rice Mill



Milled Rice Holding Tank

This tank has a divider in the middle. UR can be placed in the left side and milled rice on the other side. The miller can use the levers attached to the front to control the proportion of UR to milled rice. UR can be blended with milled rice right before packaging.



Levers

28

## Duong Heng Rice Mill

The tank (Fig 1) is where milled rice is stored right before packaging. A smaller tank (Fig 2) is stored underneath and behind the holding tank (see Fig 3). The smaller tank is used for broken rice kernels to be blended with whole kernels based on the percentage of broken rice the customer orders. This smaller tank is a potential blending point.

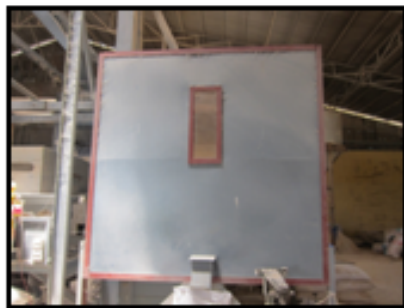


Figure 1: Front View



Figure 3: Side View



Figure 2: Back View

29

## Duong Heng Rice Mill

A storage tank with funnel can also be added at the top of the structure next to the holding tank. UR grains can then be mixed with milled rice right before processing.



Front View



Back View

30

## EXHIBIT 10. UPCOMING VENTURES

### Baitang PLC

Baitang, a project of the Cambodian Federation of Rice Millers, is a rice refinery created in 2008 as a mechanism to capture the value added of milling in-country. Baitang buys milled rice from small millers then processes it through its rice refining machinery, which takes out foreign matters and refines the rice to meet quality standards for export.

The Baitang plant currently houses a drying facility, a storage warehouse, and a reprocessing plant (which includes a precleaner, destoner, length graders, polisher, blender, and color sorter). Its output capacity is 720 tons/day, 70% of which is for export and 30% of which is for the local market. Since April 2010, rice has been exported to Australia, France, Germany, Italy, Singapore, and Spain.

A new rice mill is under construction near Battambang City which will have the capacity to mill rice at a rate of 20 tons/hr (200,000 metric tons/yr). The mill will eventually have rice husk burning equipment to supply the mill's energy needs.

Baitang does have the capacity to blend but wants to know the customers are. They won't know how much it costs to blend fortified rice because their technology is so new.

#### Cavifoods<sup>42</sup>

The Cambodia-Vietnam Foods Company (Cavifoods) is a joint venture between the Investment and Development Company of Cambodia (33% stake), Vietnam Southern Food Corporation (VF2) (37% stake), and Cambodia's Green Trade Company (30% stake). The Phnom Penh based facility will specialize in the investment, processing, storage, and exportation of rice. As of 25 January 2010, the company had been building a rice processing plant, warehouses, instant noodle and bread plants, and a rice purchasing network.

#### Paragon Corporation (ADI 2009)

Paragon was once involved in rice milling and trading but ceased operations to concentrate on property development and construction. When the real estate market crashed, Paragon began advanced negotiations with potential joint venture partners from the Philippines to build a major rice milling operation by 2011, including storage facilities in six different sites.

#### Yin Yang Rice Headquarters (ADI 2009)

Yin Yang, a Cambodian-French joint venture, is a rice refinery that polishes and refines milled rice for export (they do not mill paddy rice). Located in Sihanoukville Port, their processing equipment was supposed to be operational by mid-July 2009 with a capacity of 12 tons of milled rice/hr. I wasn't able to find more information about its progress.

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<sup>42</sup> "Cambodian Rice Venture Formed", Vietnam Net Bridge, Business in Brief, 25 January 10, <http://english.vietnamnet.vn/biz/201001/BUSINESS-IN-BRIEF-25/1-891445/>



**EXHIBIT 11. CHARACTERISTICS OF RICE PRODUCERS VISITED IN VIETNAM**

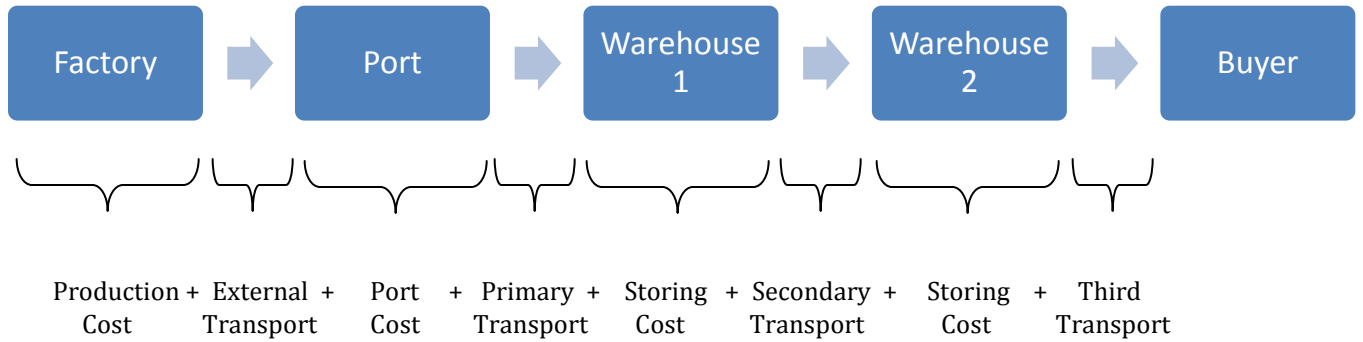
<b>Attribute</b>	<b>Vinafood I</b>	<b>Vinafood II</b>	<b>Fudo</b>	<b>GreenFood</b>	<b>Thien Huong</b>
Type		Public, large rice mill and other food firms. Has many member companies.	Private, small pasta firm	Private, large past firm	Private, large noodles and snack firm
Product	Rice, yellow maize, pepper, peanut, beans, coffee beans, sesame seeds, rice and wheat-flour based products	Fe-coated rice for the Philippines (2 yr shelf-life) (currently ban on imports), rice, yellow corn, tapioca chips, rice and flour-based products, wheat flour.	Macaroni, instant noodles, instant porridge, soup powders	Main product: noodles  Can also make macaroni. Owns a non-fried instant noodle technology patent	Instant noodles, instant porridge, snacks, soup powder, jelly, chilli sauce  Pasta seasoning is fortified with vitamins A and E.
Price			VND 17,000 or \$0.90/kg of macaroni		
Place		Most exports (60% of total VN rice exported). Trader for commercial markets	Regular distribution channels through distributors (stores and supermarkets)	Mostly exports to EU, Japan, and US. Last two years sold to distributors like any FMCG firm to retail to stores and wet markets	20% exports mostly to Holland, Malaysia, and Laos. Very little to Cambodia
RM Supply		Vertically integrated for rice	No discount on bulk purchase of milled rice	Import rice flour from Japan as VN rice has quality issues related to heavy metals	
Strengths for Fortified Rice Production		Has milling and noodle operations in Cambodia. Easy for scale-up as they have a food company in every	Willing to invest in extrusion equipment (moving to a bigger factory in 5 years); readily	Large manufacturer with a visible presence in VN commercial markets	Partnership with Govt. Govt buys instant noodles during emergency; have a high shear extruder

		province in VN. Relationships with VN and Philippines Govt.	available low-shear extrusion line		
Weaknesses for Fortified Rice Production		Need the govt or international agencies to build demand	Uncontrolled rice grinding and pasta drying steps. Need to invest in better equipment	Need to invest in extrusion production line	No commitment from top level to meet with research team

Source: Based on notes from Kalpana Beesabathuni, PATH, sent on 19 July 2010.

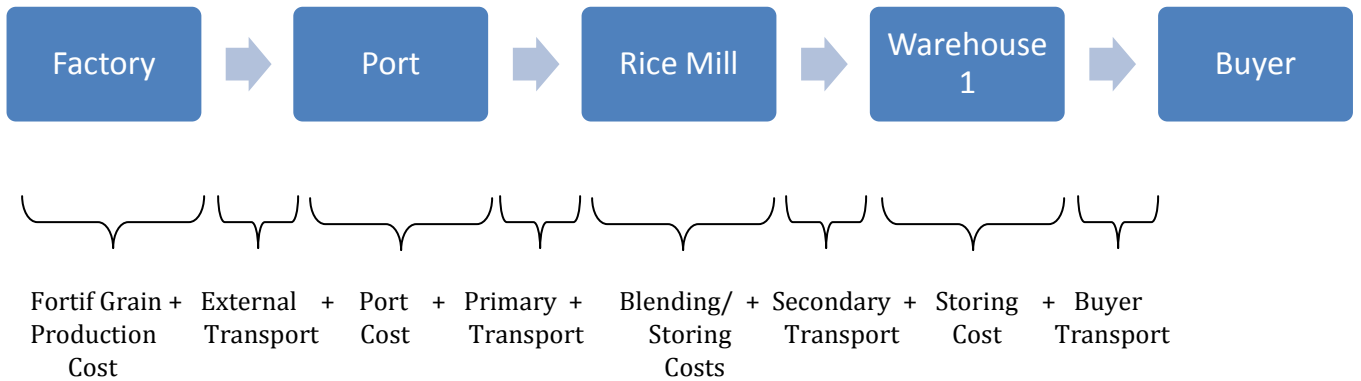
EXHIBIT 12: PRODUCTION OPTIONS IN CAMBODIA<sup>43</sup>

*Option 1: Produce and blend fortified rice grains in Vietnam*



Challenges: how to control quality in rice milling (staffing, lab tests)

*Option 2: Produce fortified rice grains in Vietnam, blend in Cambodia*

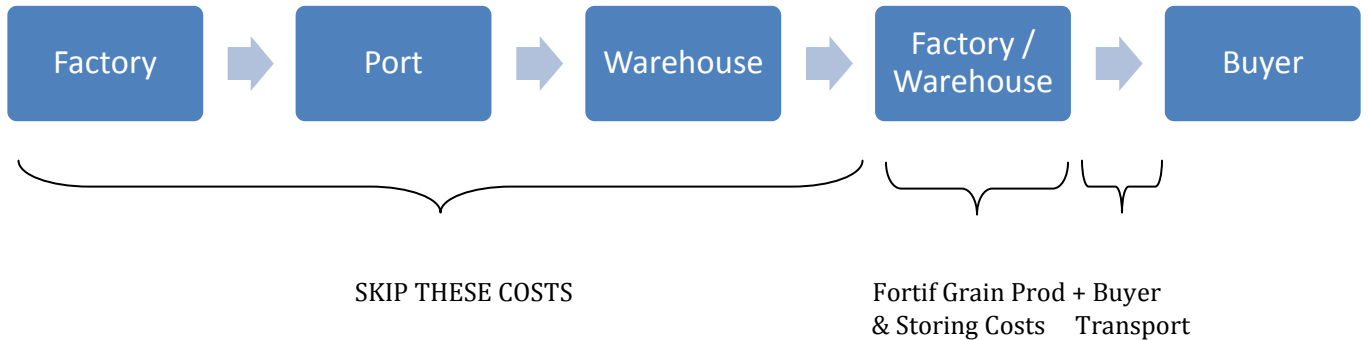


Challenges: how to control quality in rice milling (staffing, lab tests), how to build rice millers' capacity

<sup>43</sup> Eng Ly (WFP), interview with author, 15 June 2010, Phnom Penh, Cambodia.



*Option 3: Produce and blend Extruded grains in Cambodia*



*Option 1: Vietnam Production Pros and Cons*

Pros	Cons
No need to set up factory	Long transport time (1 week)
Better for short-term	Lost indirect benefits to Cambodia (jobs)

*Option 3: Cambodia Factory Pros and Cons*

Pros	Cons
Shorter transport time	Government regulations
Support Cambodia by providing jobs and building technical capacity	Long-term investment
Better for long-term (10 years +)	Need capital

Factory in Cambodia: Quick Numerical Example

Let's say that: External transportation = \$45 / MT

Primary transport = \$15 / MT

If in three years, PATH produces 60,000 MT of fortified rice, Option 3 will save

$$60,000 \text{ MT} \times (\$45 + \$15) = \$4.3 \text{ MM}$$

Eng estimates that a newly built factory will cost \$1.5 MM excluding land.

*Rough Estimation of Break Even Analysis*

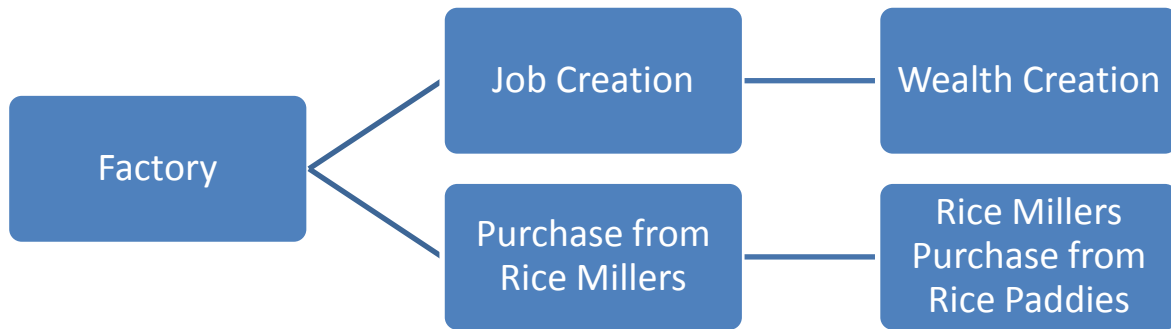
<b>Production Volume (Metric Tons)</b>	<b># of Years Until Break-Even</b>
60,000	3 yrs
15,000	6 yrs
10,000	10 yrs

If PATH is considering producing a small volume (10,000 MT or less), it will take a long time until the factory breaks even. However, if PATH is considering producing a large volume, the break-even point can be as little as three years.

Recommendation

Considering cost, transport time, and indirect benefits such as stimulating the Cambodian economy, Eng recommends that PATH procure local rice, set up a factory in Cambodia, then process in-country for the following reasons:

- More effective
- Less costly
- Easier to control quality and quantity (Q & Q)
- Factory in Cambodia would add value to Cambodia's economy, unlike a factory in Vietnam



At a minimum, Eng recommends that PATH set up a blending factory (to control quantity & quality, it's easier to manage, centralized blending, have technical experts on hand). The next step would be to decide whether to produce fortified grains in Vietnam or make it in Cambodia. The criteria would be based on the volume – for a small volume, importing fortified rice grains from Vietnam makes more sense, and for a large volume, producing fortified rice grains in Cambodia is the most effective.

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